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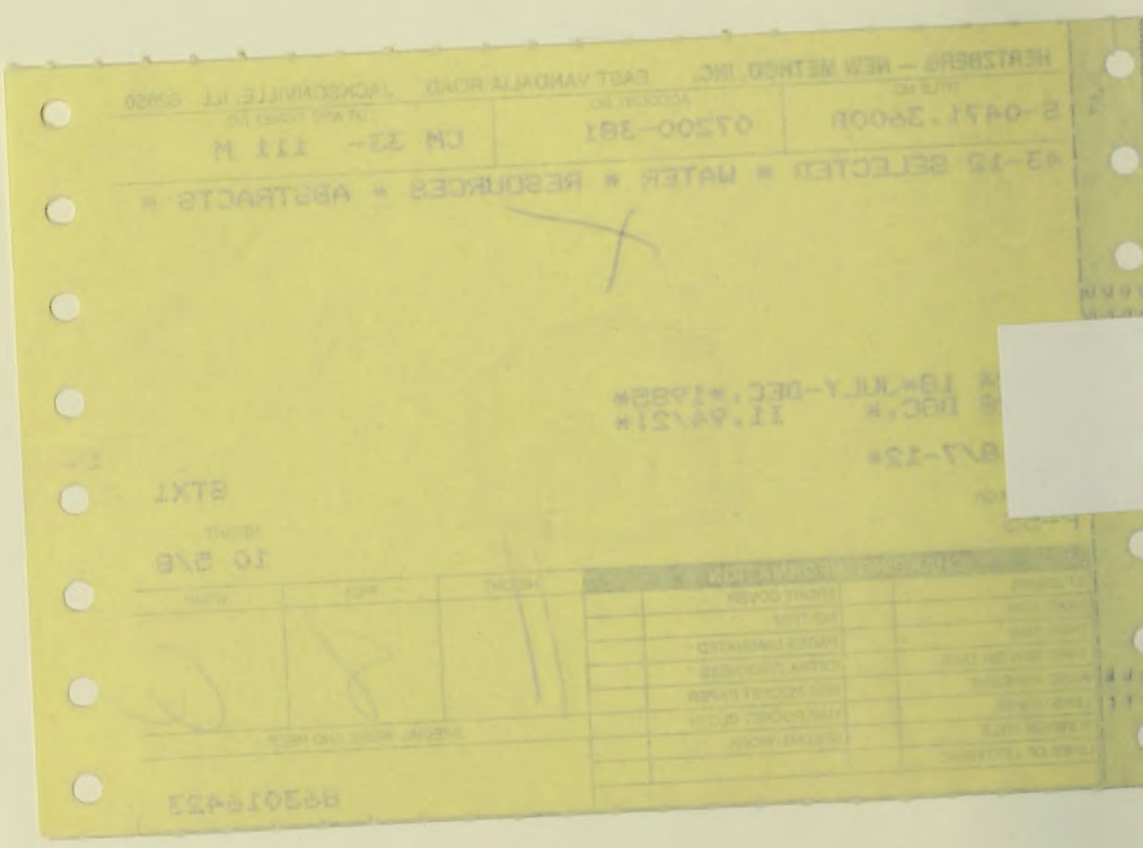

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 18, NUMBER 7
JULY 1985

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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01 NATURE OF WATER

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Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

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06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

DEPRESSIONAL STORAGE ON TILLED SOIL SURFACES,
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
C. A. Onstad.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 729-732, May/June, 1984. 6 Fig, 12 Ref.

Descriptors: *Depressional storage, *Soil properties, Roughness, Slope, Storage, Water supply, Mathematical equations, Precipitation excess, Rainfall-runoff relations.

A set of 1,060 independent determinations of microrelief from small plots was used in this study. These data were extrapolated to slopes ranging from 2 to 12% without altering individual values of random roughness. A complex depressional storage model utilizing individual point elevations within a plot was developed to estimate depressional storage assuming an impervious soil surface. Mode output included surface area of depressions, precipitation excess needed for 100% of the plot to produce runoff, and percent of the surface area contributing runoff as a function of precipitation excess needed to fill the depressions. Because the model is cumbersome and complex and not easily used in the field, outputs are related to slope steepness and random roughness using regression techniques with good results. In general, depressional storage decreases with decreasing random roughness and increasing slope steepness. Surface area of the depressions when filled increases with random roughness for low slope steepnesses. For high slope steepness, surface area increases to a maximum value at an intermediate roughness value and then begins to decrease. The amount of precipitation excess needed to fill the depressions decreases with increasing slope steepness and decreasing random roughness. Ratios of depressional storage to precipitation excess needed to fill the depressions range from near zero to about 35% depending on slope steepness and random roughness. Examples for two plots are shown for the precent of area contributing to runoff as a function of the fraction of precipitation excess needed to fill the depressions for both relatively smooth and rough surfaces and low and high slope steepnesses. The fraction of precipitation excess contributing to runoff increases fastest for smooth surfaces on steep slopes. (Baker-IVI)
W85-03376

DIFFUSION-BASED SOIL WATER SIMULATION FOR NATIVE GRASSLAND,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
For primary bibliographic entry see Field 2G.
W85-03482

NOTE ON THE APPLICABILITY OF THE JAMES-STEIN ESTIMATOR IN REGIONAL HYDROLOGIC STUDIES,
Geological Survey, Reston, VA.
J. M. Landwehr, and N. C. Matalas.
Water Resources Research, Vol. 20, No. 11, p 1630-1638, November, 1984. 9 Tab, 17 Ref.

Descriptors: *Hydrologic aspects, *James-Stein estimator, Estimating, Mathematical equations, *Statistical analysis, Sampling.

Regional hydrologic studies entail the making of point estimates of the parameter of interest at each of N sites in a region based on a record of observations from each site. In a statistical context the estimates are outcomes of random sampling experiments, each drawn from a population with mean equal to the parameter of interest at the respective site, and as such are subject to sampling errors. Thus the regional hydrologic problem may be more generally stated statistically as that of estimating the location parameter of dimension N. The applicability of the James-Stein estimator in regional hydrologic studies which entail the estimation of an N-dimensional location parameter is discussed. For the distributions considered, the assumption of normality was shown not to be critical and the estimator to be strongly robust. The effect of correlation in diminishing the relative risk advantage of the James-Stein estimator, even in the case of normally distributed random variables, is illustrated. The largest advantage accrues in the case of independent random variables with the same mean. Although there is advantage in using this estimator in water resource studies for which the risk definition is applicable, the relative advantage that accrues is tempered by the cross correlation among the variables and the degree of heterogeneity within the collection that is deemed to be the pertinent hydrologic region. (Baker-IVI)
W85-03562

DEVELOPMENT OF HYDROLOGICAL RESEARCH IN FRANCE RELATIVE TO THE INFLUENCE OF MAN ON WATER CYCLES AND THE FORECASTING OF FLOODS (LE DEVELOPPEMENT DE LA RECHERCHE HYDROLOGIQUE EN FRANCE EN RELATION AVEC L'INFLUENCE DE L'HOMME SUR LE CYCLE DE L'EAU ET LA PREVISION DES CRUES),
Academie d'Agriculture de France, Paris.
For primary bibliographic entry see Field 9C.
W85-03585

METHODOLOGY FOR PRODUCING AN INVENTORY OF SITES FOR SMALL HYDROELECTRIC SCHEMES. HAUTE-SAVOIE, A CASE STUDY (METHODOLOGIE D'UN INVENTAIRE DE SITES DE MICROCENTRALES CAS DE LA HAUTE-SAVOIE),
Centre National de Machinisme Agricole du Genie Rural, des Eaux et des Forets, Paris (France).
For primary bibliographic entry see Field 6A.
W85-03587

DESIGN OF A PHYSICALLY-BASED DISTRIBUTED PARAMETER MODEL FOR ARID-ZONE SURFACE-GROUNDWATER MANAGEMENT,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
T. H. Illangasekare, and H. J. Morel-Seytoux.
Journal of Hydrology, Vol. 74, No. 3/4, p 213-232, November, 1984. 6 Fig, 18 Ref.

Descriptors: *Arid zone, *Groundwater management, *Mathematical models, *Conjunctive use, *Saudi Arabia, Surface water, Water allocation, Saturated flow, Unsaturated flow, Model studies, Water conveyance, Wadi.

A conjunctive-use study was conducted for the management of surface- and ground-water in the coastal aquifers of the Red Sea coast in Saudi Arabia. The objective of this study was to investigate the conceptual feasibility of implementing a good development strategy of surface-and groundwater in the region. The arid hydrology of the region and the agronomic practices and traditions of water allocation unique to the region required the design and development of a special model. This paper presents the analytical and numerical procedures that were used in the design of this special management oriented hydrologic model of the surface-groundwater system. The model was developed in three components, namely: (1) the surface-water conveyance model; (2) aquifer unsaturated flow model; and (3) the aquifer saturated flow model. A storage routing technique was used to model the surface flows in the wadi. Numerical techniques based on Green and Ampt type of solutions were used to model the vertical flow in the aquifer unsaturated zone. The flow in the saturated zone of the aquifer was modeled using the discrete-kernel approach of groundwater modeling. The complete model of the physical system was obtained by combining the three model components with the proper modeling of their dynamic interactions. (Author's abstract)
W85-03751

FROM INFILTRATION TO RECHARGE: USE OF A PARAMETRIC TRANSFER FUNCTION,
Ecole Nationale Superieure d'Ingenieurs, Tunis (Tunisia).
M. Besbes, and G. De Marsily.
Journal of Hydrology, Vol. 74, No. 3/4, p 271-293, November, 1984. 13 Fig, 1 Tab, 23 Ref, 2 Append.

Descriptors: *Groundwater recharge, *Infiltration, *Transfer function, Unsaturated zone, Unconfined aquifers, Water table, Rainfall, Piezometers.

The recharge of a water-table aquifer involves transfer of the infiltration (effective rainfall) through the unsaturated zone. In certain areas the depth at which the water table lies and the properties of the unsaturated zone can vary greatly and thus the determination, as a function of time, of the recharge actually arriving in the saturated aquifer can be rather difficult. However, one needs to know this recharge in order to simulate the true behavior of the aquifer in transient state in a regional digital model of the aquifer for the purpose of calibration or prediction. The resolution of the exact flow equations in the unsaturated zone is possible, but seems still to be far too complex for practical applications. In this paper a methodology is proposed for the identification of the spatial variability of the infiltration transfer function using common climatic and piezometric data. A parameterization of these transfer functions using gamma distributions as basic functions is then suggested. Two practical examples make it possible to check the applicability of the procedure. (Author's abstract)
W85-03754

APPROXIMATE METHOD FOR PARTITIONING DAILY STREAMFLOW DATA,
Georgia Coastal Plain Experiment Station, Tifton.
A. Shirmohammad, W. G. Knisel, and J. M. Sheridan.
Journal of Hydrology, Vol. 74, No. 3/4, p 335-354, November, 1984. 7 Fig, 7 Tab, 24 Ref.

Descriptors: *Storm seepage, *Streamflow, *Storm runoff, *Georgia, Coastal Plain, Rainfall, Watersheds, Drainage area.

Subsurface flow constitutes an important component of the hydrologic cycle, and a method which would use commonly available daily hydrologic data to make estimates of subsurface flow components would be a valuable tool for the water-resource planner. An approximate method for partitioning daily total streamflow volumes into storm runoff and subsurface flow components was developed and tested with streamflow data from ten research watersheds, 2.6 to 1494.43 sq km in size, in the Coastal Plain of Georgia. Daily rainfall and streamflow data can be used to obtain reasonable estimates of storm-runoff and subsurface flow amounts. The empirical approach underestimates the storm-runoff time base for large watersheds. A power function was developed which can be used to determine the storm-runoff time base for watersheds in the Coastal Plain physiographic region. The contribution of subsurface flow to total streamflow (60-80%) represents a significant component of the hydrological cycle and consequently a significant water resource in the basins of area studied. Subsurface flow contribution to total streamflow in the Coastal Plain physiographic region is relatively independent of the size of drainage area, and data from small unit source areas give good representation of partitioned flows on much larger mixed-cover watersheds. (Moore-IVI)
W85-03758

SNOWMELT INFILTRATION TO FROZEN PRAIRIE SOILS,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
R. J. Granger, D. M. Gray, and G. E. Dyck.
Canadian Journal of Earth Sciences, Vol. 23, No. 6, p 669-677, June, 1984. 7 Fig, 1 Tab, 31 Ref.

Descriptors: *Snowmelt, *Infiltration, *Soil water, *Prairie soils, Snow cover, Melt water, Snow cover, Ice, Hydrological models, Runoff, Diurnal variation.

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Water generated by the melt of a shallow snow cover is an important component of the hydrological cycle of the Canadian Prairies. The results of 5 years of study of the interaction between snowmelt infiltration, snow cover water equivalent, and soil moisture content at the time of melt for soils in the Brown and Dark Brown zones of the Canadian Prairies are reported. Infiltration of snowmelt to an uncracked frozen Prairie soil is governed primarily by the amount and distribution of ice in the depth increment 0-30 cm, the zone of infiltration, at the time of melt. Most of the meltwater infiltrating the soil is retained within the zone. The findings suggest a simple algorithm for describing the snowmelt infiltration in hydrological models. Conceptually the phenomenon can be viewed as water filling reservoirs whose capacities to absorb and store water depend on the soil moisture storage and the water transmission properties of the zone of infiltration at the time of melt. Melt of a Prairie snow cover generally follows a diurnal pattern, especially during the early stages of the sequence. During this period snowmelt produced at the snow surface that moves into the snow cover is either retained within the snow cover or infiltrated the frozen soil. Surface runoff from an area does not usually occur until later in the melt period after the snow cover becomes ripe and isothermal at 0 C, the daylight hours and radiation intensity increase, and part of the land is snow free. By assuming infiltration is satisfied prior to active runoff, the time of runoff can be calculated from estimates of melt, water storage characterisics of the snow cover, evaporation losses, and volume of infiltration. (Baker-IVI)
W85-03765

2B. Precipitation

RADAR PRECIPITATION ESTIMATES FOR A SOIL WATER BALANCE,
Texas Agricultural Experiment Station, Temple. Blackland Research Center.
For primary bibliographic entry see Field 7A.
W85-03394

CALCULATION OF AREAL PRECIPITATION VALUES AND THE REPRESENTATIVENESS OF PRECIPITATION MEASURING NETWORKS (ZUR BERECHNUNG VON GEBIETSWERTEN DES NIEDERSCHLAGES UND DER REPRASENTATIVITAT VON NIEDERSCHLAGSMEBNETZEN),
Meteorologischer Dienst der DDR, Berlin. Forschungsinstitut fuer Hydrometeorologie.
D. Schwanitz.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 6, p 202-206, June, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Precipitation, *Rainfall, *Hydrologic models, *Berlin, *Germany (Democratic Republic), Arithmetic averaging, Thiessen method, Akin computer method, Representiative circles method, Error analysis, Data interpretation.

Precipitation data are extremely spatially and chronologically variable depending on such interdependent factors as precipitation form and type, time of year or day, type of terrain, and interval between measurements. Methods of calculating areal precipitation were compared for accuracy in the dense precipitation measuring network of the city of Berlin (German Democratic Republic), which has 45 measuring stations in an area of 2,100 sq km (47 sq km/station). The terrain is representative of the country's interior lowlands with urban areas, farmland, and forested hills. The methods studied were arithmetic averaging, the polygon (Thiessen) method, the Akin computer method, and the representative circles method (consisting of assigning to each measuring point according to type of precipitation and measurement interval a circle of variable area, for which the precipitation level measured in its center is seen as representative). The respresentative circles method showed the smallest percentage of errors (34% and 28% for measurement intervals of 12 hr and one day when precipitation types were not distinguished), followed by the Akin method (51 and 39%), polygon method (50 and 38%), and arithmetic averaging (65 and 42%). The choice of calculation method depends on characteristics of the measuring network, e.g., number and distribution of measuring points (homogeneity); equations to calculate network homogeneity are given. In addition, certain measuring points may represent certain precipitation parameters better than others. For some purposes, e.g., control of hydrological systems, it is necessary to find the measuring station that represents the entire area so that only data from this station will be used; one method of determining this is correlation and regression analysis. (Gish-IVI)
W85-03519

HYDROLOGICALLY USEFUL STATION PRECIPITATION MODEL; 1. FORMULATION,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
K. P. Georgakakos, and R. L. Bras.
Water Resources Research, Vol. 20, No. 11, p 1585-1596, November, 1984. 11 Fig, 35 Ref. National Weather Service contract NA80AA-H-00044.

Descriptors: *Precipitation, *Model studies, Weather forecasting, Prediction, Clouds, Storms, Rainfall distribution.

Rainfall prediction with time leads of the order of hours or days would be valuable in urban hydrology, and flood prediction. A one-dimensional, physically based precipitation model is formulated which attempts to cover the important elements of cloud physics that lead to precipitation. The model has several advantages in that it results in linear equations of the state, here defined as the cloud moisture content. The inputs to the model are measured at ground level and are temperature, dew-point temperature, and pressure. Although the model is based on a unit area column developed for point precipitation, it is reasonable for scales comparable to the size and time response of river basins. The spatial and time scales will be fixed by the rate of variation in space and time of the inputs. Key physical parameters in the formulation are the pressure at the cloud top, the height-averaged updraft velocity, and the inverse of the average diameter of the hydrometers at cloud base. The variables exhibit very high correlation in time and space. The parameter sources are not convenient and are unavailable in many locations. Furthermore, they will vary from storm to storm and within a storm, making real time monitoring absolutely necessary. An alternative is to parameterize the sources in terms of other more accessible meteorological variables. In comparing the model to simpler statistical approaches the results are quite satisfactory. (Baker-IVI)
W85-03557

HYDROLOGICALLY USEFUL STATION PRECIPITATION MODEL; 2. CASE STUDIES,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
K. P. Georgakakos, and R. L. Bras.
Water Resources Research, Vol. 20, No. 11, p 1597-1610, November, 1984. 18 Fig, 10 Tab, 14 Ref. National Weather Service contract NA80AA-H-00044.

Descriptors: *Precipitation, *Model studies, *Venezuela, *Boston, *Massachusetts, *Tulsa, *Oklahoma, Forecasting, Rainfall, Predictions, Snow, Thunderstorms, Tropical storms.

A physically based model of pecipitation at a point is used to make rainfall and snow predictions at locations in the US and Venezuela. The model is used in off-line and real-time modes. The latter involves the use of a Kalman filter. A set of 11 storms of different type and severity from Boston, Massachusetts, and Tulsa, Oklahoma, was the main hourly data base for the tests of this precipitation model. The storms included convective line storms, a tropical storm, large low-pressure centers of persistent rainfall northeasterlies, snowstorms, and thunderstorms with long dry periods in between. Characteristic to all tests of the deterministic precipitation model was inadequate simulation of high precipitation rates and the successful prediction of the no-precipitation periods. Improved model behavior was noted when the stochastic formulation was used. The parameterization suggested is quite robust, comparing favorably with locally calibrated linear regression alternative models. (Baker-IVI)
W85-03558

SCALE CONSIDERATIONS IN THE MODELING OF TEMPORAL RAINFALL,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
I. Rodriguez-Iturbe, V. K. Gupta, and E. Waymire.
Water Resources Research, Vol. 20, No. 11, p 1611-1619, November, 1984. 10 Fig, 2 Tab, 19 Ref. Army Research Office grant 21078-GS and NSF grant CEE-8303864.

Descriptors: *Rainfall, *Model studies, Mathematical equations, Statistical models, Temporal distribution, Rainfall intensity.

The structure of statistical dependence in temporal rainfall models is intimately tied to the scales at which descriptions are sought. Observations on temporal rainfall are invariable taken in cumulative amounts over disjoint intervals representing different time scales such as hours or days. A brief analysis is offered of three rainfall models: Poisson white noise model; rectangular pulses model; and the Neyman-Scott white noise model. Each model describes the rainfall intensity and therefore the mathematical assumptions on these models are introduced only at that stage. Analytical expressions are obtained for the mean, variance and correlation function for the process representing the sequence of cumulative rainfall amounts over disjoint intervals of an arbitrary but fixed length for each of these models. These expressions are used in two case studies for computing the model parameters as well as investigating their propriety at the hourly and daily time scales. (Baker-IVI)
W85-03559

CANALS UNDER BLIZZARD CONDITIONS,
For primary bibliographic entry see Field 8A.
W85-03581

RAINFALL, SOIL NUTRIENT STATUS AND BIOMASS OF LARGE AFRICAN SAVANNA MAMMALS,
R. East.
African Journal of Ecology, Vol. 22, No. 4, p 245-270, December, 1984. 6 Fig, 5 Tab, 127 Ref.

Descriptors: *Rainfall distribution, *Soil, *Biomass, *African Savanna, *Mammals, *Savanna, Animal populations, Ecological distribution.

Published estimates of population densities of large savanna herbivores are used to relate biomass to rainfall, and soil nutrient status as determined by geomorphology after Bell (Bell, R.H.V. (1982) The effects of soil nutrient availability on community structure in African ecosystems. In: Ecology of Tropical Savannas, ed. by B.J. Huntley and B.H Walker. Springer-Verlag, New York). This reveals that the positive correlation between total large herbivore biomass and rainfall in arid/eutrophic savannas (Coe, M.J., Cumming, D.H., and Phillipson, J. (1976) Oecologia, Vol. 22, p 341-354) also applies for nineteen out of twenty-three individual herbivore species. Hervibores are divided into two groups, arid and moist savanna species, on the basis of the rainfall at which their peak population densities occur on soils of low nutrient status (< 820 and $>$ or $= 1000$ mm, respectively). These groups reflect the division between arid/eutrophic and moist/dystrophic savannas. Arid savanna herbivores, which dominate total herbivore biomass, include grazers, mixed feeders and browsers and are less selective feeders. Their biomass tends to decline at higher levels of rainfall on low nutrient status soils and only the larger species, such as elephant, buffalo and hippopotamus, are widespread in moist/dystrophic savannas where mean annual rainfall exceeds 1000 mm. Moist savanna species are mainly highly selective grazers and

occur widely in moist/dystrophic savannas. Their biomasses are usually low and show a positive correlation with rainfall on soils of low nutrient status. Large carnivore biomass is positively correlated with rainfall in arid/eutrophic savannas, reflecting a positive relationship to prey biomass. The biomass of individual carnivore species is most closely correlated with the biomass of the preferred size of prey. These relationships suggest that natural populations of large savanna mammals tend to be close to the limits set by their food resources. (Author's abstract)
W85-03630

2C. Snow, Ice, and Frost

HOW SNOW CRYSTALS GROW,
Nevada Univ. System, Las Vegas. Desert Research Inst.
J. Hallett.
American Scientist, Vol. 72, p 582-589, November-December, 1984. 8 Fig, 6 Ref.

Descriptors: *Snow, *Crystal growth, Physical properties, Temperature effects, Wind, Ice.

Various experiments performed in an attempt to define the growth of snow crystals are reviewed. In the forms of ice which usually occur in the atmosphere, with very large-scale hexagonal symmetry, x-ray diffraction analysis readily confirms that there is a corresponding small-scale hexagonal symmetry in the arrangement of molecules. At low temperatures, below about -120 C, the cubic form is favored, and there is a little evidence that this form of ice exists in the atmosphere as well. While a lattice theory involving atomic bonding explains the fundamental basis for hexagonal symmetry, it cannot explain by itself the great variety in the shapes and sizes of ice crystals and snowflakes. All the laboratory studies indicate that the crystal shapes are complicated and not necessarily uniquely related to conditions of growth. In order to investigate the role of falling motion on crystal structure, a thermal diffusion chamber has been turned into a wind tunnel with air moving through it at a velocity equivalent to that of a falling crystal. In the case of frost, snow crystals growing near the ground, temperature and vapor density will tend to follow a diurnal cycle, with minimum temperature and maximum supersaturation just before dawn on a night with radiational cooling. For ice crystals growing on glass surfaces, the crystal orientation changes during growth as a result of interaction with the surface itself. (Baker-IVI)
W85-03314

STABILITY OF SHEET WATER FLOW UNDER A GLACIER,
Northwestern Univ., Evanston, IL. Dept. of Materials Science.
J. Weertman, and G. E. Birchfield.
Journal of Glaciology, Vol. 29, No. 103, p 374-382, 1983. 3 Fig, 7 Ref, 1 Append. NSF grants ATM-78/3961 and ATM-81/1138.

Descriptors: *Glaciers, *Laminar flow, *Channel flow, *Glacial streams, Meltwater, Basal shear stress, Heat, Water pressure, Ice overburden pressure.

R-channels are water channels at the base of a glacier that are incised upwards into the ice itself rather than downwards into the bed. It is theorized that the initial instability of water flow in a sheet under a glacier is produced by greater heat production in the flowing water and thus the larger rate of ice melting where a perturbation has increased the water sheet thickness. It may be very difficult for R-channels to be supplied with sufficient water to keep them open if the water supply for the channels is developed at the base of the glacier. The difficulty is that the pressure field around an R-channel can be such as to drive water away from the tunnel rather than towards it, even though the water pressure within the channel is lower than the average ice overburden pressure. For this study, it is assumed that instabilities have finally caused all the water to flow in channels (R-channels) at the bed. When a basal shear stress is present, the distance out to which a channel can collect water is not that much greater than the channel radius itself. It is not likely for the channel to be able to collect appreciable amounts of water that is produced at the bed. An instability either cannot develop to the point when the water flow is primarily in channels or else the water flow alternates cyclically between a state primarily of sheet flow and a state of channel flow. Channels under a glacier may have their primary origin in the melt water from the upper surface that pours down moulins and is already channelized when it reaches the bed. Whether water flow occurs in a cyclic mode or in a modified sheet flow, it is likely that sheet flow must remain important in ridding a glacier of the water that has its origin at the base of a glacier. (Moore-IVI)
W85-03341

GLACIERS IN THE NORTH-EASTERN PART OF THE CH'ING-HAI-HSI-TSANG (QINGHAI-XIZANG) PLATEAU (TIBET) AND THEIR VARIATIONS,
Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
W. Wang.
Journal of Glaciology, Vol. 29, No. 103, p 383-391, 1983. 6 Fig, 4 Tab, 6 Ref.

Descriptors: *Glaciers, *China, *Amne Machin, *Ch'i-lien Shan, *Ha-lung, *Glacier surges, Aspect, Climate, Prediction.

The Ch'ing-hai-Hsi-tsang (Quinghai-Xizang) Plateau is the largest and highest plateau area on Earth. Mt. Amne Machin (Anyemaqen) and the Ch'i-lien Shan (Qilian Shan) lie to the northeast, forming a natural divide between the glacier-permafrost of the plateau and the loess highlands. The Sino-German Joint Expedition to the Ch'ing-hai-Hsi-tsang Plateau established the first system of fixed and mobile observation stations. Forty glaciers in the Amne Machin Mountains were investigated and their inventory completed; 15 were advancing, 2 retreating and the remainder stable. The advancing glaciers are in the center of the Amne Machin Massif; the two retreating glaciers on either end show that glacier activity is not synchronous. Of the 31 glaciers in the Ch'i-lien Shan measured, 29 have been retreating during the past 15-25 years and two small ones have been advancing. Aspect is an important factor in glacier distribution. The longer glaciers and the most heavily glacierized areas are found along the north-easterly slopes. Strong evidence was found for a link between climatic change and glacier response on Ha-lung (Halong) glacier. It is forecast that this glacier will continue to advance with a surge coming within 10-20 years. Most of the retreating glaciers in the Ch'i-lien Shan will be advancing within 15 years. (Moore-IVI)
W85-03342

NET BALANCE, SURFACE LOWERING, AND ICE-FLOW PATTERN IN THE INTERIOR OF LEWIS GLACIER, MOUNT KENYA, KENYA,
Wisconsin Univ.-Madison. Dept. of Meteorology.
S. Hastenrath.
Journal of Glaciology, Vol. 29, No. 103, p 392-402, 1983. 5 Fig, 1 Tab, 13 Ref. NSF grant EAR79-23897.

Descriptors: *Lewis Glacier, *Mount Kenya, *Kenya, *Glacier balance, *Ice flow, Velocity, Topography, Mapping, Aerial photography, Residence time, Confluence, Diffluence, Glaciers.

Observations obtained in a long-term monitoring program on Lewis Glacier, Mount Kenya, include measurements of net balance and velocity at a stake network over the period 1978-82, and airborne mapping of the glacier surface topography at the beginning and end of this interval. Horizontal and vertical flow components and mass continuity are evaluated along the longitudinal axis of the glacier. The largest horizontal velocity at the surface is about 5 m/a, while the submergent vertical velocity at the surface in the upper, and the emergent component in the lower glacier are of the order of 1-2 m/a. Horizontal and vertical flow components in the interior of the glacier are calculated from the surface observations under plausible assumptions. Isotachs and streamlines plotted in a longitudinal-vertical cross-section permit the estimation of representative residence times of ice within Lewis Glacier. The largest values for the longest trajectories with submergence at the surface in the uppermost area of the glacier and emergence near the snout are of the order of a few centuries. However, such estimates are compromised, in particular, by the continuing non-equilibrium conditions of Lewis Glacier. Mass continuity is directly related to the vertical motion field. In the upper area of the glacier the submergence velocity exceeds the rise of glacier surface observed with respect to the stake network, while in the lower glacier the emergent flow component falls short of the local negative net balance. This differing behavior of altitudinal zones is consistent with the fact that actual lowering of the glacier surface topography documented by the repeated airborne mappings is larger than expected from the stake network in the upper but less in the lower glacier. This differing behavior of altitude zones appears mitigated by the tendency for confluence in the upper and diffluence in the lower glacier. (Author's abstract)
W85-03343

INVESTIGATIONS OF GLACIER HYDROLOGICAL SYSTEMS USING DYE TRACER TECHNIQUES: OBSERVATIONS AT PASTERZENGLETSCHER, AUSTRIA,
Manchester Univ. (England). Dept. of Geography.
M. Burkimsher.
Journal of Glaciology, Vol 29, No. 103, p 403-416, 1983. 6 Fig, 5 Tab, 19 Ref.

Descriptors: *Glacier hydrology, *Dye releases, *Pasterzengletscher, *Austria, Crevasses, Moulins, Tracers, Velocity, Flood peak, Diurnal variation, Seasonal variation, Glacier streams.

A comprehensive series of dye tracer tests was undertaken over two summers at Pasterzengletscher, Austria, and from these a number of important conclusions can be drawn. A lateral division of drainage on the lower tongue was proved, but this was not determined by the direction of oblique crevasses. Water from many moulins passed into two or more drainage courses, as shown by repeated patterns of multiple peaks on the time/concentration curves. The spatial pattern of travel times from different moulins on the tongue was complex, although it remained stable over time. Repeated tracer tests showed that throughflow velocities varied by up to an order of magnitude during a single day. Maximum velocities occurred at the time of peak discharge, and probably the large diurnal velocity variations are caused by changes in the proportion of the length which has channel-full pressure flow. However, seasonal velocity variations were much smaller, although changes in outflow discharge were larger than in the diurnal case. This gives strong support to the concept that channels adjust in size to the average water discharge passing through, and that these changes occur over a matter of days or a few weeks. (Author's abstract)
W85-03344

ISOTOPE STRATIFICATION IN HIGH MOUNTAIN GLACIERS: EXAMPLES FROM THE PERUVIAN ANDES AND HIMALAYA,
Institute of Physics and Nuclear Techniques, Krakow (Poland).
J. Grabczak, J. Niewodniczanski, and K. Rozanski.
Journal of Glaciology, Vol. 29, No. 103, p 417-424, 1983. 2 Fig, 1 Tab, 13 Ref.

Descriptors: *Deuterium, *Oxygen isotopes, *Glaciers, *Peru, *India, Firn, Glacier budgets, Crevasses, Snow accumulation, Melting, Sublimation, Ice, Solar radiation, Isotope fractionation, Climate.

Measurement of the heavy stable isotope content of glacier ice can provide valuable information on snow acumulation rates, firnification, and homogenization processes in the upper layers of a glacier and on its water budget. O-18 and deuterium con-

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tent was measured in snow and ice samples collected from two crevasses on temperate glaciers high in the Andes and in the Himalaya. The Andean crevasse was situated on Broggi glacier in the Huandoy group, Peru. Broggi glacier is typical of a small temperate valley glacier. The Himalayan crevasse was situated in the upper part of Gannakhui Glacier in Gannakhui Valley, Garhwal Himalaya, India. Because of its form, the crevasse can be regarded as a cornice located in the upper part of the glacier. Due to intense exposure to sun, a significant part of the annual accumulation of snow is removed by melting and sublimation, the latter being predominant. There is strong empirical evidence that in natural conditions which are characteristic of both the glaciers, sublimation of the snow cover can be approximated by the thermodynamic equilibrium process. The isotope fractionation observed in such a process should be very close to equilibrium fractionation. The short-term fluctuations, though slightly moderated, and longer-term variations can still be observed in the deeper parts of the glaciers in spite of firnification of the snow. Mid-latitude high-mountain glaciers may be a source of information on past fluctuations in climate. (Moore-IVI)
W85-03345

ELASTIC CONSTANTS OF ARTIFICIAL AND NATURAL ICE SAMPLES BY BRILLOUIN SPECTROSCOPY,
Memorial Univ. of Newfoundland, St. John's. Dept. of Physics.
P. H. Gammon, H. Kiefte, M. J. Clouter, and W. W. Denner.
Journal of Glaciology, Vol. 29, No. 103, p 433-460, 1983. 8 Fig, 8 Tab, 51 Ref.

Descriptors: *Ice, *Elastic properties, *Brillouin spectroscopy, Glacial ice, Lake ice, Sea ice, Monocrystalline ice, Polycrystalline ice.

The method of Brillouin spectroscopy has been used to measure the dynamic elastic moduli of local homogeneous regions in ice samples representing four different environments of formation. These included artificial ice frozen from distilled water, clear monocrystalline glacial ice, bubbly lake ice, and sea ice. The samples studied were found to have identical local elastic properties. Accordingly the elastic properties of homogeneous monocrystalline ice have been found not to vary with sample age, with impurities present at the time of freezing, or with crystal quality. The bulk elastic properties of ice remain, of course, subject to modification by different crystal grain textures and the presence of inclusions of various sorts. Because the elastic constants obtained in the present work are subject to smaller overall uncertainty than values measured previously, it is believed that they are the most reliable obtained to date. The values at -16 C were determined to be c sub 11 = 139.29 +/- 0.41, c sub 12 = 70.82 +/- 0.39, c sub 13 = 57.65 +/- 0.23, c sub 33 = 150.10 +/- 0.46, c sub 44 = 30.14 +/- 0.11 (units of 10 to the 8th N/sq m or kbar). A full range of derived elastic parameters for monocrystalline ice and for homogeneous isotropic polycrystalline ice has been calculated. (Author's abstract)
W85-03346

TRANSPORT OF WATER IN FROZEN SOIL: III. EXPERIMENTS ON THE EFFECTS OF ICE CONTENT,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2G.
W85-03477

COMPARATIVE UTILITY OF MICROWAVE AND SHORTWAVE SATELLITE DATA FOR ALL-WEATHER CHARTING OF SNOW COVER,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 7B.
W85-03492

2D. Evaporation and Transpiration

CORN IRRIGATION SCHEDULED BY TENSIOMETER AND THE LAMBERT MODEL IN THE HUMID SOUTHEAST,
Georgia Coastal Plain Experiment Station, Tifton.
For primary bibliographic entry see Field 2I.
W85-03358

ELEVATION - A BIAS ERROR IN SCS BLANEY CRIDDLE ET ESTIMATES,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
L. O. Pochop, J. Borrelli, and R. Burman.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 125-128, January/February, 1984. 7 Tab. 13 Ref.

Descriptors: *Evapotranspiration, *Elevation, *Blaney Criddle formula, Lysimeters, Temperature effects, Solar radiation, Alfalfa, Grasses.

Elevation adjustments for evapotranspiration estimates were investigated using Bluegrass and alfalfa data from throughout the Western states to determine an elevation adjustment for the SCS Blaney Criddle formula. A 6 to 10% adjustment per 1000 m altitude were required for calculated evapotranspiration when using the SCS Blaney Criddle formula for Kentucky bluegrass and alfalfa. The adjustment should increase the ET estimates for sites with elevations greater than the location at which the formula is calibrated and decrease estimates for sites with lower elevations. The apparent cause for the adjustment is that the mean temperatures do not accurately reflect the plant's reaction to the warm daytime temperatures and cool nights. Further, mean temperature tends to decrease while solar radiation intensity increases with elevation providing increased energy for the ET process. An approximate 10% upward adjustment in temperature based reference crop ET per 1000 m increase in elevation is generally needed for accurate estimates of ET. (Baker-IVI)
W85-03373

EVAPOTRANSPIRATION OF A FLORIDA, U.S.A., FRESHWATER WETLAND,
Florida Univ., Gainesville. Center for Wetlands.
T. J. Dolan, A. J. Hermann, S. E. Bayley, and J. Zoltek.
Journal of Hydrology, Vol. 74, No. 3/4, p 355-371, November, 1984. 3 Fig, 3 Tab, 30 Ref.

Descriptors: *Evapotranspiration, *Wetlands, *Florida, Water table, Marshes, Biomass, Soil saturation, Evaporation, Model studies.

A method for measuring the daily evapotranspiration rate in a central Florida freshwater marsh is described. The method utilized continuous records of water-table elevation in the marsh soil, and related a drop in the water table to evapotranspirative loss. The highest measured daily rate was 1.00 cm/day, recorded during September 1977. A simple model of evapotranspiration in the marsh was developed and calibrated using concurrent data for evapotranspiration, saturation deficit and aboveground biomass over a 1-yr. period. This model was then used to develop monthly estimates of marsh evapotranspiration for that year. Monthly estimates ranged from 0.12 cm/day in February 1978 to 0.56 cm/day in May 1978, with a 1-yr. total loss of 131.67 cm. These values were compared with potential evapotranspiration estimates using the Thornthwaite and Linacre methods, and with pan evaporation data for the region. (Author's abstract)
W85-03759

WHAT ARE THE LIMITS ON FOREST EVAPORATION,
National Hydrology Research Inst., Ottawa (Ontario).
F. I. Morton.
Journal of Hydrology, Vol. 74, No. 3/4, p 373-398, November, 1984. 5 Fig, 2 Tab, 51 Ref.

Descriptors: *Evaporation, *Forests, *Reviews, Canopy, Stomata, Radiant energy, Temperature, Vapor pressure, Carbon dioxide, Rainfall.

Recent research suggests that the limits on forest evaporation are only loosely related to net radiant energy. Dry-canopy evaporation appears to be limited substantially by stomatal responses to external environmental factors such as radiation, temperature, vapor pressure deficit and carbon dioxide concentration whereas wet-canopy evaporation appears to be constrained primarily by the frequency and duration of rainfall. This critical review indicates that the research on dry-canopy evaporation is now in a creative and exciting phase, although there is some danger that progress may be stifled through the use of inappropriate preconceptions and analogies. It also shows that the impressive amount of evidence indicating that wet-canopy evaporation can exceed the net radiant energy by a large amount is by no means conclusive and that the research needed to remedy this situation would be much easier and less expensive than the research needed to identify and study and as yet unknown or underestimated source of energy. (Author's abstract)
W85-03760

2E. Streamflow and Runoff

DISCHARGE COMPUTATION IN GRAVEL RIVERS (ABFLUBBERECHNUNG IN KIESFUHRENDEN FLUSSEN),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
M. Jaggi.
Wasserwirtschaft, Vol. 74, No. 5, p 263-267, May, 1984. 7 Fig, 17 Ref.

Descriptors: *Flow discharge, *Gravel rivers, Roughness, Particle size, Mathematical equations, River flow.

Discharge calculations for gravel rivers rely mainly on the estimation of grain roughness. The well-known equations for the determination of the discharge underestimate the grain friction resistance considerably. For regions with relative low roughness, an increase in the standard roughness elements provides a sufficient correction. At high relative roughness, an additional correction is necessary. A correction factor was developed based on experiments at high relative roughness. (Moore-IVI)
W85-03267

STABILITY OF SHEET WATER FLOW UNDER A GLACIER,
Northwestern Univ., Evanston, IL. Dept. of Materials Science.
For primary bibliographic entry see Field 2C.
W85-03341

INVESTIGATIONS OF GLACIER HYDROLOGICAL SYSTEMS USING DYE TRACER TECHNIQUES: OBSERVATIONS AT PASTERZENGLETSCHER, AUSTRIA,
Manchester Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W85-03344

LABORATORY STUDY OF RILL HYDRAULICS: I. VELOCITY RELATIONSHIPS,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
G. R. Foster, L. F. Huggins, and L. D. Meyer.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 790-796, May/June, 1984. 14 Fig, 2 Tab, 17 Ref.

Descriptors: *Rill erosion, *Runoff, *Velocity, Hydraulics, Rills, Soil erosion, Rainfall-runoff relations, Mathematical equations.

Flow in rills is an important component in runoff and erosion processes on upland areas. A full-sized fixed bed, fiberglass replica of an area 0.91 m wide

by 4.27 m long, which included a rill on an eroded field soil was constructed and used as the flow surface for a lab study of hydraulics of flow in a rill. Section average velocity along the rill varied according to a normal (Gaussian) distribution. Mean velocity in the rill varied with the product of discharge rate to the 0.28 power and slope steepness to the 0.48 power for a fixed rill boundary. Mean velocity was only slightly affected by rainfall. Mean velocity was also described by either the Manning or the Darcy-Weisbach uniform flow equations. Although data were insufficient to define a relationship for the standard deviation of section average velocities along the rill, the standard deviation decreased with an increase in Reynolds number on the 6 and 9% slopes. On the 3% slope, the standard deviation appeared to increase to a peak and then decrease as Reynolds number increased. Energy and momentum coefficients varied with section location and discharge rate. Typical values were 1.60 and 1.20, respectively. Velocity profiles in the middle of the rill were described by the classical Prandtl-von Karman type equation. (Baker-IVI)
W85-03387

PORTABLE RBC FLUMES FOR FURROWS AND EARTHEN CHANNELS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 7B.
W85-03393

TESTING OF THE SPUR HYDROLOGY COMPONENT ON RANGELAND WATERSHEDS IN SOUTHWEST IDAHO,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
E. P. Springer, C. W. Johnson, K. R. Cooley, and D. C. Robertson.
Transactions of the ASAE, Vol. 27, No. 4, p 1040-1046 and 1054, July/ August, 1984. 4 Fig, 5 Tab, 22 Ref.

Descriptors: *Idaho, *Watersheds, *Rangelands, *Model studies, *Rainfall-runoff relationships, Reynolds Creek, Murphy Creek, Upper Sheep Creek, Hydrology, Sediment Yield, Streamflow, Runoff, Model studies.

The hydrology and sediment yield components of the SPUR (Simulation of Production and Utilization of Rangelands) model are applied to three source basins of the Reynolds Creek Experimental Watershed in southwest Idaho. Calibration with observed streamflow gave coefficients of determination, R2, of 0.63, 0.67, and 0.85 for monthly runoff volumes at Murphy Creek, Upper Sheep Creek and Reynolds Mountain East watershed, respectively. The timing of monthly runoff volume was reasonably accurate. Insufficient information was available to calibrate the snow accumulation and melt routines. The parameter sets for these routines were very consistent between watersheds despite the different snow accumulation and melt patterns on the watersheds. Sediment yield predictions were poor, and indicated a need for further investigation of models applicable to these steep, rough mountain channels. (Author's abstract)
W85-03395

SUBSOIL CHARACTERISTICS INFLUENCE HYDROLOGIC RESPONSE TO NO-TILLAGE,
Agricultural Research Service, Coshocton, OH.
For primary bibliographic entry see Field 3F.
W85-03396

FIRST AND SECOND ORDER ANALYSES OF PARAMETER UNCERTAINTY IN DRAINAGE DESIGN,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
S. O. Prasher, S. O. D. Russell, T. H. Podmore, and S.-T. Chieng.
Transactions of the ASAE, Vol. 27, No. 4, p 1081-1086, July/August, 1984. 3 Fig, 2 Tab, 20 Ref.

Descriptors: *Drainage design, *Mathematical analysis, *Agricultural hydrology, Model studies, Agricultural runoff.

First order analysis offers an approach part way between the deterministic steady state methods in general use by practitioners in agricultural drainage design and the stochastic techniques being developed by the research community. First or second order analysis involves only a relatively small extension beyond the deterministic methods of analysis used in conventional practice. First and second order analyses require information about the first two moments of the input variables only, that is, their mean and variance (or co-variances if they are correlated). The means of the random functions derived in these two analyses will be different but the variance-covariance will not. Applications to both the conventional steady state design procedure based on Hooghoudt's formula and a nonsteady method based on Boussinesq's equation are presented. This method can provide the designer with an indication of the reliability of his estimates, a way of selecting a design to meet specified criteria with a specified probability of success, and a way of comparing the relative importance of uncertainty in the various input parameters. (Author's abstract)
W85-03400

CURRENT MEASUREMENTS IN LAKE CONSTANCE (STROMUNGEN IM BODENSEE),
Baden-Wuerttemberg Landesanstalt fuer Umweltschutz (Germany, F.R.). Inst. fuer Wasser- und Abfallwirtschaft.
For primary bibliographic entry see Field 2H.
W85-03438

TWO-DIMENSIONAL HN-MODELS OF FLOOD DISCHARGE IN RIVERS WITH FLOOD PLAINS, (ZWEIDIMENSIONALE HN-MODELLE DES HOCHWASSERABFLUSSES IN FLUSSEN MIT VORLANDERN),
Hanover Univ. (Germany, F.R.). Lehrstuhl fuer Stroemungsmechanik.
C. Urban, and W. Zielke.
Wasserwirtschaft, Vol. 74, No. 10 p 488-493, October, 1984. 8 Fig, 10 Ref.

Descriptors: *Numerical models, *Hydrodynamics, *Flood plains, *Flood discharge, River flow, Model studies, Finite element method, Difference method.

For the simulation of currents in rivers with flood plains, Hydrodynamic Numerical models can be used. From the viewpoint of hydrodynamics, this implies the calculation of horizontal two-dimensional free surface flows with a very complicated topography, locally changing roughness and boundries which depend on the water level. The models are based on difference and finite element methods. For stationary conditions, the equation systems are elliptical, whereas they are hyperbolic in the case of nonstationary conditions; they are solved with local discretization and iteratively, or in time increments. The models are discussed and experience from their application is reported. The main stress is on the calculation of the current velocity distribution and the water level over a given area. Furthermore, the coupling of one- and two-dimensional models are discussed, as well as the range of application for stationary and instationary models. (Author's abstract)
W85-03449

MINICOMPUTER PROGRAM FOR WATER-LEVEL CALCULATION AND FORECASTING AND ITS TESTING ON THE ODER BETWEEN EISENHUTTENSTADT AND KIETZ (KLEINRECHNERPROGRAMM ZUR WASSERSTANDSBERECHNUNG UND -VORHERSAGE UND DESSEN ERPROBUNG AM ODERABSCHNITT EISENHUTTENSTADT-KIETZ),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
E. Schmidt, and L. Luckner.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 6, p 195-202, June, 1983. 16 Fig, 2 Tab, 16 Ref.

Descriptors: *Computers, *Computer models, *Oder River, *Germany (Democratic Republic), *Poland, River forecasting, Model studies, Hydrologic models, River flow, Flood forecasting, Minicomputers.

Prediction of floodwaters on the mid-Oder (on the border between the German Democratic Republic and Poland) is important to alleviate the effects of surprise flooding of bank filtrate facilities, sewage networks, and agricultural land. The GRABEN computer program for the simulation of flow processes in running water was adapted in three stages to predict water level on the Oder: development of a minicomputer version of GRABEN; investigation of the possibility of adapting parameters to the model structure; and design of a forecasting model for the Eisenhuttenstadt-Kietz section of the Oder. The omission of the acceleration components in the St. Venant equations enabled GRABEN to be used on the minicomputer even for large river systems. The aim of the parameter adaptation procedure was to select the storage capacity B as a function of the water level H for every 'knot' (measuring point) of the model and the hydraulic conductivity A as a function of the water level H(-) for every 'string' of the model (stretch of water between two consecutive 'knots') such that H and Q (flow) as measured by the model corresponded as accurately as possible to actual values. This was achieved through a series of approximations, in the last phase of which, system output was determined not by water levels measured at the Kietz gauge but through iteration from calculated water levels over a given water-level:flow ratio for the lower knots (type 2 limiting condition). The introduction of the type 2 condition allowed conceptualization of the model without linking it to a hydrological model. Accurate agreement of model predictions with actual data from previous years was achieved. Future development of the model will include the introduction of identification procedures free of subjectivity for the parameters and broader coverage of water levels and river sections. (Gish-IVI)
W85-03518

STOCHASTIC DYNAMIC PROGRAMMING MODELS FOR RESERVOIR OPERATION OPTIMIZATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, B. F. Sule, and D. P. Loucks.
Water Resources Research, Vol. 20, No. 11, p 1499-1505, November, 1984. 5 Tab, 46 Ref.

Descriptors: *Stochastic process, *Reservoir operation, *Optimization, *Aswan, *Egypt, Systems analysis, Model studies, Water management, Dynamic programming, Reservoir releases.

A stochastic dynamic programming model is developed which employs the best forecast of the current period's inflow to define a reservoir release policy and to calculate the expected benefits from future operations. Use of the best inflow forecast as a hydrologic state variable, instead of the preceding period's inflow, resulted in substantial improvements in simulated reservoir operations with derived stationary reservoir operating policies. While these results are for a dam at Aswan in the Nile River Basin, operators of other reservoir systems also have available to them information other than the preceding period's inflow which can be used to develop improved inflow forecasts. The point stressed is that both stationary and nonstationary SDP models can identify better reservoir operating policies if better hydrologic state variables are employed. A stationary reservoir operating policy was obtained that outperformed the corresponding nonstationary reservoir operating algorithm which employed the preceding period's inflow as the hydrologic state variable. The results illustrate the potential value of snowpack, lake level, soil moisture, groundwater and streamflow information likely to be available to improve reservoir operations. Stochastic dynamic programming algorithms only identify the optimal policy within the class of policies examined. If policies in the space examined fail to make use of such hydrologic information, or employ only release targets when ending storage targets with constraints on releases would be more appropriate, then the best reservoir operating policies cannot be identified. (Baker-IVI)
W85-03551

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SOLUTION OF SURFACE WATER FLOW EQUATIONS USING CLEBSCH VARIABLES,
Technisch Physische Dienst TNO-TH, Delft (Netherlands). Numerical Simulations Group.
W. Zijl.
Water Resources Research, Vol. 20, No. 11, p 1650-1658, November, 1984. 3 Fig, 20 Ref.

Descriptors: *Streamflow, *Mathematical equations, *Clebsch variables, Vertical transport, Fluid mechanics, Groundwater, Reservoirs, Vorticity, Computers.

A formulation based on so-called Clebsch variables is presented. This formulation is basically equivalent to a formulation based on the vorticity. However, the formulation based on Clebsch variables dose not exhibit the disadvantages of the formulation based on the vorticity. Since in the Clebsch representation an explicit expression of the pressure is available, this formulation may be considered as an extension of the well-known potential theory for irrotational flow. A groundwater reservoir simulator solving for the pressure, temperature, and concentration can, in principle, be applied to determine the Clebsch variables describing flow in surface water, thus unifying the mathematical description of surface and subsurface hydrology. A computer program based on a formulation with Clebsch variables is quite competitive, especially for three-dimenisonal calculations where it should lead to a more economical use of the computer. (Baker-IVI)
W85-03565

SUFFICIENT CONDITIONS FOR RIVER MEANDERING: A SIMULATION APPROACH,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
A. D. Howard, and T. R. Knutson.
Water Resources Research, Vol. 20, No. 11, p 1659-1667, November, 1984. 6 Fig, 58 Ref.

Descriptors: *Rivers, *Meanders, *Simulation, Model studies, Streamflow, Erosion, Erosion control, Channel migration, Banks, Cutoffs.

A simulation approach is employed to produce realistic meandering patterns starting from an initially straight channel with small random perturbations. The model assumes that nominal migration rates increase as channel curvature increases but reach a maximum when bend radius divided by channel width is about 3, with decreasing rates for sharper bends, in accord with observations of earlier investigators. It is also necessary to assume that local migration rates are a weighted average of local and upstream nominal rates, with the weighting decreasing upstream. The model includes provisions for neck cutoffs and may be used to forecast future patterns of channel migration in meandering streams. Refinements to be made the model include selection of appropriate values of adjustable model parameters, possible modifications of the weighting procedures based on new theoretical or empirical information, provision for spatially and temporally variable bank resistance, and incorporation of procedures for modeling of chute cutoffs. (Baker-IVI)
W85-03566

REAL-TIME FLOOD FORECASTING TECHNIQUE,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W85-03708

ALTERNATIVE APPROACH TO LINEAR AND NONLINEAR STABILITY CALCULATIONS AT FINITE REYNOLDS NUMBERS,
University Coll., London (England). Dept. of Mathematics.
For primary bibliographic entry see Field 8B.
W85-03749

DEVELOPMENT OF FINITE-AMPLITUDE DISTURBANCES IN POISEUILLE FLOW,
Akademiya Nauk SSSR, Novosibirsk. Inst. Teoreticheskoi i Prikladnoi Mekhaniki.
For primary bibliographic entry see Field 8B.
W85-03750

2F. Groundwater

THREE-DIMENSIONAL GEOLOGIC MAPPING: A BASIS FOR HYDROGEOLOGIC AND LAND-USE EVALUATIONS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 8E.
W85-03272

ELECTRONIC TRANSDUCER FOR CONTINUOUS WATER LEVEL MONITORING,
Southern Florida Water Management District, West Palm Beach, FL.
For primary bibliographic entry see Field 7B.
W85-03371

EFFECTS OF GROUNDWATER GEOCHEMISTRY ON THE PERMEABILITY OF GROUTED FRACTURES,
Memorial Univ. of Newfoundland, St. John's. Dept. of Earth Sciences.
J. E. Gale, and E. J. Reardon.
Canadian Geotechnical Journal, Vol. 21, No. 1, p 8-20, February, 1984. 16 Fig, 1 Tab, 5 Ref.

Descriptors: *Permeability, *Groundwater, *Geochemistry, *Fracture permeability, Granite, Calcite.

A granite core containing a natural fracture, oriented parallel to the core axis, was collected, prepared, and its permeability measured in a hydrostatic test cell at different confining pressures. After the permeability hysteresis had been removed by several cycles of increasing and decreasing confining pressure, grout was placed within the fracture plane and allowed to cure for 40 days. Distilled water was forced through the sample until a significant flow rate developed. The influent solution for the sample was changed twice during the study to examine the effects of differing concentrations of Ca(HCO3)2 solutions on calcite precipitation within the fracture plane. The interaction of the Ca(HCO3)2 solution with the grout material resulted in a decrease in the permeability of the fracture plane over several months. At the close of the experiments, the sample was removed from the hydrostatic cell and opened along the fracture plane. The fracture exhibited two discrete braided channelways each with an average width of 2 mm. Precipitated calcite formed a rind along the walls of the channelways averaging 0.25 mm in thickness. The quantity of calcite precipitate determined from physical measurements was in reasonable agreement with that calculated using reaction rate expressions for calcite precipitation. The results of this study suggest the possibility that strategically located geochemical material could induce a geochemical evolution of groundwater within poorly grouted fractures, so as to decrease the permeability of the fractured rock system. (Author's abstract)
W85-03416

IMPACT OF GROUNDWATER ON MINING AND UNDERGROUND SPACE DEVELOPMENT IN THE NIAGARA ESCARPMENT AREA,
R. L. Nadon, and J. E. Gale.
Canadian Geotechnical Journal, Vol. 21, No. 1, p 60-74, February, 1984. 17 Fig, 3 Tab, 19 Ref. Ontario Geological Survey grant 92.

Descriptors: *Niagara Escarpment, *Groundwater, *Mining, *Underground space development, Unconfined aquifers, Permeability coefficient, Aquatards, Hydrogeology.

A field, laboratory, and numerical modelling study was undertaken to determine the impact of groundwater on mining activities and underground space development in the Paleozoic rock units of the Niagara Escarpment near Milton, Ontario. Five holes were drilled at a site next to the Dufferin quarry, penetrating the Amabel dolostone, the Reynales dolostone, the Cabot Head shale, the Manitoulin limestone, the Whirlpool sandstone, and the top part of the Queenston shale. Results of hydrogeological field and laboratory tests indicate the presence of an unconfined aquifer with an average hydraulic conductivity of 0.00002 m/s and a confined sandstone aquifer with conductivity of 0.0000005 m/s separated by a shale and limestone aquitard having a conductivity of less than 10 to the -9 m/s. Numerical model simulations of the groundwater flow system indicate that, for a 2 sq km underground mine located in the dolostone cap rock, the inflow rates range from 8 L/s to over 30 L/s with significant dewatering of the unconfined aquifer occurring within a distance of 1500 m of the mine boundaries. Calculations for a hypothetical mine located in the Whirlpool and Manitoulin Formations gave inflow rates of less than 3 L/s. It is concluded that groundwater conditions will not interfere with mining operations in either the dolostone unit or in the limestone-sandstone unit but could adversely affect subsequent space development in the dolostone unit. (Author's abstract)
W85-03417

SEEPAGE THROUGH TILL FOUNDATIONS OF DAMS OF THE EASTMAIN - OPINACA - LA GRANDE DIVERSION,
Societe d'Energie de la Baie James, Montreal (Quebec).
J.-J. Pare, N. S. Verma, A. A. Loiselle, and S. Pinzariu.
Canadian Geotechtechnical Journal, Vol. 21, No. 1, p 75-91, February, 1984. 13 Fig, 5 Tab, 6 Ref.

Descriptors: *La Grande Complex, *Quebec, *Reservoirs, *Seepage, *Dams, *Dykes, Pore pressure, Permeability coefficient, Anisotropy.

The EOL (Eastmain - Opinaca - La Grande) diversion scheme of the La Grande Complex (phase I) for the James Bay Hydroelectric development in northern Quebec diverts the waters of the Eastmain, Opinaca, and Petite Opinaca Rivers into the LG 2 reservoir. The EOL diversion consists of four dams and seven dykes about half of which are founded for part of their length on overburden foundations of variable thickness and consisting of heterogeneous deposits of glacial till or sandy and silty alluvia. The till core of these zoned embankments is either placed directly on the till strata or extended through the alluvia to the underlying till by a core trench. The construction of these embankments was completed in 1979 and the maximum reservoir level achieved in November 1980. This paper deals with the seepage pore pressure behavior in the overburden foundations, namely, dams OA-10B and OA-11 and the dyke OA-8B, during and subsequent to the reservoir filling. The results of the parametric seepage analyses carried out by finite element methods are compared with the observations. Special attempts are made to resolve the long-existing speculations regarding the anisotropy of natural deposits. Comments are made regarding the effective anisotropy of such deposits in the James Bay region and its effect on exit gradients and uplift forces, which influence the design and safety of dams and dykes. (Author's abstract)
W85-03418

STEADY STATE MODEL FOR FLOW IN SATURATED-UNSATURATED SOILS,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
A. T. Papagianakis, and D. G. Fredlund.
Canadian Geotechnical Journal, Vol. 21, No. 3, p 419-430, August, 1984. 16 Fig, 5 Tab, 16 Ref.

Descriptors: *Seepage, *Saturated soils, *Unsaturated soils, *Unsaturated flow, Groundwater flow, Model studies, Unsaturated zone, Permeability coefficient, Interstitial water, Finite elements.

A model is proposed describing continuous flow between saturated and unsaturated soil. The flow is assumed to be two dimensional and under steady state conditions. In the unsaturated zone, the coefficient of permeability is treated as a function of pore-water pressure head. The nonlinear differen-

tial equation governing the flow is solved using an iterative finite element scheme. The flow equation for an element is derived using the Galerkin weighed residuals method. Several example problems are solved and compared with flow net solutions. The proposed flow model is superior to traditional models, which consider flow only in the saturated zone. The results show that the zero pressure isobar is not an upper flow boundary. The finite element solution is shown to be relatively insensitive to the function used to express the relationship between the coefficient of permeability and the pore-water pressure head. (Author's abstract)
W85-03424

GEOCHEMICAL REACTIONS ASSOCIATED WITH LOW-TEMPERATURE THERMAL ENERGY STORAGE IN AQUIFERS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
C. D. Palmer, and J. A. Cherry.
Canadian Geotechnical Journal, Vol. 21, No. 3, p 475-488, August, 1984. 16 Fig, 4 Tab, 35 Ref. Natural Sciences and Engineering Research Council of Canada grant G0453.

Descriptors: *Groundwater, *Thermal energy storage, *Heat storage, *Geochemistry, Aquifers, Scaling, Pipes.

The geochemical mass transfer model WATEGM-SE is used to illustrate by example potential chemical reactions that can occur at a hypothetical low-temperature thermal energy aquifer storage facility. Important processes that control the chemistry include heating and cooling of the water, equilibration of the pumped water with the atmospheric partial pressure of CO2 and O2, and the mixing of the injection water with the native groundwater during the injection, storage, and recovery cycles. For the given example, 0.3 mmol/L of calcite would be precipitated under closed system pumping and heating from 10 to 50 C while a total of 1.9 mmol/L would be precipitated under the open condition. If this calcite were to form scale within the facility's piping then considerable lengths can be affected depending on the pumping rate. Alternatively, if the precipitate is kept in suspension it will be transported to the injection well and will be filtered out by the aquifer itself. This filtration can result in significant decreases in porosity and hence permeability in the immediate vicinity of the injection well. Mixing of the injection water with the native groundwater changes the water chemistry and can result in mineral supersaturation or undersaturation depending on the composition of these waters and the proportions in which they are mixed. The effect of mixing on the given example is undersaturation with respect to calcite and supersaturation with respect to amorphous Fe(OH)3. The pe values in the simulations of mixtures of an oxidizing injection water and a reducing native groundwater yielded some results with significantly higher pe values than the oxidizing injection water. The use of equilibrium geochemical mass transfer models tempered by an understanding of their limitations may prove to be an effective tool for evaluation of potential chemical reactions associated with low-temperature aquifer thermal energy storage facilities. (Author's abstract)
W85-03425

BOREHOLE MEASUREMENTS AND ITS APPLICATION, SHOWN BY AN EXAMPLE OF TWO ARTESIAN WELLS (BOHRLOCHMESSMETHODEN UND IHRE EINSATZMOGLICHKEITEN, GEZEIGT AM BEISPIEL ZWEIER ARTESISCHER BRUNNEN),
Bundesversuchs- und Forschungsanstalt Arsenal, Vienna (Austria).
P. Hacker, and J. Ullrich.
Wasserwirtschaft, Vol. 74, No. 9, p 437-440, September, 1984. 4 Fig, 4 Ref.

Descriptors: *Boreholes, *Artesian wells, *Austria, Water rights, Wells, Confined aquifers, Groundwater.

Borehole-geophysical measurements of two artesian wells from different geographical areas but with similar geological situations have been carried out in Upper Austria and Burgenland. They contributed to the solution of questions like the internal loss of water due to the closing of the well, depth of the confined aquifer and the sanding up of the uncased borehole when it is not constantly in use. Therefore it is necessary to have a precise hydrological examination especially for questions concerning water rights. (Author's abstract)
W85-03445

COMPARISON OF STEADY-STATE LAND-DRAINAGE EQUATIONS,
National Coll. of Agricultural Engineering, Silsoe (England).
C. J. Lovell, and E. G. Youngs.
Agricultural Water Management, Vol. 9, No. 1, p 1-21, June, 1984. 10 Fig, 1 Tab, 24 Ref.

Descriptors: *Drainage, *Mathematical equations, *Water table gradient, Hodographic analysis, Groundwater barriers, Groundwater recharge, Drain spacing, Drainage practices.

The physical assumptions and mathematical approximations leading to ten steady-state drainage equations for installations of parallel cylindrical drains laid above a horizontal impermeable barrier, are critically examined. Water-table heights were calculated from the equations for a range of depths of impermeable barrier and of rainfall rates, using the drain's radius obtained by the hodograph analysis for infinite depth of soil. A consideration of the available solutions show that the water-table height is known with sufficient accuracy for small depths of impermeable barrier and for large depths, but at intermediate depths the solutions lead to an unsatisfactorily large uncertainty in its position. Of the drainage equations, Houghoudt's equivalent depth equation, when used with the optimum drain radius given by the hodograph analysis for infinite soil depth, is the only one that gives results contained mainly within the known bounds that result from a consideration of the combination of equations. (Author's abstract)
W85-03479

STUDIES ON THE TECHNOLOGY OF UNDERGROUND WATER TREATMENT (UNTERSUCHUNGEN ZU DEN TECHNOLOGIEN DER AUFBEREITUNG VON WASSER IM UNTERGRUND),
Forschungszentrum Wassertechnik, Dresden (German D.R.).
For primary bibliographic entry see Field 5F.
W85-03526

STUDIES ON IRON AND MANGANESE REMOVAL IN A GROUNDWATER CONDUCTOR (UNTERSUCHUNGEN ZUR ENTEISENUNG UND ENTMANGANUNG IM GRUNDWASSERLEITER),
VEB Projektierung Wasserwirtschaft, Erfurt (German D.R.).
For primary bibliographic entry see Field 5F.
W85-03527

KINETICS OF IRON OXIDATION DURING GROUNDWATER FILTRATION IN THE GROUNDWATER CONDUCTOR (ZUR KINETIK DER OXYDATION VON EISEN BEI DER FILTRATION VON GRUNDWASSER IM GRUNDWASSERLEITER),
Institutul de Stiinte Biologice, Bucharest (Romania).
For primary bibliographic entry see Field 5F.
W85-03533

USE OF KRIGGING TO FORECAST FRACTURATION OF ROCKS (PREVISION PAR KRIGEAGE DE LA FRACTURATION DES ROCHES),
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
M. Razack, and P. Deshons.
Comptes Rendus Hebdomadaires des Seances Academie des Sciences, Paris, Series II, Vol. 299, No. 9, p 573-576, September, 1984. 1 Fig, 4 Ref.

Descriptors: *Kriging, *Geological fractures, Forecasting, Groundwater reservoirs, Aquifers, Hydrogeology.

The possibilities of forecasting rock fracturing by kriging are analyzed for the purpose of identifying fissured structure in groundwater reservoirs. The method was applied to a 16 sq km site on the Causse du Larzac, which is in the area of Saint-Maurice de Navacelles. The geostatistical processing method proved applicable and efficient in forecasting fracturing as well as particular fracture families related to the reservoir structure. The example studied here concerns fractures of the subsurface. Within the framework of the identification of the structure of reservoir fissures, which remains a major consideration in hydrogeology, as is natural, deep fractures are important. Geostatistical processing in general and kriging in particular contribute substantially to this result. (Moore-IVI)
W85-03536

DEFORMATIONS AND STRUCTURE OF RESERVOIRS IN THE MESOZOIC CARBONATE SERIES OF CENTRAL PORTUGAL (EASTERN PART OF FATIMA PLATEAU) (DEFORMATIONS CASSANTES ET STRUCTURE DE MAGASIN DANS LA COUVERTURE CARBONATEEE MESOZOIQUE DU CENTRE DU PORTUGAL (EST DU PLATEAU DE FATIMA)),
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
C. Drogue, and C. A. Costa Almeida.
Comptes Rendus Hebdomadaires des Seances Academie des Sciences, Paris, Series II, Vol. 299, No. 9, p 577-580, September, 1984. 2 Fig, 13 Ref.

Descriptors: *Geological fractures, *Deformation, *Fatima Plateau, *Portugal, Karst, Aquifers, Permeability coefficient.

In this fractured reservoir, with three tectonic phases, the dissolution conduits most often follow the main fractures which show several movements, some of which are compressive. The fractures opened by a stretching and later subjected to compression, must in some cases maintain a residual hydraulic conductivity which permits the development of deep karstification. (Author's abstract)
W85-03537

KRAFLA GEOTHERMAL FIELD, ICELAND; 1. ANALYSIS OF WELL TEST DATA,
California Univ., Berkeley. Lawrence Berkeley Lab.
G. S. Bodvarsson, S. M. Benson, O. Sigurdsson, V. Stefansson, and E. T. Eliasson.
Water Resources Research, Vol. 20, No. 11, p 1515-1530, November, 1984. 22 Fig, 1 Tab, 39 Ref. DOE contract DE-AC03-76SF00098.

Descriptors: *Krafla Geothermal Field, *Iceland, *Geothermal resources, Injection wells, Transmissivity, Model studies, Reservoirs, Water resources development, Scaling, Chemical composition, Well tests, Volcanoes.

The geological setting of the Krafla geothermal field in Iceland is described and well test data to be used in extensive modeling studies are presented. From a hydrogeological standpont, the Krafla geothermal field is a complex system. The reservoirs are primarily two phase, with fractures dominating the fluid flow paths. Reservoir temperatures are high but chemical composition of the fluids and the effects of noncondensible gases cause frequent scaling problems in many of the wells. The volcanic activity at the sites has unfavorably altered the chemical composition of the reservoir fluids, thus increasing the scaling problems. A detailed analysis of injection test data from the Krafla wells has been performed. These data are complicated by various factors such as wellbore effects, nonisothermal effects, two-phase effects, and the fractured nature of the reservoir rocks. Theoretical studies have been conducted to assess the impact of the different complicating factors and a simple model for the analysis of the injection test data has been developed. The average transmissivity of the Krafla reservoirs is 2.0 Dm, with values for most

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of the wells falling within the range of 1.5-2.5 Dm. Thus the transmissivities of the Krafla wells are rather similar to one another, but the average value is about an order of magnitude lower than those reported for most commercially successful geothermal fields. The analysis also yields high storativity values for the Krafla wells that are clearly indicative of the two-phase nature of the Krafla reservoirs. As the storativity is affected by many factors, no additional information is readily obtained from the calculated storativity values. (Baker-IVI)
W85-03553

KRAFLA GEOTHERMAL FIELD, ICELAND; 2. THE NATURAL STATE OF THE SYSTEM,
California Univ., Berkeley. Lawrence Berkeley Lab.
G. S. Bodvarsson, K. Pruess, V. Stefansson, and E. T. Eliasson.
Water Resources Research, Vol. 20, No. 11, p 1531-1544, November, 1984. 21 Fig, 1 Tab, 23 Ref. DOE contract DE-AC03-76F00098.

Descriptors: *Krafla Geothermal Field, *Iceland, *Geothermal resources, Model studies, Wells, Mass transport, Heat transfer, Condensation, Groundwater recharge, Heat loss, Groundwater movement, Hot springs.

A two-dimensional model is developed of the natural state of the Krafla geothermal systems that matches well all relevant data from the field. The model shows that the thermodynamic conditions of the reservoir system in the old and new wellfields are controlled by the upflow zones in Hveragil and a new wellfield. The lower reservoir in the old wellfield and the reservoir in the new wellfield are two phase with average vapor saturations of 10-20% in the fracture system. Fluids from an upflow zone recharge the reservoir in the new wellfield at a rate of 0.010 kg/s m. The fluids flow laterally along a high-permeability fracture zone at a depth of about 1 km and mix with fluids from the lower reservoir. The fluids mix in a ratio of about 2:23 with a higher mass flow coming from the lower reservoir in the old wellfield. The natural fluid flows are highest in the Hveragil fault zone where about 0.008 kg/s m of high-enthalpy steam is discharged to surface springs; the remainder recharges the upper reservoir in the old wellfield. In the Hveragil fault zone, extensive boiling takes place so that lower temperature waters feed the upper reservoir. The temperatures in other parts of the reservoir system are high, about 300 C at a depth of 1000 m and 345 C at a depth of 2000 m. While convection dominates the heat transfer in the system, conductive heat loss through the caprock is substantial. The heat fluxes from the bottom of the reservoir system are estimated at 2.0 W/sq m. These heat fluxes are small compared to the heat flux discharged through surface springs. (Baker-IVI)
W85-03554

KRAFLA GEOTHERMAL FIELD, ICELAND; 3. THE GENERATING CAPACITY OF THE FIELD,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 4B.
W85-03555

KRAFLA GEOTHERMAL FIELD, ICELAND; 4. HISTORY MATCH AND PREDICTION OF INDIVIDUAL WELL PERFORMANCE,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 4B.
W85-03556

SOLUTION OF SURFACE WATER FLOW EQUATIONS USING CLEBSCH VARIABLES,
Technisch Physische Dienst TNO-TH, Delft (Netherlands). Numerical Simulations Group.
For primary bibliographic entry see Field 2E.
W85-03565

FINITE ELEMENT DUAL MESH METHOD TO CALCULATE NODAL DARCY VELOCITIES IN NONHOMOGENEOUS AND ANISOTROPIC AQUIFERS,
Auburn Univ., AL. Dept. of Civil Engineering.
V. Batu.
Water Resources Research, Vol. 20, No. 11, p 1705-1717, 1984. 12 Fig, 5 Tab, 13 Ref.

Descriptors: *Finite element method, *Darcy's Law, *Groundwater movement, *Aquifer characteristics, Anisotropic aquifers, Steady flow, Permeability, Seepage, Porosity.

Natural porous media, such as confined and unconfined aquifers, are generally highly nonhomogeneous and anisotropic as compared with man-made media such as earth dams and levees. A finite element dual mesh method is developed to calculate the nodal Darcy velocity component in a highly nonhomogeneous and anisotropic aquifer of constant porosity under steady flow conditions. The finite element method is used to calculate the total head distribution. The finite difference forms of the total head gradients are used to calculate the Darcy velocity components. The dual mesh method is quite convenient to calculate the nodal Darcy velocities with sufficient accuracy. The continuity principle is satisfied to an acceptable degree. The results are compared with an analytical solution and agreement was excellent. The dual mesh method can be applied to any nonhomogeneous and anisotopic porous medium to calculate the nodal Darcy velocities. (Baker-IVI)
W85-03571

EIGENVALUE SOLUTION CONTINUOUS IN TIME TO THE SPATIALLY DISCRETIZED SOLUTE TRANSPORT EQUATION IN STEADY GROUNDWATER FLOW,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-03573

TECHNIQUE OF REINITIALIZATION FOR EFFICIENT SIMULATION OF LARGE AQUIFERS USING THE DISCRETE KERNEL APPROACH,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
T. H. Illangasekare, H. J. Morel-Seytoux, and K. L. Verdin.
Water Resources Research, Vol. 20, No. 11, p 1733-1742, November, 1984. 9 Fig, 38 Ref, 1 Append. OWRT project B-199-Colorado, grant 14-34-0001-9109.

Descriptors: *Aquifers, *Discrete kernel method, *Finite element method, *Simulation, Groundwater movement, Drawdown, Finite difference methods, Mathematical equations, Partial differential equations.

The numerical technique of finite differences is commonly used to solve the partial differential equation describing saturated flow in aquifers (Boussinesq equation). This technique uses the known initial conditions at the beginning of the time step and the net excitations acting on the aquifer during the time step to compute the unknown heads at the end of the time step. This procedure requires the solution of a generally large system of simultaneous equations (equal to the number of nodes) at each simulation time step. Such an operation may become very costly for types of management problems where generally large aquifers have to be simulated numerous times at short time steps for a long time horizon. A technique which uses the discrete kernel approach and which requires the solution of the saturated flow equation for a small scanning grid system for a few time steps is presented. These solutions for few periods are used to simulate the heads in the total aquifer for long time horizons by a simple discrete convolution. The capability of the technique to handle point excitations and to predict point aquifer drawdowns are demonstrated. A cost comparison is made between the use of this technique and the conventional finite difference technique to solve a test aquifer simulation problem. (Author's abstract)
W85-03574

GROUNDWATER CONTAMINATION FROM AN INACTIVE URANIUM MILL TAILINGS PILE: 1. APPLICATION OF A CHEMICAL MIXING MODEL,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5B.
W85-03575

THEORETICAL ANALYSIS OF THE ROLE OF GROUNDWATER FLOW IN THE GENESIS OF STRATABOUND ORE DEPOSITS. 1. MATHEMATICAL AND NUMERICAL MODEL,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
G. Garven, and R. A. Freeze.
American Journal of Science, Vol. 284, No. 10, p 1085-1124, December, 1984. 11 Fig, 2 Tab, 78 Ref.

Descriptors: *Ore deposits, *Groundwater movement, *Mathematical models, Gravity, Model studies, Computers, Simulation, Sedimentary basins, Lead, Zinc, Carbonate rocks, Advection, Dispersion.

Numerical modeling is used to gain insight into the role of groundwater flow in the genesis of ore deposits in sedimentary basins. Depending on the stage of evolution of a basin, either a compaction-drive or gravity-drive fluid-flow system may developed. The quantitative examination of the role of gravity-driven groundwater flow in ore genesis was examined. Special attention was given to lead-zinc deposits in carbonate rocks because of their importance, but the results have general application to other types of stratabound epigenetic deposits. Numerical modeling techniques were used to develop a computer code for simulation of regional transport processes along cross sections. The finite-element method was applied to solve the steady state, fluid flow, and heat transport equations, and a moving-particle random-walk algorithm was developed to predict the advection and dispersion of aqueous species. A simulation approach provides a demonstration of the numerical patterns in modeling ore-forming processes in sedimentary basins. It confirms the ability of gravity-driven flow systems to provide favorable conditions for ore formation near the edge of a basin. (Baker-IVI)
W85-03672

THEORETICAL ANALYSIS OF THE ROLE OF GROUNDWATER FLOW IN THE GENESIS OF STRATABOUND ORE DEPOSITS. 2. QUANTITATIVE RESULTS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2K.
W85-03673

EFFECT OF ORGANIC CONTAMINATION UPON MICROBIAL DISTRIBUTIONS AND HETEROTROPHIC UPTAKE IN A CAPE COD, MASS., AQUIFER,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W85-03736

PROTECT AND MONITOR GROUNDWATER,
Fluor Canada Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 5G.
W85-03744

ADAPTIVE PUMPING TEST ANALYSIS,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power.
Z. Sen.
Journal of Hydrology, Vol. 74, No. 3/4, p 259-270, November, 1984. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Pumping tests, Transmissivity, Storativity, Groundwater storage, Kalman filter, Estimation.

Evaluation of groundwater resources requires accurate determination of aquifer water-storage and water transmission abilities, but conventional aquifer parameter estimations are dependent on the analyst's personal judgement and experience. Aquifer parameters have been determined adaptively from pumping-test data by employing the Kalman filter technique, which leads to global estimates after sequences of local estimates. The application of this technique leads to storativity and transmissivity estimates after each record of time-drawdown data. Each additional drawdown measurement reliably updates previous estimates by reducing the error variance. The procedure avoids type-curve matching and sequentially yields estimates of transmissivity and storativity. The procedure is rapidly convergent especially for storativity estimates. (Moore-IVI)
W85-03753

INFLUENCE OF ANISOTROPY ON RELATIONS BETWEEN ELECTRICAL AND HYDRAULIC PROPERTIES OF AQUIFERS,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
W. E. Kelly, and P. F. Reiter.
Journal of Hydrology, Vol. 74, No. 3/4, p 311-321, November, 1984. 7 Fig, 6 Ref. NSF grant ENG 78 19408.

Descriptors: *Anisotropy, *Permeability coefficient, *Porosity, *Resistivity, Aquifer layering, Conductance, Electrical properties, Hydraulic properties, Mathematical models, Analytic models.

Relations between aquifer formation factor and hydraulic conductivity are strongly dependent on in-situ correlations between porosity and hydraulic conductivity. A second factor which influences aquifer relations is horizontal layering. The influence of aquifer layering was studied with idealized analytic and numerical models. For uniform layering analytic models are used to demonstrate that for inverse correlations between porosity and hydraulic conductivity, the best field relations are obtained when the transverse resistance of the aquifer is defined by the sounding curve and the average transverse resistivity is used in correlations. When the longitudinal conductance is the parameter defined, the influence of aquifer anisotropy is significant and may introduce scatter in field correlations. (Author's abstract)
W85-03756

2G. Water In Soils

NEUTRON METER CALIBRATION AND ERROR CONTROL,
Agricultural Research Service, Temple, TX.
V. L. Hauser.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 722-728, May/June, 1984. 7 Fig, 8 Tab, 42 Ref.

Descriptors: *Neutron meters, *Calibration, *Errors, *Soil water, Soil temperature, Measuring instruments.

Modern neutron meters reliably measure soil water content. Good accuracy requires an understanding of theory, accurate calibration, and knowledge of possible errors. The theory is explained along with the calibration of one-depth moisture meters. A new method for near-surface calibration and sources for error are discussed. A small error in positioning the probe at a specified depth results in significant errors for reading at depths less than 15 cm on the soil. Significant errors may be introduced into neutron meter data by temperature effects commonly encountered in use. A few simple rules are listed to avoid errors caused by variations in temperature. (Baker-IVI)
W85-03375

TILLED SOIL SUBSIDENCE DURING REPEATED WETTING,
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
C. A. Onstad, M. L. Wolfe, C. L. Larson, and D. C. Slack.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 733-736, May/June, 1984. 3 Fig, 5 Tab, 5 Ref.

Descriptors: *Soil water, *Soil properties, *Soil subsidence, Permeability coefficient, Leaching, Tillage, Rainfall, Roughness, Soil density.

A total of 15.2 cm of water was applied without raindrop impact energy to six replicates of four freshly tilled soils to determine its effect on subsidence, random roughness, bulk density, and hydraulic conductivity. Furnace filter material was used to absorb rainfall kinetic energy and prevent surface sealing. Microrelief measurements were made after tillage and after each of the four water applications. These measurements were used to calculate random roughness and bulk density. Soil samples were taken for hydraulic conductivity evaluations. Random roughness and hydraulic conductivity decreased with the application or water, while bulk density increased. Simple regression models were developed for predicting each of the parameters as a function of amount of applied water. For random roughness the model explained from 90 to 97% of the variation depending on soil type. For bulk density, the model explained 84 to 96% of the variation and for hydraulic conductivity the model explained 57 to 63% of the variation depending on soil type. (Baker-IVI)
W85-03377

SPECTRAL ANALYSIS OF WATER ADVANCE IN LEVEL BASINS,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
B. R. Hanson, and S. W. Kite.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 751-761, May/June, 1984. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Spectral analysis, *Soil properties, *Furrow irrigation, Statistical analysis, Soil water, Infiltration, Basins, Spatial distribution.

The potential of using time or space series statisics as a tool for evaluating irrigation systems was investigated. For an alternate furrow irrigation sequence, almost all of the variance in the water advance was caused by differences between non-wheel furrows and wheel furrows. Little variance was attributed to differences among wheel furrows or among non-wheel furrows. Where all furrows were irrigated, most of the variance in the detrended data was due to periodic effects. Variance due to random behavior among wheel furrows or among non-wheel furrows appeared to be small. Compaction of non-wheel furrows increased the water advance early in the irrigation season but had little or no effect during the latter part. Periodicity in these data is obvious and questions remain concerning this type of analysis where the periodic component is not easily detected or is nonexistent. The possibility of relating the behavior of the sample spectrum to distribution uniformity and application efficiency also needs to be investigated. (Baker-IVI)
W85-03380

UNSATURATED SOIL HYDRAULIC PROPERTIES FROM REDISTRIBUTION OF INJECTED WATER,
Colorado State Univ., Fort Collins. Cooperative Extension Service.
M. Mahmoodian-Shooshtari, L. A. Davis, D. B. McWhorter, and A. Klute.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 784-796, May/June, 1984. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Soil water, *Soil properties, *Hydraulic properties, Clay, Sand, Injection, Permeability coefficient, Soil water suction, Unsaturated flow.

Calculation of flows in unsaturated soils requires that the functional relationships among hydraulic conductivity, solution pressure, and solution content be known, but the time and cost involved in field measurement of these hydraulic properties is substantial, even for a single site, and is often prohibitive for multiple locations. An analytical and experimental investigation of a matching method for the determination of the parameters in the Brooks-Corey K(h) and h(0) relationships is presented. The method is based upon fitting an analytically derived response function to the corresponding measured one for one-dimensional redistribution of water injected into the soil. Comparisons of the parameter values derived by the matching method with those obtained in independent experiments on six soils ranging from clay to sand are made. Close agreement between hydraulic conductivities Km and the characteristic suctions Hd determined by the two methods was observed. The Brooks-Corey parameter, gamma, was less satisfactorily estimated by the matching procedure, probably because the flow process is not sensitive to the value of gamma. (Baker-IVI)
W85-03386

SOIL MOISTURE RESPONSES TO CROPPING AND TILLAGE ON WESTERN IOWA LOESS SOILS,
Agricultural Research Service, Council Bluffs, IA.
R. G. Spomer, and T. Hjelmfelt.
Transaction of the ASAE, Vol. 27, No. 3, p 822-826, May/June, 1984. 7 Fig, 10 Ref.

Descriptors: *Soil water, *Cropping, *Tillage, *Loess soils, *Iowa, Grass, Corn, Permeability coefficient, Rainfall, Recharge.

Observations on the Treynor, Iowa, research watersheds indicated that soil moisture storage was affected more by cropping (grass versus corn) than tillage (conventional versus till-plant), but neither treatment made a significant difference. Continuous corn grown with conservation tillage or conventional tillage resulted in no soil moisture storage difference in the 0 to 0.6 m (0 to 2 ft) depth. Soil moisture was slightly greater in the 1.2 to 1.8 m (4 to 6 ft) zone for conservation tillage compared to conventional tillage. Results were for an 8-year period which included wet, droughty, and average rainfall years. Average soil moisture during the growing season for the grass treatment at the 0 to 0.6 m (0 to 2 ft) soil depth was slightly less than soil moisture at this soil depth for continuous conventionally-tilled corn treatment. The soil at the 1.2 to 1.8 m (4 to 6 ft) depth under grass was slightly more moist than soil at this depth for continuous corn with conventional tillage. Soil moisture was best correlated with rainfall and crop stage; and withdrawal and recharge were most apparent in the 0 to 0.6 m (0 to 2 ft) depth of the soil. The rapid response of ground water and baseflow to precipitation as observed on the loess soils in western Iowa was explained by the large hydraulic conductivities previously determined. Vertical saturated soil water conductivity was shown to be about 0.5 cm/min (0.2 in./min) in the loess soil and 1 cm/min (0.5 in./min) horizontally in the Turton member of the De Forest alluvium. (Author's abstract)
W85-03391

SOIL PROPERTIES OF SURFACE MINED LAND,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
D. M. Silburn, and F. R. Crow.
Transactions of the ASAE, Vol. 27, No. 3, May/June, 1984. 2 Fig, 6 Tab, 17 Ref.

Descriptors: *Reclamation, *Soil water, *Oklahoma, *Permeability coefficient, *Mine wastes, Runoff, Bulk density, Soil moisture retention.

Properties of premined and postmined soil profiles were measured on three surface mined areas in eastern Oklahoma. Two types of spoil were represented in the reclaimed profiles, clay spoil and shale spoil. Properties determined were: bulk density, moisture retention (at saturation, 0.1 bar and 15 bar suction), texture, percent coarse fragments, and saturated hydraulic conductivity. Coarse frag-

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ments in shale spoil sigificantly reduce the available moisture holding capacity and reduce infiltration. The 0.1 bar moisture and the mean available water content of the shale spoils were significantly less than that of other soils due to the coarse fragments. At the 60 cm root depth, the total available water of the topsoil-covered spoil profiles was about 85% of the total available water of the natural soil. Topsoiling was beneficial from the point of view of water availability as it increased both the potential rooting depth and the storage capacity per unit of root depth. Gravitational water capicity in all reclaimed profiles was less than for natural soils, indicating a reduction in percentage of large pores. Measured saturated hydraulic conductivity values indicated that the shale spoils and clay spoils were less permeable than the natural subsoils by about one and two orders of magnitude respectively. Consequently, mining runoff from the reclaimed profiles will be greater than from natural soils. (Collier-IVI)
W85-03392

EVAPOTRANSPIRATION OF LETTUCE IN RELATION TO WATER TABLE DEPTH,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih, and G. S. Rahi.
Transactions of the ASAE, Vol. 27, No. 4, p 1074-1080, July/August, 1984. 6 Fig, 6 Tab, 8 Ref.

Descriptors: *Evapotranspiration, *Florida, *Everglades, *Agriculture, *Lettuce, *Water table, Lysimeters, Pan evaporation, Transpiration, Water use efficiecy, Biomass.

Studies of the evapotranspiration (ET) and water use efficiency for lettuce in relation to water table depth were conducted in nine lysimeters on organic soil. The water tables were controlled at 45, 60, and 85 cm with three replications. Two crops of lettuce were raised. The lettuce ET and water use efficiency are inversely related to the water table depth. The average daily ET varied from 2.0 to 3.4 mm/day. The lettuce required about 14 to 24 kg of water to produce 1 kg of fresh biomass, and required about 19 to 35 kg of water to produce 1 kg of marketable yield. The ratio of ET to the standard pan evaporation increased steadily to a peak around the lettuce heading development period, then the ratio declined toward the harvest. The lettuce grown in the 60 cm water table is as good as the conventional water table (85 cm). (Author's abstract)
W85-03399

OPTIMAL DRAIN DESIGN FOR ARID, IRRIGATED AREAS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W85-03403

TEMPORAL CHANGES OF GROUNDWATER PRESSURE IN A NATURAL SLOPE OF NONFISSURED CLAY,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
T. C. Kenney, and K. C. Lau.
Canadian Geotechnical Journal, Vol. 20, No. 1, p 138-146, 1984. 10 Fig, 7 Ref. Ministry of Natural Resources of Ontario grant GR-113 and Natural Sciences Research Council of Canada grant A4543.

Descriptors: *Groundwater pressure, *Slopes, *Clay, *Piezometric head, Coefficient of consolidation, Consolidation theory, Wabi Creek, New Liskeard, Ontario, Lake Barlow.

A field study was made of changes of groundwater pressures over a 10 year period in a slope composed of nonfissured clay having a value of coefficient of consolidation c sub v = 0.1 sq m/ day. The slope is a portion of the eastern bank of the Wabi Creek near New Liskeard, Ontario, located within the boundaries of the glacial Lake Barlow. Measurements of piezometric levels are reported together with calculated annual changes of safety factor of the slope. A method is suggested for estimating the most severe groundwater pressures that a clay slope can be expected to experience; except near the ground surface, the groundwater pressures remain quite steady. Using this method, estimates were made of the minimum expected value of safety factor of the slope at the test site. Using consolidation theory, predictions were made of changes of piezometric levels for the condition of zero infiltration based on the postulate that these changes were the direct result of changes of hydraulic conditions at the ground surface. Estimates, based on consolidation theory, of changes of piezometric level in soils having similar values of coefficient of consolidation indicate very slow response of groundwater pressures to changes of hydraulic conditions at the ground surface. The predictions were in agreement with the field measurements. (Collier-IVI)
W85-03420

STEADY STATE MODEL FOR FLOW IN SATURATED-UNSATURATED SOILS,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W85-03424

TRANSPORT OF WATER IN FROZEN SOIL: III. EXPERIMENTS ON THE EFFECTS OF ICE CONTENT,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano, A. Tice, and J. Oliphant.
Advances in Water Resources, Vol. 7, No. 1, p 28-34, March, 1984. 10 Fig, 1 Tab, 5 Ref.

Descriptors: *Soil water, *Soil water movement, *Frozen soil, *Interstitial water, *Ice, Transport, Clays, Frozen ground, Water vapor, Soil columns.

In frozen soil almost all pore liquid water is frozen and the total water content is given by the sum of unfrozen water content and ice content. The soil selected for this study, called Morin clay, was a marine-deposited clay. The main experiment consisted of connecting two long columns of soil with the same size and the same dry density. One of them was uniformly dry with a negligibly small water content, while the other was uniformly wet. While the column was maintained at -1 C, water was transported from the wet part to the dry part across the contact surface between the wet and dry soil columns. In another experiment, a 2-mm gap was made between the wet and dry columns to interrupt the transport of water in a liquid phase. The cumulative flux of water during a 17 day period was reduced by 65% by the air gap and the water content in the wet part near x = 0 was about 20%; thus, the transport of water in vapor phase is still significant at this relatively high total water content. In frozen soil, ice fills more pore space as the total water content increases; hence, unlike in unfrozen soil where the presence of pore water markedly enhances water movement, pore water (ice) in frozen soil probably reduces water flow. The flux of water in unsaturated frozen soil is proportional to the gradient of total water content; theoretical justification of this proposed physical law was made by the use of the two-phase flow theory. The experimental results support the proposed physical law. (Collier-IVI)
W85-03477

DIFFUSION-BASED SOIL WATER SIMULATION FOR NATIVE GRASSLAND,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
R. De Jong, and H. N. Hayhoe.
Agricultural Water Management, Vol. 9, No. 1, p 47-60, June, 1984. 4 Fig, 2 Tab, 28 Ref.

Descriptors: *Soil water, *Simulation analysis, *Saskatchewan, *Grasslands, *Diffusion, Evapotranspiration, Precipitation, Permeability coefficient, Hydrologic models.

A previously developed diffusion-based soil water simulation model (Hayhoe, H.N., 1981. Soil Sci., Vol. 131, p 334-343; Hayhoe, H.N. and De Jong, R., 1982. Computer Simulation Model of Soil Water Movement and Uptake by Plant Roots. Land Resource Institute, Agriculture Canada, Ottawa, 74 pp) was tested under native grassland conditions in the semi-arid region of Saskatchewan, Canada. The model, which made extensive use of measured soil physical parameters and seasonal crop growth characteristics, was 'driven' by daily precipitation and potential evapotranspiration data. Model predictions of crop water use and soil water content in the root zone agreed well with measured values and a realistic separation of the components of actual evapotranspiration was obtained. By decreasing the lower limit of water availability to plant roots during dry periods a better correspondence between measured and simulated water use was obtained, thereby supporting previous work that soil water content at 15,000 cm H20 suction does not necessarily represent the permanent wilting point. (Author's abstract)
W85-03482

COMPARISON AND SELECTION OF FURROW IRRIGATION MODELS,
Concepcion Univ. (Chile).
For primary bibliographic entry see Field 3F.
W85-03484

IN SITU ESTIMATION OF HYDRAULIC CONDUCTIVITY USING SIMPLIFIED METHODS,
Montana Agricultural Experiment Station, Conrad. Western Triangle Agricultural Research Center.
A. J. Jones, and R. J. Wagenet.
Water Resources Research, Vol. 20, No. 11, p 1620-1626, November, 1984. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Permeability coefficient, *Hydraulic conductivity, *Soil water movement, *Soil water, Mathematical equations, Spatial distribution, Estimating equations, Infiltration, Farmington, Utah.

Adequate and effective management of soil and water often necessitates characterization of soil hydraulic properties over large areas. If a large number of field locations are to be characterized, conventional techniques are cumbersome owing to logistical considerations. Simplifying assumptions about the flow regimes during redistribution of soil water after a steady state attained during infiltration have produced several approximate methods useful in estimating the in situ relationship between hydraulic conductivity and water content. Five simplified methods of estimating the relationship between hydraulic conductivity K and water content were compared. Redistribution of water following constant rate infiltration was monitored for a 10 day period at 100 locations and seven depths at each location within a 5000 sq m fallow sandy loam field at a Utah Agricultural Experiment Station farm in Farmington, Utah. All the methods assumed a unit hydraulic gradient during redistribution and an exponential relationship between K and water content. (Baker-IVI)
W85-03560

CONCEPTUAL MODEL OF DEEP UNSATURATED ZONES WITH NEGLIGIBLE RECHARGE,
Disposal Safety, Inc., Washington, DC.
B. Ross.
Water Resources Research, Vol. 20, No. 11, p 1627-1629, November, 1984. 1 Fig, 7 Ref. NRC contract NRC-02-82-047.

Descriptors: *Infiltration, *Soil water, *Soil water movement, *Unsaturated zone, Arid zone, Groundwater recharge, Leaching, Water pollution control, Groundwater protection, Soil water suction, Water vapor, Waste disposal.

Because of interest in the disposal of hazardous wastes, there has been increased attention to the movement of water in the very deep unsaturated zones of arid areas. The arid areas are distinguished by low rates of recharge to the groundwater system. When net recharge is less than about 0.03 mm/yr, moisture movement in deep unsaturated zones at steady state will be dominated by

upward movement of vapor driven by the geothermal gradient. With zero net recharge there will be a downward flow of liquid water equal to the upward vapor flux. This will produce a profile of suction potential versus depth qualitatively similar to that expected if recharge is not negligible. Consequently, the existence of a region of uniform potential is not in itself evidence of recharge. When recharge rates exceed about 0.03 mm/yr, deep unsaturated zones at steady state may be analyzed by neglecting vapor movement and assuming effective hydraulic conductivity and recharge to be equal. These ideas can be extended to stratified media by fairly direct means. Intermittent or nonuniform recharge presents a more difficult problem. (Baker-IVI)
W85-03561

GREEN-AMPT MODEL OF INFILTRATION IN A CRACKED SOIL,
Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Div. of Mineral Physics.
M. R. Davidson.
Water Resources Research, Vol. 20, No. 11, p 1685-1690, November, 1984. 6 Fig, 18 Ref, 1 Append.

Descriptors: *Infiltration, *Soil water, *Model studies, *Macropores, Soil cracks, Mathematical equations, Wetting front.

The presence of surface-connected macroscopic channels (macropores), such as worm holes, root holes, or cracks, in soils can be very important as preferred flow paths for the vertical transfer of water and solutes for the surface. The motion of the wetting front in a two-dimensional Green-Ampt model of infiltration into a soil containing regularly spaced water-filled vertical cracks is traced using a stepwise numerical procedure which progressively solves an integral equation for the velocity at points on the front at each time step. Initially, the calculated front exhibits a mushrooming effect at its base which diminishes both with time and as moisture potential becomes more negative. The shape of the front is independent of crack spacing/depth ratio until the interaction of wetted tongues emanating from adjacent cracks. Thereafter the front becomes flatter and advances further relative to the crack depth, with decreasing crack spacing and increasingly negative moisture potential. (Baker-IVI)
W85-03569

PE-PVC-SUCTION CUP IN SANDWICH CONSTRUCTION FOR TAKING SEEPAGE WATER SAMPLES, (EINE KUNSTSTOFF-SAUGKERZE IN SANDWICHBAUWEISE ZUR GEWINNUNG VON SICKERWASSERPROBEN),
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Hydrogeologie und Hydrochemie.
For primary bibliographic entry see Field 7B.
W85-03592

ECOLOGICAL EFFECTS OF HEATHER BURNING; I. WATER INFILTRATION, MOISTURE RETENTION AND POROSITY OF SURFACE SOIL,
Aberdeen Univ. (Scotland). Dept. of Botany.
A. U. Mallik, C. H. Gimingham, and A. A. Rahman.
Journal of Ecology, Vol. 72, No. 3, p 767-776, November, 1984. 4 Fig, 4 Tab, 42 Ref.

Descriptors: *Soil moisture retention, *Infiltration, *Soil porosity, *Fire, *Heather, *Scotland, Heathlands, Ash, Organic matter, Litter, Pore volume.

Vegetation fires induce important changes both in the soil and in the climate near the ground. Measurements were made of water infiltration, water retention and porosity of soils of burned and unburned plots of heathland in a study area located in the Muir of Dinnet National Nature Reserve, Scotland. On the burned plot the rate of infiltration was decreased by up to 74% compared to the unburned plot. Moisture retention in the soil of the burned plot was increased considerably compared to the unburned plot. The effect was more pronounced in the top 2 cm of soil and decreased with depth. Mercury intrusion porosimetry was used to investigate the porosity of the surface layers of soil following burning of the vegetation. The decrease in water infiltration on the burned plot may be a result of ash particles clogging the soil pores in the upper soil layer. The density of larger pores is reduced, with a concomitant increase in the density of smaller pores. This reduces the rate of water percolation through the soil and increases the water retaining capacity. Much of the organic matter, litter, and roots at the surface are destroyed on the burned plot and this may contribute to the reduced pore volume of the surface sample. (Moore-IVI)
W85-03739

SIMPLIFIED DETERMINATION AND SENSITIVITY ANALYSIS OF SOIL-MOISTURE RETENTION CURVES AND HYDRAULIC CONDUCTIVITY,
Thessaloniki Univ., Salonika (Greece). School of Technology.
E. Sidiropoulos, and S. Yannopoulos.
Journal of Hydrology, Vol. 74, No. 3/4, p 295-309, November, 1984. 11 Fig, 2 Tab, 19 Ref.

Descriptors: *Permeability coefficient, *Soil moisture retention, *Sensitivity analysis, Soil water, Residual water content, Hydraulic properties.

A simple algorithm is presented that estimates the parameters contained in the Van Genuchten analytical soil-moisture characteristics curves. No graphical estimations are involved and convergence is rapid. The values obtained from the simple algorithm are introduced as starting values in a Newton-Raphson minimization procedure which yields more accurate evaluations of the parameters. The very good approximation offered by the simple algorithm is responsible for the small number of subsequent Newton-Raphson iterations. Based on the final results of the minimization scheme an analytical sensitivity analysis is carried out with respect to changes induced in the basic parameters 'residual water content'. Soils with a wide range of hydraulic properties were subjected to the above analysis. It is demonstrated that for lower water contents the sensitivity of the hydraulic conductivity becomes by 2-5 orders of magnitude larger than it is for higher ones. (Author's abstract)
W85-03755

NUMERICAL SIMULATIONS OF SOIL-WATER FLOW DURING WETTING IN A NON-HOMOGENEOUS SOIL,
Rissho Univ., Tokyo (Japan). Dept. of Geography.
M. Higuchi.
Journal of Hydrology, Vol. 74, No. 3/4, p 323-334, November, 1984. 4 Fig, 13 Ref.

Descriptors: *Soil water, *Infiltration, *Wetting, *Tokyo, *Japan, Simulation, Mathematical models, Richards equation, Soil water movement, Capillary potential.

Soil-water movement during rain infiltration and redistribution in an actual nonhomogeneous soil is studied numerically. The results of numerical simulations are compared with the data obtained from field observations at Kiyose city, Tokyo, Japan, for two 3-day periods of observation. Richards' equation is used with capillary potential as a dependent variable. Computed profiles agree well with the observations though there are some minor deviations. Possible causes of these deviations might be that the following factors are ignored in the computations: short-circuiting; viscous resistance to air flow and compressibilities of air and water; hysteresis of pore water; and instability (fingering) during infiltration. (Moore-IVI)
W85-03757

2H. Lakes

ROLE OF PHOSPHATASES IN PHOSPHORUS MINERALIZATION DURING DECOMPOSITION OF LAKE PHYTOPLANKTON BLOOMS,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
G. Z. Halemejko, and R. J. Chrost.
Archiv fur Hydrobiologie, Vol. 101, No. 4, p 489-502, October, 1984. 5 Fig, 2 Tab, 22 Ref.

Descriptors: *Eutrophication, *Phytoplankton, *Phosphorus, *Lakes, *Lake Glebokie, *Poland, Seasonal variation, Algae, Decomposition, Phosphatases, Cyanophyta, Dynoflagellates.

The rate of phytoplankton decomposition under laboratory conditions which closely simulate the natural conditions in the upper layer of the trophoplytic zone of an eutrophic lake, Lake Glebokie, Poland. Much attention was given to the transformation and mineralization of organic phosphorus from decomposing algae and the role of phosphatases and bacteria in these processes. The decomposition of seston was a microbiological process mediated mainly by bacteria. The decomposition of phytoplankton caused the rapid release of a considerable amount of inorganic phosphorus to the environment. Approximately 80% of the microorganisms participating in this decomposition produced alkaline and acid phosphatases which hydrolyzed organic phosphorus compounds in the seston and water. Of particular importance in this process was the role of free phosphatases, extracellularly released to the environment. The rate of phytoplankton decomposition depended on the species composition of the algae forming it. Summer phytoplankton, composed of dinoflagellates and blue-green algae, was decomposed the fastest, the spring and autumn blooms much slower. (Baker-IVI)
W85-03230

DIEL VARIATION IN PRIMARY PRODUCTION AND THE VERTICAL DISTRIBUTION OF PHYTOPLANKTON IN A POLYHUMIC LAKE,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
L. Arvola.
Archiv fur Hydrobiologie, Vol. 101, No. 4, p 503-519, October, 1984. 9 Fig, 3 Tab, 33 Ref.

Descriptors: *Primary productivity, *Phytoplankton, *Vertical distribution, *Diel variation, *Lakes, *Finland, Nutrients, Light intensity, Temperature effects, Chlorophyll a, Biomass, Solar radiation.

Four 24 hr diurnal experiments were made in a small polyhumic lake in southern Finland having a shallow, sharp thermocline. The purpose was to examine the relationship of the diel variations of primary production with the active vertical migrations of phytoplankton. Primary production, chorophyll a, phytoplankton biomass, and species composition were analyzed at different depths of epilimnion at 4 hr intervals. Primary productivity was closely correlated with irradiance at the subsurface, while only a slight correlation was at the surface. The efficiency of primary production varied substantially between different experiments and depths, although it was usually higher in morning and afternoon than at mid day. Chlorophyll a concentration correlated closely with phytoplankton biomass, but in one experiment chlorophyll concentration increased at the surface and subsurface slower in relation to phytoplankton biomass than in deeper water layers. Some flagellated phytoplankton species had diel variations in their vertical distributions, but only Cryptomonas ovata showed distinctly active vertical migrations, even through a 15 C gradient of temperature. A complex interaction between light intensity and nutrient concentration seemed to affect the diel primary production and the vertical distribution of flagellates. (Baker-IVI)
W85-03231

ULTRASTRUCTURE OF LACUSTRINE SEDIMENTING MATERIALS IN THE COLLOIDAL SIZE RANGE,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 2J.
W85-03232

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SPATIAL AND SEASONAL VARIATIONS OF PHOSPHATE SOLUBILIZING BACTERIA IN FISH PONDS OF VARYING FISH FARMING MANAGEMENTS,
Kalyani Univ. (India). Dept. of Zoology.
B. B. Jana, and G. N. Patel.
Archiv fur Hydrobiologie, Vol. 101, No. 4, p 555-568, October, 1984. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Phosphates, *Seasonal variations, *Fish farming, *India, *Bacteria, Nutrients, Spatial distribution, Aquaculture, Carp, Fish management.

Counts of phosphate solubilizing bacteria (PSB) were determined twice a month in water and sediments of six ponds under polyculture, monoculture and traditional systems of fish farming over two and a half years at two fish farms in India. The polyculture ponds were stocked with three species of Indian major carp and three exotic carp, and the monoculture ponds were stocked with a single species of Indian major carp, both at a density of 6000/ha. The traditional fish pond had been stocked largely with three species of Indian major carp. The distribution pattern of PSB varied markedly depending upon the farm sites, farming management and season. Seasonal trends of PSB were expressed by using appropriate mathematical models. Harmonic analysis of empirical function with 12 ordinates was the best model to depict the annual cycle of PSB in some ponds, while the polynomial equations of third to fifth degree and running averages were most appropriate in other fish ponds. Computation of step wise multiple regression analysis between log transformation of monthly bacterial numbers and environmnental factors in these six ponds, showed extremely significant results. About 72% of the variations of PSB occurring in water and 78% in sediments were attributable to variations in four selected parameters in surface water and six parameters in bottom environments. (Baker-IVI)
W85-03233

RE-EXAMINATION OF THE SUBMERGED TREE FAUNA IN LAKE KARIBA (SOUTH CENTRAL AFRICA), 24 YEARS AFTER INUNDATION,
Newcastle upon Tyne Univ. (England). Dept. of Zoology.
P. J. Boon.
Archiv fur Hydrobiologie, Vol. 101, No. 4, p 569-576, October, 1984. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Lake Kariba, *Africa, *Invertebrates, *Flooding, *Reservoirs, Trees, Tropical regions, Aquatic insects, Oligochaetes, Succession.

The creation of Lake Kariba in the early 1960's led to a succession of changes that have since been found to be characteristic of many tropical manmade lakes. The flooding of 5,100 sq km of woodland provided new areas for benthic colonization. A survey of the benthic macroinvertebrates associated with submerged trees in Lake Kariba was carried out during August, 1982. Samples taken from three areas near Sinamwenda were dominated by the burrowing mayfly, Povilla adusta. The other main taxa found were Amphipsyche senegalensis, Ecnomus spp., chironomids and oligochaetes. P. adusta was more numerous on exposed and semi-exposed trees than in sheltered areas, whereas oligochaetes were mainly associated with the latter. The net-spinning hydropsychid A. senegalensis was restricted to areas of water movement, where its ecological requirements could be met. Although community structure was similar to that observed sixteen years ago, P. adusta had increased to over 90% of the total biomass, whereas chironomid populations were drastically reduced. These changes may represent successional adjustments. Changes in submerged tree faunas, as well as other habitat alterations occurring since the formation of the lake illustrate the need for a complete re-examination of the biology of Lake Kariba. (Baker-IVI)
W85-03234

LIMNOLOGY OF LAKE ALEXANDRINA, RIVER MURRAY, SOUTH AUSTRALIA, AND THE EFFECTS OF NUTRIENTS AND LIGHT ON THE PHYTOPLANKTON,
Adelaide Univ. (Australia). Dept. of Zoology.
M. C. Geddes.
Australian Journal of Marine and Freshwater Research, Vol. 35, No. 4, p 399-415, June, 1984. 8 Fig, 6 Tab, 44 Ref.

Descriptors: *Lake Alexandrina, *River Murray, *South Australia, *Nutrients, *Light, *Phytoplankton, Turbidity, Light extinction, Algae, Biomass, Limnology, Phosphorus, Nitrogen, Chlorophyll a, Eutrophication.

Lake Alexandrina is a shallow, well-mixed freshwater system at the mouth of the River Murray. Median water renewal time is 109 days. The lake is characterized by high turbidity and high light extinction, with mean values of 93 NTU and 6.54 ln units/m, respectively. Background extinction is high and the algal biomass contributes little to light extinction. Changes in turbidity reflect disproportionate contributions from the Murray and its major tributary the Darling. Based on total phosphorus and total Kjeldahl nitrogen levels, the lake is chemically eutrophic-hypertrophic but the nitrogen to phosphorus ratio is low and levels of filterable and soluble reactive phosphorus and especially NO3/NO2-N are often low, suggesting that most of the nutrients are in particulate form and perhaps unavailable for plant growth. From 1975 to 1978, the ulotrichous green alga Planctonema lauterbornii generally accounted for more than 95% of algal cells. It was growing under conditions of low average irradiance in the mixed water column. Chlorophyll a varied seasonally, with peak values in late spring. The summer drop in chlorophyll a correlated with low availability of nutrients, especially NO3/NO2-N. Low light availability appeared to preclude blue-green algae during the present study although blooms were recorded in 1965-1967 and 1972-1973. (Author's abstract)
W85-03242

SEASONAL STUDIES ON THE ZOOPLANKTON COMMUNITY OF LAKE ALEXANDRINA, RIVER MURRAY, SOUTH AUSTRALIA, AND THE ROLE OF TURBIDITY IN DETERMINING ZOOPLANKTON COMMUNITY STRUCTURE,
Adelaide Univ. (Australia). Dept. of Zoology.
M. C. Geddes.
Australian Journal of Marine and Freshwater Research, Vol. 35, No. 4, p 417-26, June, 1984. 3 Fig, 4 Tab, 24 Ref.

Descriptors: *Lake Alexandrina, *River Murray, *South Australia, *Zooplankton, *Turbidity, Copepods, Cladocerans, Rotifers, Predation, Seasonal variation.

Zooplankton was quantitatively collected from Lake Alexandrina from November 1975 until March 1978. Twenty-eight species of zooplankton were identified, although momentary species composition usually comprised two calanoids, one cyclopoid, from three to six cladocerans and from zero to four rotifers. There were no consistent patterns in the vertical or horizontal distribution of the major zooplankters. Some species, including Boeckella triarticulata, Calamoecia ampulla, Bosmina meridionalis, Ceriodaphnia quadrangula and possibly Daphnia carinata were perennial, whereas Diaphanosoma unguiculatum, Moina micrua and Daphnia lumholtzi were seasonal. Zooplankton density was relatively high and constant throughout the study. The zooplankton community included both large and small species. In Lake Alexandrina, high turbidity may preclude size-selective fish predation, allowing the persistence of large species, while invertebrate predation may be insufficient to remove small species. (Author's abstract)
W85-03243

OVERWINTERING OF MICROCYSTIS AERUGINOSA KUTZ. IN A SHALLOW LAKE,
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
N. Takamura, M. Yasuno, and K. Sugahara.
Journal of Plankton Research, Vol. 6, No. 6, p 1019-1029, 1984. 7 Fig, 1 Tab, 30 Ref.

Descriptors: *Microcystis, *Overwintering, *Lake Katsumigaura, *Japan, Phytoplankton, Seasonal variation, Standing crop, Eutrophication, Photosynthesis, Phycobilin, Chlorophyll, Lake sediments.

Populations of cyanobacteria increase in many temperate and tropical lakes with an increase in nutrient loading. Microcystis is abundant throughout the winter in sediment as vegetative colonies in some lakes and reservoirs. Standing crop and photosynthetic activity of Microcystis aeruginosa in both the plankton and sediment were investigated from November 1979 to May 1982 in Lake Kasumigaura, Japan. Lake Kasumigaura has a surface areas of 167.7 sq km and an average depth of 4.0 m. This study was carried out at the center of Takahamairi Bay, where Microcystis bloomed in dense numbers every summer. The number of planktonic Microcystis colonies decreased from early autumn to early spring, but increased in the sediment during late summer and autumn. Overwintering colonies in the sediment were about 100-1000 times greater per unit area than those in lake water. No photo-inhibition of photosynthesis could be observed in overwintering Microcystis. The values of the initial slopes of photosynthesis-light (P-I) curves were similar to those of the summer population, although the maximum photosynthetic rate (Pmax) measured at 20 C was lower than that of the summer planktonic population. In winter the values of Pmax, initial slope of the P-I curve, and the ratio of phycobilin to chlorophyll a sorted from sediment were higher than in colonies from the plankton. Colonies on the sediment may provide an inoculum to the plankton. (Moore-IVI)
W85-03245

MEASUREMENTS OF NITRIFICATION RATES IN LAKE SEDIMENTS: COMPARISON OF THE NITRIFICATION INHIBITORS NITRAPYRIN AND ALLYTHIOUREA,
Freshwater Biological Association, Ambleside (England).
G. H. Hall.
Microbial Ecology, Vol. 10, No. 1, p 25-36, 1984. 2 Fig, 4 Tab, 36 Ref. European Economic Community contract ENV. 651 U.K. (H).

Descriptors: *Nitrification, *Lake sediments, *Nitrapyrin, *Allythiourea, Ammonia, Nitrates, Sediment, Cores, Sample preparation.

A method of measuring rates of nitrification in intact marine sediment cores has been modified and adapted for use in freshwater sediments. The technique involves subsampling a sediment core into mini-cores. Half of these cores are treated with an inhibitor of chemolithotrophic nitrification and, after incubation, differences in ammonia and nitrate concentrations between inhibited and uninhibited systems are calculated. The within-treatment variability of ammonia and nitrate concentrations could be reduced by storing the cores overnight prior to subsampling. Estimates of the nitrification rate using the difference in ammonia concentrations between the inhibited and uninhibited mini-cores were always greater than the rate estimate using the difference in nitrate concentrations. Comparison between the results using the nitrification inhibitors allylthiourea (ATU) and nitrapyrin (N-Serve) indicated that the former appeared to give larger values for the nitrification rate than did the latter. Differences in the efficiency of these inhibitors in the control of nitrification under the conditions used partly explain these results. Data are also presented on the effect of N-Serve and ATU on some other nitrogen transformations affecting ammonia and nitrate concentrations. (Author's abstract)
W85-03304

CONTRIBUTION OF NITRIFICATION IN THE WATER COLUMN AND PROFUNDAL SEDIMENTS TO THE TOTAL OXYGEN DEFICIT OF THE HYPOLIMNION OF A MESOTROPHIC LAKE (GRASMERE, ENGLISH LAKE DISTRICT),

Freshwater Biological Association, Ambleside (England).
G. H. Hall, and C. Jeffries.
Microbial Ecology, Vol. 10, No. 1, p 37-46, 1984. 2 Fig, 4 Tab, 30 Ref. European Economic Community contract ENV. 651 U.K. (H).

Descriptors: *Lake sediments, *Nitrification, *Oxygen depletion, *Grasmere, *England, Mesotrophic lakes, Hypolimnion, Chemical reactions, Allylthiourea, Nitrates, Profundal zone.

Estimates of in situ nitrifying activity have been made in the hypolimnetic water column and surface 1.0 cm of profundal sediments at 2 sites in Grasmere, a mesotrophic lake in the English Lake District. Increases of nitrate concentrations were used to estimate nitrification in the water column whereas a mini-core technique, involving the use of a nitrification inhibitor (allylthiourea), was used to estimate the rate in surface sediments. The pattern of oxygen depletion in the water column was used to estimate the maximum depth to which sediments affect the overlying water. Nitrification in the sediment and in the water column made approximately equal contributions to the total areal oxygen deficit and, as a whole, nitrification accounted for 15-20% of the total oxygen depletion. There was no significant difference in oxygen depletion due to nitrification between the 2 sites. Attempts were made, using the nitrification potential technique, to determine the depth distribution of nitrifying activity in the surface 1.0 cm of sediment. (Author's abstract)
W85-03305

INORGANIC NITROGEN UPTAKE IN OLIGOTROPHIC LAKE TAUPO, NEW ZEALAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 2K.
W85-03307

PARTICULATE ALLOCHTHONOUS INPUTS: RELATIONSHIPS WITH STREAM SIZE IN AN UNDISTURBED WATERSHED,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
M. E. Conners, and R. J. Naiman.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 10, p 1473-1484, October, 1984. 7 Fig, 5 Tab, 29 Ref. NSF grant DEB 81-05677.

Descriptors: *Streams, *Litter, *Particulates, *Allochthonous inputs, *Quebec, Forest watersheds, Stream order, Vegetation, Riparian zone, Organic matter, Floods, Entrainment, Primary productivity, Organic carbon.

Four streams of a pristine boreal watershed in eastern Quebec were examined to assess the composition, seasonal pattern, and ash-free dry mass (AFDM) of particulate allochthonous input. Study sites on streams ranging from first to sixth order exhibited significant differences in the types and magnitude of litter input. Composition of litterfall varied according to vegetation and physical structure of the riparian zone. Although the forest in the watershed is dominated by conifers, deciduous leaves dominated annual budgets and seasonal input patterns. Annual litterfall per unit area of stream surface declined exponentially with increasing stream order (r sq = 0.98) from 307-534g AFDM/sq m/yr in a first-order stream to 15-17 g AFDM/sq m/yr in a sixth-order stream. Lateral inputs of 25-70 g AFDM/sq m/yr were not related to stream size, but were strongly influenced by riparian structure and entrainment of organic matter during spring flooding. Total input per unit length increased logarithmically with increasing order (r sq = 0.87), approaching 1000 g AFDM/sq m/yr in the fifth- and sixth-order streams. A watershed budget calculated from these results estimates a total input of 729 t/yr to streams of this 673-sq km watershed. When particulate allochthonous input is compared with primary production measurements in these streams, 81-95% of the organic carbon supplied to the first- and second-order streams is allochthonous, but 85-95% of the supply to the fifth- and sixth-order streams is autochthonous. While these trends agree with predictions of the synthetic continuum model, the importance of local effects in the results illustrates the need for a more mechanistic approach in allochthonous input research. (Author's abstract)
W85-03309

INTAKES AS SAMPLING LOCATIONS FOR INVESTIGATING LONG-TERM TRENDS IN ZOOPLANKTON POPULATIONS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 7B.
W85-03311

NITROGEN CYCLE AND ALGAL GROWTH MODELING,
Metcalf and Eddy, Inc., Boston, MA.
For primary bibliographic entry see Field 5B.
W85-03335

CURRENT MEASUREMENTS IN LAKE CONSTANCE (STROMUNGEN IM BODENSEE),
Baden-Wuerttemberg Landesanstalt fuer Umweltschutz (Germany, F.R.). Inst. fuer Wasser- und Abfallwirtschaft.
E. Hollan.
Wasserwirtschaft, Vol. 74, No. 7/8, p 366-373, July/August, 1984. 8 Fig, 22 Ref.

Descriptors: *Lake Constance, *Germany (Federal Republic), *Water currents, Coriolis force, Wind-driven currents.

Wind-induced currents and the hydraulic flow of the main tributaries in Lake Constance have been measured by means of oceanographical mooring systems and the Kiel-Multisonde. Details of the dynamical reaction to wind forcing and increased inflow are discussed in two cases which show clearly the Coriolis effect. Considerable spatial and time-dependent variations of the current field are caused by the transient wind over the lake and the irregular bottom configuration. Finally, recent methods of current measurements in lakes are outlined. (Author's abstract)
W85-03438

FINITE ELEMENT/FINITE DIFFERENCE WAVE MODEL FOR DEPTH VARYING NEARLY HORIZONTAL FLOW,
Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
J. P. Laible.
Advances in Water Resources, Vol. 7, No. 1, p 2-14, March, 1984. 12 Fig, 1 Tab, 29 Ref, 1 Append.

Descriptors: *Wave models, *Finite element method, *Finite difference methods, Galerkin finite element method, Lakes, Flow characteristics, Mathematical studies, Path of pollutants, Model studies, Bays.

A numerical solution for the depth varying nearly horizontal flow equations is developed using the Galerkin finite element method and a wave equation type formulation. This approach allows for the simulation of non-steady circulations in shallow bodies of water which are free of numerical oscillation in both the stage solution (i.e. no 2 Delta x waves) and in the velocity field. The solution variables for the velocity field are the surface and near bottom velocities and the surface and near bottom gradients (i.e. delta u/delta z) multiplied by the depth for each of the cartesian directions. Hermitian polynomials are used to define the vertical structure of the flow while the nine node isoparametric quadrilateral is used for horizontal discretization. The solution produces u(x, y, z, t), v(x, y, z, t), zeta(x, y, t) by an explicit time marching scheme for the wave equation and an implicit scheme for the momentum equation. Only a two-dimension surface grid is required and the option exists in the present program to use finite elements, finite differences, or a mixed formulation. The utility of the model is demonstrated by numerical examples for which laboratory results exist and for an actual body of water for which current studies are presently being pursued. (Author's abstract)
W85-03474

CARBON CYCLE AND THE RATE OF VERTICAL ACCUMULATION OF PEAT IN THE MISSISSIPPI RIVER DELTAIC PLAIN,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. D. Delaune, and C. J. Smith.
Southeastern Geology, Vol. 25, No. 2, p 61-69, October, 1984. 5 Fig, 1 Tab, 28 Ref.

Descriptors: *Carbon cycle, *Peat, *Mississippi River Delta, *Accumulation, *Biomass, Brackish water, Sediments, Cycling nutrients, Carbon dioxide, Methane, Marshes, Cesium radioisotopes.

A large percentage of the annual plant biomass production in interdistributary basins of the Mississippi River delta plain either remains on the marsh in the form of organic-rich sediment (peat) or is lost to the atmosphere as carbon dioxide and methane. Peat is formed due to vertical accretion as the marsh surface is maintained relative to a mean water level. The rate of accretion determined from Cs-137 dating averaged 0.85 cm and 0.95 cm/yr for the fresh and brackish peat deposits respectively. However, increase in water level, obtained from analysis of tide gauge data, was estimated to be in order of .60-1.0 cm/yr. The rapid rate of peat accumulation (254-296 g C/sq m/yr) is attributed to increases in water level due to subsidence resulting from the consolidation of Mississippi River deltaic deposits. (Author's abstract)
W85-03487

LIGHT CLIMATE IN THE GIPPSLAND LAKES, VICTORIA,
Victoria Ministry for Conservation, Queenscliff (Australia). Marine Science Labs.
N. J. Hickman, P. E. McShane, and D. M. Axelrad.
Australian Journal of Marine Freshwater Research, Vol. 35, No. 5, p 517-524, October, 1984. 6 Fig, 26 Ref.

Descriptors: *Australia, Victoria, Lake Wellington, Lake Victoria, Lake King, Lake Gippsland, *Light penetration, *Biomass, Phytoplankton, Gilvin, Tripton, Chlorophyll, Solar radiation, Particulate matter, Lakes.

Variation in the light climate of Lakes Wellington, Victoria and King, Gippsland, (Victoria, Australia) occurred both seasonally and between the three lakes studied. Absorption of photosynthetically active radiation was related primarily to concentration of non-chlorophyllous particulate material (tripton) with dissolved organic material (gilvin) and particulate chlorophyll being of lesser importance in influencing light climate. Lake waters were characterized by selective attenuation of red (650-700 nm wavelength) and blue (400-500 nm wavelength) quanta with depth. Though most photosynthetically active radiation in Lake Wellington was removed in the first one m of depth, phytoplankton biomass was higher than in Lake King which has more available light. Vertical mixing, resulting in periodic exposure of phytoplankton to surface light levels, is suggested as a mechanism whereby the relatively high phytoplankton biomass of Lake Wellington is maintained. (Author's abstract)
W85-03495

STUDIES OF THE HYDROBIOLOGY OF A TROPICAL LAKE IN NORTH-WESTERN QUEENSLAND. III. GROWTH, CHEMICAL COMPOSITION AND POTENTIAL FOR HARVESTING OF THE AQUATIC VEGETATION,
C. M. Finlayson, T. P. Farrell, and D. J. Griffiths.
Australian Journal of Marine Freshwater Research, Vol. 35, No. 5, p 525-536, October, 1984. 4 Fig, 4 Tab, 31 Ref.

Descriptors: Queensland, *Australia, Lake Moondarra, *Aquatic plants, *Plant growth, Macrophytes, Biomass, Hydrilla, Potamogeton, Nitrogen, Heavy metals, Copper, Lead, Zinc, Phosphorus, Water pollution treatment, Biological treatment, Lakes.

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The biomass of aquatic plant species and the standing crop of submerged species were estimated in Lake Moondarra from 1977 to 1979. In July 1978, the biomass of Salvinia molesta exceeded 53,000 t fresh weight, with a density of 167 t/ha (0.81 kg dry wt/sq m). Hydrilla verticillata reached a maximum density of almost three g dry wt/sq m and Potamogeton crispus more than double that density. Photosynthetic activity of a range of species was high, and was still detectable at water depths allowing only very low light penetration. Organic nitrogen concentrations were high (0.91 - 4.37% dry wt), and phosphorus (0.07 - 0.47% dry wt) appeared to be a limiting factor for growth of the aquatic plants. Heavy metal concentrations varied with species, location and season but, although generally higher than world-wide 'mean' values (48 micro g/g copper, 11 micro g/g lead, 14.3 micro g/g zinc), were significantly less than those of aquatic macrophytes in heavily polluted environments. H. verticillata was more efficient than S. molesta in removal of nitrogen, phosphorus, and zinc, whereas for copper and lead the reverse was true. The potential for using this property of the aquatic plants and subsequent harvesting in order to remove nutrients and metals from the lake is also discussed. (Author's abstract)
W85-03496

137CS DIFFUSION IN THE HIGHLY ORGANIC SEDIMENT OF HIDDEN LAKE, FRASER ISLAND, QUEENSLAND,
Australian National Univ., Canberra. Environmental Geochemistry Group.
T. Torgersen, and M. E. Longmore.
Australian Journal of Marine and Freshwater Research, Vol. 35, No. 5, p 537-548, October, 1984. 7 Fig, 2 Tab, 25 Ref.

Descriptors: *Cesium radioisotopes, *Hidden Lake, *Fraser Island, *Australia, *Carbon radioisotopes, *Lake sediments, *Organic matter, Lead radioisotopes Lakes, Diffusion, Bioturbation, Adsorption, Absorption, Sediment-water interfaces, Mathematical models.

The vertical distribution of Cs-137 (originating from nuclear fallout since 1954) in the highly organic sediment of Hidden Lake was found to be inconsistent with C-14 and Pb-210 data. Mathematical models of bioturbation indicate that this mechanism cannot explain the discrepancy. Diffusive migration of Cs-137 was modelled using the experimentally determined value approximately equal to 140 for the distribution coefficient, K sub D, of Cs-137 in Hidden Lake sediment. Cs-137 is diffusing in the sediment at an effective rate of circa 0.000001 sq cm/s due to the low value of K sub D. The diffusive mechanism was further modified by adsorption or absorption at or near the sediment-water interface. (Author's abstract)
W85-03497

PHYTOPLANKTON DIVERSITY IN INLAND WATERS OF DIFFERENT TROPHIC STATUS,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
Y. Ogawa, and S. Ichimura.
Japanese Journal of Limnology, Vol. 45, No. 3, p 173-177, July, 1984. 4 Fig, 15 Ref.

Descriptors: *Trophic level, *Phytoplankton, *Species diversity, Eutrophication, Population dynamics, Cyanophyta.

Phytoplankton diversity in 23 water bodies of different trophic status was evaluated by the Shannon index. Phytoplankton diversity was low in very oligotrophic waters. In increased as the trophic state moved to a mesotrophic condition, and high values of more than 3 bits/cell were obtained in both mesotrophic and slightly eutrophic waters. The diversity was reduced in eutrophic waters, and the lowest values of 0.16 to 0.31 bits/cell were obtained in eutrophic and hypereutrophic waters. The phytoplankton diversity was affected by the number of component phytoplankton taxa and the phytoplankton composition. The richness was low in oligotrophic waters, 4-7 genera, and high in eutrophic waters, but it decreased significantly in hypereutrophic waters. Although richness increased in highly eutrophic waters, the phytoplankton diversity decreased. The reduction of diversity may be caused by less stable equitability in water samples. In eutrophic and hypereutrophic waters, the phytoplankton assemblage consisted primarily of blue-green algae such as Microcystis which lead to a low diversity. (Baker-IVI)
W85-03506

PHOSPHATE EXCHANGE BETWEEN LITTORAL SEDIMENTS AND OVERLYING WATER IN AN OLIGOTROPHIC NORTH-TEMPERATE LAKE,
McGill Univ., Montreal (Quebec). Dept. of Biology.
A. J. Twinch, and R. H. Peters.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 11, p 1609-1617, November, 1984. 6 Fig, 3 Tab, 58 Ref.

Descriptors: *Phosphates, *Cycling nutrients, *Lake sediments, *Oligotrophic lakes, *Lake Memphremagog, *Ontario, *Vermont, Nutrients, Sediments, Littoral zone, Algae, Aerobic conditions, Sediment-water interfaces.

The soluble phosphate equilibrium between aerobic sediment and overlying water was examined in intact cores of marginal sediment and water from Lake Memphremagog. Radiotracer experiments demonstrated a dynamic phosphate exchange between sediments and water under steady-state conditions. Perturbations of this equilibrium in batch and continuous-flow systems show that aerobic sediment can act as a phosphate source or sink, depending on the phosphate concentration of the overlying water. The existence of an oxidized microzone on the sediment surface does not preclude phosphate release when concentrations in the overlying water drop below the equilibrium concentration. Under natural conditions, soluble reactive phosphorus concentrations in the surface waters of Lake Memphremagog are always lower than the equilibrium concentrations measured in this study. This suggests that aerobic marginal sediments may serve as a phosphate source in lakes where algal demand maintains low levels of soluble phosphate in the water. (Author's abstract)
W85-03599

IMPORTANCE TO MUSSELS OF THE BENTHIC BOUNDARY LAYER,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
D. J. Wildish, and D. D. Kristmanson.
Canadian Journal Fisheries and Aquatic Sciences, Vol. 41, No. 11, p 1618-1625, November, 1984. 3 Fig, 5 Tab, 14 Ref.

Descriptors: *Mussels, *Seston, *Boundary layers, *Ecology, Hydrodynamics, Mollusks, Aquatic animals, Feeding activities, Adenosine triphosphate.

Populations of the blue mussel Mytilus edulis (Linnaeus, 1758) and horse mussel Modiolus modiolus (Linnaeus, 1758) were examined to determine whether feeding activities deplete the sestonic food supply. The experiments were conducted in a 5-m-long by 50-cm-wide flume in which a turbulent boundary layer flow was created. The seston concentration was measured both as ATP content and numbers of bacteria by acridine orange staining technique on separate subsamples of seawater. Sampling locations were at the flume inlet and at a point 3.6 m downstream (outlet). Four of the five replicated experiments with blue mussels had significant ATP-seston depletion but no reduction in bacterial numbers at the outlet sampling location. Of three replicated experiments with horse mussles, two had significant ATP-seston depletion and all three had significantly fewer bacterial numbers at the outlet sampling location. These results provide direct evidence in support of the hypothesis that seawater hydrodynamic factors may be critical in determining the food supply available to suspension-feeding animals; the results confirm circumstantial evidence on this point obtained from field observations by previous investigators. Experimental verification of seston depletion is a necessary, but not sufficient, step in establishing that suspension-feeding animals may be food limited as required by the trophic group mutual exclusion hypothesis. (Author's abstract)
W85-03600

QUANTIFICATION OF WOOD HABITAT IN SUBTROPICAL COASTAL PLAIN STREAMS,
Georgia Univ., Athens. Dept. of Entomology.
J. B. Wallace, and A. C. Benke.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 11, p 1643-1652, November, 1984. 3 Fig, 5 Tab, 45 Ref. NSF grant DEB-8104427.

Descriptors: *Ecology, *Aquatic habitats, *Snags, *Streams, *Ogeechee River, *Black Creek, *Georgia, Stream banks, Ecology, Snag removal.

To assess the importance of woody debris in two relatively unaltered Coastal Plain streams in the southeastern United States, a line intersect technique, developed by foresters, was used to estimate volume, mass, surface area, and spatial distribution The ash-free dry mass of in-channel woody material was 6.5 kg/sq m of stream channel bottom in the sixty-order Ogeechee River and 5.0 kg/sq m in the fourth-order Black Creek. Most wood is located near the erosional bank in these meandering streams. These wood mass estimates are much higher than expected for middle-order streams and are similar to those from several small headwater streams in other regions. Due to their very low slopes (< 0.02%), these streams appear to have insufficient stream power to move large woody materials. Snag, or woody, habitat is the major stable substrate in these sandy-bottomed streams and is a site of high invertebrate diversity and productivity. In-channel snag surface area per square metre of channel bottom was 0.249-0.433 sq m in the Ogeechee and 0.191-0.379 sq m in Black Creek, depending on the hydrograph stage. With invertebrate biomass of 6.6 dry mass/sq m of snag surface, this results in an invertebrate biomass of at least 1.88 g/sq m of channel bottom. Wood is also important to fishes, providing a rich source of invertebrate food, habitat, and cover. In addition to its obvious biological role, wood enhances the ability of a stream to process and conserve nutrient and energy inputs and has a major influence on the hydrodynamic behavior of the river. The quantification of wood habitat seems mandatory to assess past or potential impacts of snag removal on ecosystem processes in low-gradient streams. (Author's abtract)
W85-03601

PHOSPHORUS FLUX THROUGH EPILIMNETIC ZOOPLANKTON FROM LAKE ONTARIO: RELATIONSHIP WITH BODY SIZE AND SIGNIFICANCE TO PHYTOPLANKTON,
Waterloo Univ. (Ontario). Dept. of Biology.
W. D. Taylor.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 1, p 1702-1712, 10 Fig, 3 Tab, 39 Ref.

Descriptors: *Phosphorus, *Cycling nutrients, *Epilimnion, *Zooplankton, *Lake Ontario, *Phytoplankton, Plankton, Nutrients, Isotope studies.

The flux of phosphate through epilimnetic zooplankton from Lake Ontario was measured by adding labeled PO4 into whole lakewater, monitoring its accumulation by zooplankton over 48 h, and then measuring its release when animals were returned to unlabeled lake water. Phosphorus uptake was calculated as the sum of accumulation and release rates. The 10 species examined ranged in size from 36-micro m Codonella cratera to 1-mm Daphnia retrocurva. Phosphorus uptake rates of herbivorous zooplankton ranged about 200-fold and increased with body size within and among species, although not proportionally. Among species, there was a pronounced allometry, with smaller species having much higher rates per unit size. This allometry is similar to that described for other metabolic parameters and body size. There was no tendency for smaller species to release a greater fraction of the label they took up. These results suggest that the biomass of zooplankton consuming a given phytoplankton production will

e much smaller if small zooplankton dominate, nd therefore, this phosphorus sink will be much naller. Further, the flow of phosphorus to higher ophic levels may be reduced. The result of hanging the zooplankton size-distribution may be change the amount of spring total phosphorus vailable to summer phytoplankton. (Author's ab-ract)
V85-03606

IPPER LIMIT OF PHYTOPLANKTON PRO-)UCTION IN NATURAL WATERS (UBER DIE)BERE GRENZE DER PHYTOPLANKTON-RODUKTION IN NATURLICHEN GEWAS-ERN),
nstitut fuer Wasserwirtschaft, Berlin (German).R.).
. Baumert, and D. Uhlmann.
Vissenschaftliche Zeitschrift der Humboldt-Uni-ersitat zu Berlin. Mathematisch-Naturwissens-haftliche Reihe, Vol. 33, No. 4, p 390-392, 1984. 1 ig, 12 Ref.

Descriptors: *Productivity, *Phytoplankton, Mathematical equations, Solar radiation, Light enetration, Eutrophication, Respiration.

Mathematical equations were developed which de-cribe maximal phytoplankton production in natu-al waters. The quantitative dependence of this on he optical characteristics of the water column is mportant due to the close link between production nd eutrophication. Net production (Pi sub n) is een as the difference between gross production, vhich is determined by quantum yield, and respira-ion. For given figures for biomass concentration nd depth of homogeneity of the water, there is an ptimal rate of respiration that leads to maximal Pi ub n. The inequality devised to describe Pi sub n ncludes the following factors: the intensity of pho-osynthetically active radiation (PAR) immediately elow the water surface; and a vertical light-sub-luing coefficient composed of absorption through ure water, plus absorption through suspended natter, plus absorption through 'yellow matter' oefficients. The maximal daily integral of PAR is bout 13 MJ/sq m/day. The equations correspond-d well to actual data. (Gish-IVI)
W85-03611

BEHAVIOUR OF DISSOLVED SILICA DURING THE MIXING OF RIVER AND SEA WATERS IN TOKYO BAY,
Tokyo Univ. of Fisheries (Japan). Lab. of Marine Chemistry.
A. Kamatani, and M. Takano.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 5, p 505-512, November, 1984. 3 Fig, 25 Ref.

Descriptors: *Silica, *Mixing, *Tokyo Bay, *Japan, Seasonal variation, Aluminium, Diatoms, Bays.

The behavior of dissolved silica was studied in Tokyo Bay during six surveys in 1979 and 1980. The data from late spring and mid-summer samples showed concave mixing curves of silica versus salinity, whereas for the winter samples a simple conservative dilution curve was obtained. Plots of particulate silicon to particulate aluminium showed that even for winter samples as well as summer ones there were some processes removing silica from solution. The processes could not be adequately explained by adsorption onto suspended solids. The data are indicative of uptake by diatoms as the principal removal mechanism. Most of the diatom skeletons settled to the bottom where dissolution was rapid. The silica-salinity curves in this study thus demonstrate an apparent removal process for dissolved silica. This is because during summer the displacement rate of biogenic silica from a unit water column to the bottom as fecal pellets or by sinking is greater than the supply rate of dissolved silica by the action of diffusion and mixing of bottom water enriched with dissolved silica whereas in winter these rates are reasonably balanced. (Author's abstract)
W85-03632

DISSOLVED CHROMIUM IN THE ST. LAWRENCE ESTUARY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 2L.
W85-03633

PRIMARY PRODUCTION OF PHYTOPLANKTON IN THE OLIGOHUMIC KITKA LAKES IN NORTHERN FINLAND,
Oulu Univ. (Finland). Oulanka Biological Station.
P. Kankaala, S. Hellsten, and E. Alasaarela.
Aqua Fennica, Vol. 14, No. 1, p 65-78, 1984. 6 Fig, 2 Tab, 31 Ref.

Descriptors: *Kitka lakes, *Finland, *Primary productivity, *Phytoplankton, Chlorophyll a, Phosphorus, Nitrogen, Seasonal variation, Ice cover, Nutrients, Humus.

The primary production of phytoplankton, the chlorophyll a content and the chemistry of water were investigated weekly during the iceless period in the Kitka lakes (lat. 66 degrees 15' N, long. 29 degrees 00' W) in 1981 and 1982. During the iceless period of 4-5 months, the ecosystem of the lakes is adapted to effective production and nutrient utilization. In the northeastern oligohumic basin the annual primary production was 17 g/sq m/a in both of the study years, while in the southwestern basin influenced by humus-containing waters and waste waters it was 23 g C/sq m/a in 1982. The corresponding total phosphorus concentrations were 6-12 micro-g P/l and 11-17 micro-g P/l. In late winter, the mineral nitrogen concentration of the water was 150 micro-g N/l, but during the relatively high primary production prevailing immediately after the break-up of the ice, mineral nitrogen was depleted almost completely, and it remained at a low level for the rest of summer. The phytoplankton production is restricted by the ice cover, which persists long in the lake; during the iceless period the level of production is determined by the rate of mineralization of the nutrients. (Author's abstract)
W85-03680

SEASONAL AND COMPARATIVE ASPECTS OF CHEMICAL STRATIFICATION IN SOME TROPICAL CRATER LAKES, ETHIOPIA,
Addis Ababa Univ. (Ethiopia).
R. B. Wood, R. M. Baxter, and M. V. Prosser.
Freshwater Biology, Vol. 14, No. 6, p 551-573, December, 1984. 15 Fig, 31 Ref.

Descriptors: *Crater lakes, *Chemical stratification, *Seasonal variation, *Ethiopia, *Lake Pawlo, *Lake Bishoftu, *Lake Aranguadi, *Lake Kilotes, Stratification, Wind, Mixing, Phytoplankton, Thermal properties.

Water samples were taken from four crater lakes, all between 1870 and 2000 m altitude, in Ethiopia: Lake Pawlo, Lake Bishoftu, Lake Aranguadi and Lake Kilotes. Measurements of oxygen, pH, phosphate, nitrate, nitrite, hydroxylamine, ammonium and sulfide were made during 1964, 1965 and 1966 at fairly regular intervals. The seasonal pattern of the dynamics of these chemical constituents relates closely to the pattern of thermal stratification and mixing. Interactions between the chemical constituents are examined and comparisons are made between the four lakes which differ widely in their depth, exposure to wind and standing crops of phytoplankton. The vertical distribution of the chemical constituents is used to help define the limits of circulation of surface waters. Seasonality in the tropics where variation in day-length and ambient temperature may be quite small is a much more subtle phenomenon than occurs in temperate zones. Thermal control of the seasonal chemical preformance of Lake Pawlo is demonstrated and biological events may be related. Such control is gradual during the deepening of the mixed zone and more profound at periods of turnover. The same applies to Lake Bishogtu. Lake Aranguadi also fits the Pawlo pattern, although extremely high algal crops tend to accentuate the biological effects superimposed on the basic thermally controlled chemical events. The thermal pattern is exaggerated by morphometric factors such as the considerable protection from wind. With near-uniform thermal and chemical conditions, and little change in day-length, Lake Kilotes is a much more typical, shallow tropical type lake in which diurnal changes are likely to be more significant than seasonal ones. (Moore-IVI)
W85-03683

DIEL AND SEASONAL PHYSICO-CHEMICAL FLUCTUATIONS IN A SMALL NATURAL WEST AFRICAN LAKE,
Waterloo Univ. (Ontario). Dept. of Biology.
L. Hare, and J. C. H. Carter.
Freshwater Biology, Vol. 14, No. 6, p 597-610, December, 1984. 10 Fig, 3 Tab, 34 Ref.

Descriptors: *Opi Lakes, *Nigeria, *Seasonal variation, *Diel variation, *Physicochemical properties, Limnology, Stratification, Climate, Wind, Water temperature, Water circulation, Air temperature, Water depth.

The Opi Lakes are located in the West African Guinea Savanna region near its southern border with the coastal forest. Opi Lake A is typical of lakes in the area with the exception that it has no permanent surface inlet and consequently fluctuates seasonally in depth. Opi Lake experiences a distinct seasonality in weather, largely related to the north-south movements of a broad discontinuity between dry and humid air masses. The waters of Opi Lake were very dilute (15-24 micro-S/cm at 25 C) and somewhat acid (pH 6.0-6.5), probably a result of the highly leached lateritic soils in its small drainage basin. Annual minimum water temperatures were recorded during the early dry season, which may be attributed to the influence of the Harmattan winds (dry, northerly winds) on the lake and the absence of pronounced rainy season flooding. The smallest temperature differences between surface and bottom waters occurred in the early morning. A diel cycle of daytime thermal stratification and complete or near-complete nighttime destratification occurred throughout the year. During the dry season, when prevailing winds were strong and lake depth shallow, night-time destratification was accompanied by deep circulation. In the rainy season, when prevailing winds were weak and lake depth was greatest, deep vertical circulation apparently did not take place, as evidenced by anoxia in near-bottom waters. The cycle of stratification and circulation in Opi Lake is similar to that found in some Ethiopian crater lakes, but is the reverse of that found in most tropical lakes for which a seasonal stratification period is known. The pattern observed in Opi Lake appears to result from seasonal differences in lake depth, wind and air temperature. (Moore-IVI)
W85-03685

DOWNSTREAM INCREASE IN THE ABUNDANCE AND HETEROTROPHIC ACTIVITY OF SUSPENDED BACTERIA IN AN INTERMITTENT CALCAREOUS HEADSTREAM,
Hull Univ. (England). Dept. of Plant Biology.
R. Goulder.
Freshwater Biology, Vol. 14, No. 6, p 611-619, December, 1984. 6 Fig, 2 Tab, 23 Ref.

Descriptors: *Bacteria, *Heterotrophic activity, *Headwaters, *Mill Beck, *England, Aquatic plants, Springs, Intermittent streams, Calcareous streams, Groundwater, Culverts, Streambeds.

Suspended bacteria in running waters bring about the heterotrophic degradation of dissolved and particulate organic matter and hence, where there is organic pollution, assist in the self-purification process. Samples were collected at the principal source of Mill Beck (near Market Weighton, England), at 200 m intervals downstream to 1600 m and at the center of Crunkhill Spring basin. The concentration of total bacteria was determined by the acridine-orange direct-count method. Concentration of total bacteria and heterotrophic activity (as turnover rate for glucose assimilation) in the water of the intermittent spring-fed calcareous headstream increased with distance from the source. This increase was gradual rather than stepwise and might be due to release of bacteria from submerged vegetation and the stream bed, and to input of terrestrial bacteria with groundwater. The

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increment per unit length of stream was greatest in summer when aquatic vegetation was most abundant and discharge was low. When the stream was partly dry, isolated peaks of suspended bacteria occurred and there was no regular downstream increase. Crunkhill Spring, which upwelled into a natural basin, consistently contained more suspended bacteria than the principal source, which was an artificial culvert. The level of suspended bacteria at the extreme source of spring-fed calcareous streams may therefore depend on the physical layout; streams with an artificial culvert or pipe-source may initially contain fewer bacteria. (Moore-IVI)
W85-03686

EFFECTS OF PHOSPHORUS AND NITROGEN ENRICHMENT ON THE PHYTOPLANKTON IN A TROPICAL RESERVOIR (LOBO RESERVOIR, BRAZIL),
Universidade Estadual Paulista, Botucatu (Brazil). Inst. Basico de Biologia Medica e Agricola.
R. Henry, J. G. Tundisi, and P. R. Curi.
Hydrobiologia, Vol. 118, No. 2, p 117-185, November, 1984. 2 Fig, 4 Tab, 43 Ref.

Descriptors: *Lobo Reservoir, *Brazil, *Phosphorus, *Nitrogen, *Phytoplankton, Tropic zone, Limiting nutrients, Algal growth, Nitrates, Nitrites, Ammonia, Urea, Chlorophyll a, Carotenoids, Suspended solids.

Phosphorus may have a limiting effect for phytoplankton growth in temperate lakes and reservoirs, but in the tropics nitrogen also seems to be a critical nutrient. The effects of enrichment with phosphate (0-500 micro-g/l) and forms of nitrogen (nitrate, nitrite, ammonia and urea) (0-3500 micro-g/l) on the phytoplankton growth were studied in surface water samples collected from Lobo Reservoir (Brazil) in July. After 14 days in situ incubation, the following variables were measured: suspended matter, chlorophyll a, cell concentrations and carotenoid:chlorophyll. Enrichment effects were tested through multivariate analysis of eleven hypotheses. Phosphate alone caused no significant effects, but enrichment with nitrogen caused a substantial increase in the growth of phytoplankton. Comparison between the different forms of nitrogen showed insignificant effects after their additions with 350 micro-g/l and in combination with phosphate. When nitrogen was added in large quantities (3,500 micro-g/l), significant differences between the nitrogeneous forms were found, with urea causing the strongest effect. In July, nitrogen clearly was the primary limiting factor to algal growth in Lobo Reservoir. (Moore-IVI)
W85-03694

EFFECT OF NITROGEN AND FIBER CONTENT ON THE DECOMPOSITION OF THE WATERHYACINTH (EICHHORNIA CRASSIPES (MART.) SOLMS),
Center for Marine Biotechnology, Fort Pierce, FL.
T. A. DeBusk, and F. E. Dierberg.
Hydrobiologia, Vol. 118, No. 2, p 199-204, November, 1984. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Water hyacinth, *Decomposition, *Nitrogen, *Fiber, *Florida, Aquatic plants, Macrophytes, Plant composition, Nutrient removal ponds, Nutrients, Roots, Aerial tissues, Biomass.

Variability in decomposition rates of aquatic macrophytes may be related to differences in plant composition. Water hyacinth decomposition was measured in situ at two locations in south-central Florida. Site 1 was Lake Washington, a mesotrophic lake with inorganic nitrogen-poor waters. Site 2, in Coral Springs, was a domestic wastewater treatment facility in which water hyacinth-filled ponds were used as a nutrient removal system for secondarily treated domestic sewage. The total nitrogen concentration in the sewage lagoon water was 7-fold higher than that at Lake Washington. High nitrogen (2.8%), low fiber (49%) water hyacinth aerial tissues collected from the eutrophic site decomposed more rapidly than low nitrogen (1.3%), high fiber (58%) aerial tissues collected from the nutrient-poor site. Roots (65% fiber) decomposed much more slowly than aerial tissues (49% fiber). Because the biomass distribution (aerial/root) and nitrogen and fiber content of water hyacinths fluctuate both seasonally and with nitrogen availability, considerable temporal and site-to-site variability in decomposition dependent processes exists in aquatic systems infested by this species. (Moore-IVI)
W85-03696

SIZE-FRACTIONATION OF NATURAL PHYTOPLANKTON COMMUNITIES IN NUTRIENT BIOASSAY STUDIES,
California Univ., Davis. Div. of Environmental Studies.
J. L. Lane, and C. R. Goldman.
Hydrobiologia, Vol. 118, No. 2, p 219-223, November, 1984. 3 Fig, 21 Ref.

Descriptors: *Nutrients, *Bioassay, *Size-fractionation, *Phytoplankton, *Lake Tahoe, *Crater Lake, *California, Oligotrophic lakes, Algae, Size classes, Lake management.

Lake management policies based on regulating nutrient sources or availability are the most practical means of controlling algal populations. A number of methods have been devised to determine nutrient deficiency in lakes including a variety of laboratory and in situ nutrient enrichment bioassay methods. Size-fractionated nutrient bioassays can provide valuable information about community nutrient requirements which would not be evident when viewing the community as a homogeneous unit. This is demonstrated with several examples from bioassays performed for two ultraoligotrophic systems - Lake Tahoe, California and Crater Lake, Oregon. Size-fractionation can reveal statistically significant stimulation of subdominant phytoplankton size classes when the total community response is insignificant. The degree and type of nutrient deficiency may vary between size classes. Phytoplankton communities at different depths may be deficient in the same nutrient but the particular size class exhibiting this deficiency may differ. (Moore-IVI)
W85-03697

SIGNIFICANCE OF INTERNAL LOADING TO LAKE PHOSPHOROUS BUDGETS,
For primary bibliographic entry see Field 5B.
W85-03710

PHOTOSYNTHETIC ACTIVITY OF CHLOROPHYLL A IN FRESHWATER PLANKTON,
Akademiya Nauk SSSR, Leningrad. Zoologicheskii Inst.
V. V. Bul'on.
Doklady Biological Sciences, Vol. 274, No. 1-6, p 27-29, July, 1984. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Phytoplankton, *Chlorophyll a, *Photosynthesis, *Mongolia, Lakes, Reservoirs, Mathematical equations.

Use of the assimilation number as a measure of the photosynthetic activity of chlorophyll a has been studied in many bodies of water and is frequently used in computational methods for determining the photosynthetic rate of plankton. The ratio between the planktonic photosynthetic rate and chlorophyll a content in lakes of northern and temperate latitudes is considered. Two methods, the oxygen and the radiocarbon methods, have been developed to determine the photosynthetic rate of plankton and are widely used in nearly equal measure in hydrobiological studies. Data for 16 lakes in Mongolia are presented. In fresh bodies of water of northern and temperate latitudes the average daily assimilation number is close to 30 micro-g C/micro-g/day or to 2 micro-g C/micro-g/hr, and is virtually independent of the chlorophyll a concentration. (Baker-IVI)
W85-03718

APPLICATION OF A PRIMARY PRODUCTION MODEL TO EPIPHYTIC ALGAE IN A SHALLOW, EUTROPHIC LAKE,
George Mason Univ., Fairfax, VA. Dept. of Biology.
R. C. Jones.
Ecology, Vol. 65, No. 6, p 1895-1903, December, 1984. 7 Fig, 1 Tab, 55 Ref. NSF grants DEB-19777, ENV 77-10188, and DEB 78-10690.

Descriptors: *Lake Wingra, *Wisconsin, *Algal growth, *Eutrophic lakes, *Primary productivity, Algae, Littoral zone, Biomass, Photosynthesis, Light intensity, Mathematical equations.

Epiphytic algae are important in lakes as sources of primary production, competitors for light and nutrients with macrophytes and phytoplankton, and food sources for littoral invertebrates. A modification of Fee's phytoplankton model (Fee, E. J. 1973. Journal of the Fisheries Research Board of Canada 30:1447-1468.) was used to calculate the production of algae epiphytic on the submersed macrophyte Myriophyllum spicatum in shallow, eutrophic Lake Wingra, Wisconsin. The model involved integration of four basic relationships using time- and depth-stepped difference equations. These four relationships are depth distribution of algal biomass, photosynthesis per unit biomass as a function of light intensity, irradiance-depth relationship, and diurnal variation in surface irradiance. Epiphyte production in the littoral zone of Lake Wingra was 29-38 g/sq m/yr, putting the lake at the lower range of reported values. The lower production values resulted from less dense weedbeds rather than lower density of epiphytes. Algal biomass defined the upper bound for production, while irradiance levels on each day determined actual production by decreasing this potential by varying degrees. The fact that algal biomass alone was responsible for most of the seasonal variation in epiphyte production suggests that care should be taken in accurately measuring both depth and areal distributions of algal biomass when assessing epiphyte production. The importance of epiphytes to total primary production in Lake Wingra was rather minor. (Baker-IVI)
W85-03730

INFLUENCE OF PH ON TERMINAL CARBON METABOLISM IN ANOXIC SEDIMENTS FROM A MILDLY ACIDIC LAKE,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
T. J. Phelps, and J. G. Zeikus.
Applied and Environmental Microbiology, Vol. 48, No. 6, p 1088-1095, December, 1984. 5 Fig, 5 Tab, 40 Ref.

Descriptors: *Hydrogen ion concentration, *Anaerobic digestion, *Lake sediments, *Knaak Lake, *Wisconsin, Acid lakes, Bacteria, Anoxic conditions, Methanogenesis.

The transformation of hydrogen and various one- and two-carbon metabolites during organic decomposition in anoxic environments is performed by terminal bacterial trophic groups. Carbon and electron flow pathways and the bacterial populations responsible for transformation of H2-CO2, formate, methanol, methylamine, acetate, glycine, ethanol, and lactate were examined in sediments collected from Knaack Lake, Wisconsin. Knaack Lake is a small meromictic lake whose bottom waters and sediments are permanently anoxic, devoid of detectable sulfate. and remain at a temperature of 4 C. Methane was produced predominantly from acetate, and only 4% of the total CH4 was derived from CO2. Methanogenesis was limited by low environmental temperature and sulfide levels and more importantly by low pH. Increasing in vitro pH to neutral values enhanced total methane production rates and the percentage of CO2 transformed to methane but did not alter the amount of C-14 CO2 produced from C-14 labeled acetate (about 24%). Methanogenesis from acetate and both heterolactic- and acetic acid-producing fermentations were important to the anaerobic digestion process. The microbial population appears limited by the in situ pH, but it is nevertheless adapted to carbon mineralization at lower rates and with higher pool sized of acidic metabolites. (Moore-IVI)
W85-03735

SSESSING PHYTOPLANKTON AND BAC-ERIOPLANKTON PRODUCTION DURING ARLY SPRING IN LAKE ERKEN, SWEDEN, ppsala Univ. (Sweden). Limnologiska Institu-onen.
. T. Bell, and J. Kuparinen.
pplied and Environmental Microbiology, Vol. 8, No. 6, p 1221-1230, December, 1984. 3 Fig, 7 ab, 73 Ref. Swedish Natural Science Research Council grant B-BU 3083-105.

Descriptors: *Phytoplankton, *Bacteria, *Primary roductivity, *Lake Erken, *Sweden, Plankton, Diatoms, Algae, Biomass, Carbon radioisotopes, Tritium, Bacterial growth.

The spring development of both phytoplankton nd bacterioplankton was investigated between 18 April and 7 May 1983 in mesotrophic Lake Erken, weden. By using the lake as a batch culture, the im was to estimate, via different methods, the roduction of phytoplankton and bacterioplankton n the lake and to compare these production esti-nates with the actual increase in phytoplankton nd bacterioplankton biomass. The average water emperature was 3.5 C. Of the phytoplankton bio-nass, > 90% was the diatom Stephanodiscus antzchii var. pusillus, by the peak of the bloom. The C-14 and O2 methods of estimating primary roduction gave equivalent results (r = 0.999) vith a photosynthetic quotient of 1.63. The theo-etical photosynthetic quotient predicted from the C/NO3N assimilation ratio was 1.57. The total ntegrated incorporation of (C-14) bicarbonate into articulate material (> 1 micro-m) was similar to he increase in phytoplankton carbon determined rom cell counts. Bacterioplankton increased from .5 x 10 to the 9th to 1.52 x 10 to the 9th cells/liter about 0.5 micro-g of C/liter/day). Estimates of acterioplankton production from rates of tritiated hymidine incorporation were ca. 1.2 to 1.7 micro-g of C/liter/day. Bacterial respiration, measured by a high-precision Winkler technique, was esti-nated as 4.8 micro-g of C/liter/day, indicating a acterial growth yield of 25%. The bulk of the acterioplankton production was accounted for by algal extracellular products. Gross bacterioplank-on production (production plus respiration) was 20% of gross primary production, per square meter of surface area. There was no indication that acterioplankton production was underestimated by the tritiated thymidine incorporation method. (Author's abstract)
W85-03738

MICROCYSTIS AERUGINOSA AND UNDERWATER LIGHT ATTENUATION IN A HYPERTROPHIC LAKE (HARTBEESPOORT DAM, SOUTH AFRICA),
National Inst. for Water Research, Pretoria (South Africa).
R. D. Robarts, and T. Zohary.
Journal of Ecology, Vol. 72, No. 3, p 1001-1017, November, 1984. 10 Fig, 3 Tab, 33 Ref.

Descriptors: *Hartbeespoort Dam, *South Africa, *Light attenuation, *Microcystis, Hypertrophic lakes, Primary productivity, Phytoplankton, Algae, Population dynamics, Chlorophyll a, Stratification, Mixing.

Underwater light attenuation, primary productivity and phytoplankton dynamics were studied in the hypertrophic Hartbeespoort Dam. Microcystis aeruginosa dominated the phytoplankton population during most of the year. Nitrogen and phosphorus availabilities were always in excess of algal requirements. Green light (550 nm) penetrated furthest and blue light (443 nm) the least. The euphotic zone (zeu) depth (1% PAR) ranged between 0.6 m and 6.4 m (x = 3.7 m) and surface chlorophyll alpha concentrations ranged betweeen 3.4 mg/cu m and 1000 mg/cu m in 1982-83. The bulk of the chlorophyll was usually contained within the upper 4 m of the water column. The chlorophyll a concentration was a major factor determining underwater light attenuation. Changes in Microcystis aeruginosa colony size moderated the effect of chlorophyll a concentration on attentuation. The euphotic zone depth increased when colony size increased and decreased when colony size decreased. Primary productivity, measured by uptake of C-14 CO2, ranged between 46.3 mg C/sq m/h and 2290 mg C/sq m/h in 1982-83. Production was usually restricted to the upper 4 m of the water column (maximum depth 22-32 m) due to the vertical stratification of the phytoplankton and algal self-shading. Primary production was significantly correlated with chlorophyll a concentration. It is proposed that two major reasons for the dominance of M. aeruginosa of the phytoplankton population in this hypertrophic lake which is subject to low wind speeds are the ability of the alga to maintain itself in the upper part of the water column and the increase in colony size as the population accumulates at the surface with any decrease in mixing and turbulence. (Author's abstract)
W85-03740

2I. Water In Plants

DIFFERENTIAL PERFORMANCE OF CLEOME GYNANDRA L. (C4) AND C. SPECIOSA L. (C3) UNDER WATER, STRESS AND RECOVERY,
Sri Venkateswara Univ., Tirupati (India). Dept. of Botany.
U. D. J. Kumar, R. Saraswathy, and V. S. R. Das.
Environmental and Experimental Botany, Vol. 24, No. 4, p 305-310, November, 1984. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Plant growth, *Water stress, *Cleome, Plants, Leaves, Water potentials, Photosynthesis, Leaves, Water potential, Stomatal conductance.

Changes were investigated in leaf water status, net photosynthesis, stomatal conductance and the levels of two solutes, sugars and proline, in the two species of the genus Cleome. The response patterns during water stress and recovery of Cleome gynandra L. and Cleome speciosa L. were studied. Leaf water potential in both species changed little in the first 2 days of the stress period. There was no noticeable influence of water stress in the leaf water potential, RWC, and net photosynthesis in C. gynandra until day 4 after induction of water stress in contrast to a greater reduction of these parameters in C. speciosa from day 2 of stress induction. Stress onset was sooner in C. speciosa than in C. gynandra. The former attained its critical water potential on day 7 while the latter attained the critical water potential on day 9. The decrease in stomatal conductance and net photosynthesis was correlated with the decrease in leaf water potential and RWC. The accumulation and decrease of solutes comprising soluble sugar and proline were more pronounced in C. speciosa suggesting that the solute levels are related to water stress sensitivity. (Baker-IVI)
W85-03219

EFFECTS OF CORN STALK ORIENTATION AND WATER CONTENT ON PASSIVE MICROWAVE SENSING OF SOIL MOISTURE,
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
For primary bibliographic entry see Field 7B.
W85-03302

EFFECTS OF CO2 ENRICHMENT AND WATER STRESS ON GROWTH OF LIQUIDAMBAR STYRACIFLUA AND PINUS TAEDA SEEDLINGS,
Duke Univ., Durham, NC. Dept. of Botany.
L. C. Tolley, and B. R. Strain.
Canadian Journal of Botany, Vol. 62, No. 90, p 2135-2139, October, 1984. 4 Tab, 12 Ref. NSF grants DEB 78-23640, DEB 81-19442 and DEB 80-21312.

Descriptors: *Carbon dioxide, *Water stress, *Pine trees, *Sweetgums, Seedlings, Plant growth, Drought, Biomass.

Mathematical growth analysis techniques were used to assess the possible interactive effects of atomspheric carbon dioxide enrichment and water stress on growth and biomass partitioning of Liquidambar styraciflua L. (sweetgum) and Pinus taeda L. (loblolly pine) seedlings. Plants were grown from seed under 1000 micro-mol/sq m/s photosynthetic photon flux density at CO2 concentrations of 350, 675, and 1000 micro-L/L for 56 days. At this time, half the seedlings in each CO2 treatment had water withheld until plant water potentials reached about -2.5 MPa in the most stressed plants, while the remaining plants were well watered. At the end of the drying cycle, stressed plants were returned to well-watered conditions for a 14-day recovery period. The greatest effects of water stress on growth were seen following the recovery period and were most severe for sweetgum seedlings grown at the lowest CO2 concentration. For sweetgum seedlings in particular, the reduction of early seedling growth following exposure to a period of drought under normal atmospheric CO2 concentration was ameliorated by growing plants under elevated CO2, primarily because of maintenance of greater net assimilation rates following a period of stress. The data presented here suggest that a doubling of atmospheric CO2 concentration would enable sweetgum seedlings to become established in drier sites which are currently dominated by loblolly pine seedlings. (Author's abstract)
W85-03319

DROUGHT RESPONSE OF GRAIN LEGUMES UNDER IRRIGATION GRADIENT: II. PLANT WATER STATUS AND CANOPY TEMPERATURE,
International Rice Research Inst., Los Banos, Laguna (Philippines). Multiple Cropping Dept.
R. K. Pandey, W. A. T. Herrera, and J. W. Pendleton.
Agronomy Journal, Vol. 76, No. 4, p 553-557, July/August, 1984. 5 Fig, 21 Ref.

Descriptors: *Leaves, *Water potential, *Canopy temperature, *Legumes, *Drought resistance, Mungbeans, Soybeans, Peanuts, Cowpeas, Vegetable crops, Crop production, Water stress.

A great need exists in semiarid or tropical areas to include food legumes in rice (Oryza sativa L.) based cropping systems during the post monsoon or dry season. The seed of these legumes provide needed protein for the prevalent high starch diets. Mungbean (Vigna radiata L.), cowpea (Vigna unguiculata L.), soybean (Glycine max L.), and peanut (Arachis hypogea L.) are four short-season legumes receiving attention. The purpose of this research was to compare their drought responses on a medium-deep Tropudalf soil by using a line-source sprinkler irrigation system. This paper presents findings on plant water status and canopy temperature and their relationships to yield. Plant water status was determined with a pressure chamber and canopy temperature with an infrared thermometer. Plants exhibited leaf water potentials between 1300 to 1400 h of -1.20 MPa in mungbean, -1.40 MPa in cowpea, -1.41 MPa in soybean, and -0.67 MPa in peanut in the dry regimes 60 days after emergence. Seasonal leaf water potential was closely related to canopy temperature in all four legumes. Increasing water stress decreased leaf water potential and increased canopy-air temperature differences (delta T). The seasonal cumulative leaf water potential and delta T during crop growth were negatively correlated with yield and may be useful for selecting crop species for drought prone areas. Peanut had a higher leaf water potential and maintained a lower canopy temperature than the other species. (Author's abstract)
W85-03355

EFFECT OF MOISTURE STRESS ON SEED GROWTH IN SOYBEANS,
Georgia Univ., Athens. Dept. of Agronomy.
L. Meckel, D. B. Egli, R. E. Phillips, D. Radcliffe, and J. E. Leggett.
Agronomy Journal, Vol. 76, No. 4, p 647-650, July/August, 1984. 1 Fig, 3 Tab, 26 Ref.

Descriptors: *Soybeans, *Water stress, *Seeds, *Crop production *Drought resistance, Vegetable crops, Legumes, Crop yield, Moisture stress.

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The growth of an individual soybean (Glycine max (L.) Merr.) seed is an important part of the yield production process. An understanding of the effect of environmental factors on the growth of individual seeds is needed to enhance our understanding of the effect of the environment on yield. Soybeans were grown in the field on a Maury silt loam soil (fine, mixed, mesic Typic Paleudalfs) for 3 years (1979 to 1981) and subjected to varying levels of moisture stress to investigate the effect of moisture stress on seed growth. Irrigated controls were compared with moisture stress treatments from planting to beginning seed fill (growth stage R5), during seed filling (growth stage R5 to R7) or from planting to maturity (severe stress). Fruits were tagged at beginning seed fill and sampled at weekly intervals to estimate the seed growth rate and the effective filling period (EFP). Although the stress treatments reduced yield and vegetative growth, the rate of seed growth (mg/seed/day) was not affected. The seed-filling period (estimated as days from growth stage R5 to R7 or EFP) was shortened by the severe stress treatment in 1979 and 1981 (statistically significant only in 1979), and there was a trend for the period of R5 to R7 to be shortened by late stress in 1980 and 1981. The data suggest that the rate of individual seed growth is less sensitive to moisture stress than other plant processes. The seed filling period was more sensitive to moisture stress than seed growth rate and the effect of moisture stress on the duration of seed fill may be one way that stress reduces soybean yield. (Author's abstract)
W85-03356

MODIFICATION OF COTTON WATER RELATIONS AND GROWTH WITH MEPIQUAT CHLORIDE,
Texas Agricultural Experiment Station, Lubbock.
For primary bibliographic entry see Field 3F.
W85-03357

CORN IRRIGATION SCHEDULED BY TENSIOMETER AND THE LAMBERT MODEL IN THE HUMID SOUTHEAST,
Georgia Coastal Plain Experiment Station, Tifton.
J. E. Hook, E. D. Threadgill, and J. R. Lambert.
Agronomy Journal, Vol. 76, No. 4, p 695-700, July/August, 1984. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Corn, *Irrigation practices, *Tensiometers, *Model studies, Evapotranspiration, Transpiration, Evaporation, Soil water, Crop production.

A need for a grower acceptable irrigation scheduling technique was brought about by rapid expansion in irrigated land in the Southeast. A modified Jensen-Haise evapotranspiration formula was adapted into an irrigation scheduling and forecasting model for this region. The purpose of this study was to determine if the Lambert model was as effective as tensiometer scheduling in meeting irrigation needs of field corn (Zea mays L.). Corn was grown in seven replicated field experiments and two nonreplicated production scale experiments. Yield and water were compared after irrigation was applied either when soil water pressure in the 150-300 mm zone fell below -30 kPa as indicated by tensiometers or when called for by the model. The comparisons were conducted for 3 years on two soils, Tifton loamy sand (fine-loamy, siliceous, thermic Plinthic Paleudult) and Bonifay sand (loamy, siliceous, thermic, grossarenic Plinthic Paleudult). In five of the comparisons a nonirrigated check was included. The treatment irrigated by the Lambert model yielded 11.1 Mg/ha over all seven experiments; the tensiometer irrigated treatment yielded 11.0 Mg/ha, and the nonirrigated treatment yielded 4.3 Mg/ha. There were no significant differences between the two irrigated treatments within any year on either soil. The mean yearly water required by the model was 285 mm, compared to 237 mm for the tensiometer. In four of the seven experiments the model called for more water than the tensiometer treatment. Model predicted soil water content was generally greater than measured soil water content for the Bonifay soil but was not significantly different for the Tifton soil. Experience with the Lambert model indicated that it was difficult to determine some of the required model inputs but with correct inputs the model could accurately predict soil water content and corn water requirements. (Author's abstract)
W85-03358

DROUGHT AND FLOODING EFFECTS ON N2 FIXATION, WATER RELATIONS, AND DIFFUSIVE RESISTANCE OF SOYBEAN,
Florida Univ., Gainesville.
J. M. Bennett, and S. L. Albrecht.
Agronomy Journal, Vol. 76, No. 5, p 735-740, September/October, 1984. 8 Fig, 25 Ref.

Descriptors: *Soybeans, *Nitrogen fixation, *Drought resistance, *Flooding, Leaves, Crop production, Water potential.

Symbiotic N2 fixation depends on an interaction between bacteria and a host plant and is affected by both aerial and below-ground environments. The specific objectives of this study were to determine the effects of drought and flooding on nitrogenase activity of soybeans (Glycine max (L.) Merr.) growing in sandy soils and to relate the changes in activity to the availability of soil water and to observed stress responses of the shoot. Three greenhouse experiments were conducted in which plants were subjected to drought or flooding for 14 days. During the stress periods, midday measurements of gravimetric soil water content, leaf water potential (Psi L), leaf diffusive resistance, nodule water potential (Psi nod), and nitrogenase activity were collected. Flooding of soybeans for 14 days had little effect on Psi L, leaf diffusive resistance, or Psi nod. Although some initial leaf yellowing and structural alterations of the root and crown were apparent in the flooded plants, the nitrogenase activities of nodules after removal from the flooded environment were similar to those of the controls by the termination of the experiment. Data from drought stressed plants indicated a very sensitive response of nitrogenase activity to reductions in Psi nod and further suggest that nodules surrounded by dry soil may desiccate to water potentials lower than those observed for leaf tissue. Even after water deficits reduced midday N2 fixation to near zero for several days, rewatering restored activities to values equal to or above those of well-watered plants. Reduced rates of nitrogenase activity were observed as Psi L decreased and diffusive resistance increased. (Author's abstract)
W85-03359

FIELD STUDY OF PLANT RESISTANCE TO WATER FLOW IN ALFALFA,
New Mexico State Univ., Las Cruces.
A. S. Abdul-Jabbar, D. G. Lugg, T. W. Sammis, and L. W. Gay.
Agronomy Journal, Vol. 76, No. 5, p 765-769, September/October, 1984. 4 Fig, 3 Tab, 30 Ref.

Descriptors: *Alfalfa, *Leaves, *Water potential, *Transpiration, *Soil resistance, *Soil water potential, Evapotranspiration, Evaporation, Ohm's law.

The objective of this study was to investigate the plant resistance to water flow (Rp) in alfalfa (Medicago sativa L.) under field conditions. Plant resistance was computed using Ohm's law analog from leaf water potential (Psi l), transpiration rate (T), soil resistance (Rs), and soil water potential (Psi s). A pressure chamber was used to measure Psi l hourly throughout the 3 days, 18, 19, and 20 Aug. 1982. Evapotranspiration rate (ET) was measured continuously using the energy balance-Bowen ratio method, and T was assumed to equal ET because the alfalfa completely covered the soil, thus limiting evaporation from the soil. The leaf area index was 4.3. Soil resistance was computed from root radius and root length density data, and had a value of 698 h, which was much smaller than the calculated value of Rp. Soil water potential was calculated from soil moisture content data obtained using a neutron probe. Using this approach, Rp was almost constant throughout the day from 0730 to 1500 h, with an average value of 197,000 h. From 0730 to 1500 h, Rp was not significantly correlated ($P < 0.05$) with the water potential gradient (Psi l - Psi s) ($r = 0.08$). In addition, Rp was not significantly correlated with values of T above 0.2 mm/h ($r = -0.32$). Plant resistance to water flow in alfalfa was similar to reported values for other crops. (Author's abstract)
W85-03360

CROP WATER STRESS INDEX, SOIL WATER, AND RUBBER YIELD RELATIONS FOR THE GUAYULE PLANT,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
F. S. Nakayama, and D. A. Bucks.
Agronomy Journal, Vol. 76, No. 5, p 791-794, September/October 1984. 4 Fig, 12 Ref.

Descriptors: *Water stress, *Soil water, *Crop yield, *Guayule, Canopy temperature, Vapor pressure, Drought resistance, Irrigation.

Canopy temperature measurements based on remote infrared thermometric techniques and atmospheric vapor pressure deficits from meteorological parameters were used for developing crop water stress indices (CWSI) for three varieties of the drought-tolerant guayule plant (Parthenium argentatum A. Gray). Measurements were conducted on a coarse-loamy, mixed, hyperthermic Typic Calciorthids soil. Six irrigation levels were used to obtain relations between plant stress and soil water content, and also rubber yield. The results of the initial phase of a long-term experiment showed that the CWSI values were related negatively to the fraction of available soil water in the 0 to 1.8 m of soil depth. The CWSI of the 510-day-old perennial plant taken during the actively growing period could also be inversely related to the rubber yield. (Author's abstract)
W85-03361

LEAF WATER AND TURGOR POTENTIAL THRESHOLD VALUES FOR LEAF GROWTH OF WHEAT,
Soil and Irrigation Research Inst., Pretoria (South Africa).
J. Eastham, D. M. Oosterhuis, and S. Walker.
Agronomy Journal, Vol. 76, No. 5, p 841-847, September/October 1984. 6 Fig, 40 Ref.

Descriptors: *South Africa, *Leaves, *Water potential, *Turgor potential, *Wheat, Water stress, Irrigation, Plant growth.

Environmental factors affecting leaf growth must be understood for accurate predictions of yield by crop modeling. Water is one of the most important of these factors. The effect of water deficits on the relationships between leaf elongation and leaf water and turgor potentials was investigated on wheat (Triticum aestivium L.) grown under field conditions on a Rhodic Paleustalf in the Highfield Plateau of the Republic of South Africa. Leaf growth rates of water stressed and nonstressed wheat were measured, and corresponding values of leaf water, osmotic and turgor potentials obtained using thermocouple psychrometers. Water stress resulted in a reduced growth rate and a lower total cumulative growth. The growth curve was made up of two phases, an initial phase of both lamina and leaf sheath elongation, and a second phase of leaf sheath elongation, and a second phase of leaf sheath elongation alone. The different relationships between growth rate and midday leaf turgor potential in the two phases indicated leaf sheath elongation to be more sensitive to stress than lamina elongation. The water-stressed treatment had a lower water potential threshold value for elongation of -2571 kPa compared with -1671 kPa for well-watered plants. Turgor potential threshold values for elongation in the stressed plants were also lower by 197 kPa for the phase of leaf lamina and sheath elongation, and by 488 kPa for the phase of sheath elongation alone. Stress acclimation apparently occurred by osmotic adjustment to maintain turgor potentials necessary for elongation. (Author's abstract)
W85-03362

MOISTURE SENSOR-CONTROLLED IRRIGATION FOR MAINTAINING BERMUDAGRASS TURF,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 3F.
W85-03363

EVALUATION OF COTTON CANOPY TEMPERATURE TO DETECT CROP WATER STRESS,
Agricultural Research Service, Bushland, TX.
C. A. Howell, J. L. Hatfield, H. Yamada, and K. R. Davis.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 84-88, January/February, 1984. 12 Fig, 25 Ref.

Descriptors: *Water stress, *Canopy temperature, Crop water stress index, *Cotton, *California, Soil water, Crop yield, Temperature, Osmotic potential, Soil matric potential, Irrigation scheduling.

The crop water stress index (CWSI) was demonstrated to be a sensitive plant indicator of both matric potential stress and soil osmotic potential stress for cotton. Although irrigation scheduling decisions were not based on the CWSI in these experiments, its potential use to time irrigation applications appears good. The unstressed baseline does not depend on crop row spacing for cotton. The unstressed baseline for cotton does not exhibit seasonal change. The unstressed baseline for Acala cotton appeared universally applicable to a large cotton growing region in California having similar climatic conditions. Cotton lint yield was linearly related to mean seasonal crop water stress index. The CWSI is sensitive to osmotic potential stress which results from soil salinity in the absence of soil matric potential stress. The infrared thermometer offered a method of quickly assessing crop stress over large areas which previously required intensive labor requirements. The CWSI can be used to monitor the cropwater stress under irrigation systems which are frequency of rate controlled such as center pivot sprinkler, lateral move sprinkler and trickle irrigation systems. The CWSI could indicate the need to either increase or decrease irrigation amounts or frequency. (Baker-IVI)
W85-03368

DYNAMICS OF WATER IN ZEA MAYS L.: SENSITIVITY ANALYSIS OF TROIKA,
Clemson Univ., SC. Dept. of Agricultural Engineering.
J. R. Lambert, and D. C. Reicosky.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 117-124, January/February, 1984. 13 Fig, 1 Tab, 35 Ref.

Descriptors: *Leaves, *Water potentials, *Corn, Soil water, Roots, Plants, Soil-water-plant relationships, Simulation, Model studies.

Water movement from the soil into roots, through the plant, and out into the atmosphere in response to the microclimate was simulated for field grown maize plants using TROIKA, a model for simulating water flow. Predicted leaf water potentials were compared with field measured values. A sensitivity analysis of the simulation model was performed to indicate the required measurement accuracy for certain parameters. The results of this sensitivity analysis of TROIKA indicate stem resistance to be of vital importance in calculating leaf water potential. Leaf area should be determined with an accuracy of 5 to 10% to keep simulated leaf water potentials within a bar of the observed leaf water potential. Root length and root permeability have similar, less dramatic effects. The model is relatively insensitive to changes in root radius and leaf width. Soil moisture content affects the sensitivity of leaf water potential to variations in all system parameters studied. Other environmental variables will also affect the sensitivity of leaf water potentials to variations in the system parameters. Studies of soil plant atmosphere water relations sometimes include exploration of root systems in addition to measurements above ground. This sensitivity analysis indicates that root radius can be roughly estimated and that care should be taken not to underestimate root length of density, by retrieving all roots. (Baker-IVI)
W85-03372

SOIL MOISTURE RESPONSES TO CROPPING AND TILLAGE ON WESTERN IOWA LOESS SOILS,
Agricultural Research Service, Council Bluffs, IA.
For primary bibliographic entry see Field 2G.
W85-03391

EVAPOTRANSPIRATION OF LETTUCE IN RELATION TO WATER TABLE DEPTH,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W85-03399

LEAF WATER POTENTIALS, FIRE AND THE REGENERATION OF MALLEE EUCALYPTS IN SEMI-ARID, SOUTH-EASTERN AUSTRALIA,
Monash Univ., Clayton (Australia). Dept. of Botany.
A. B. Wellington.
Oecologia (Berlin), Vol. 64, No. 3, p 360-362, November, 1984. 14 Ref.

Descriptors: *Leaves, *Water potential, *Fire, *Mallee, *Australia, *Semiarid lands, *Regeneration, Drought, Evapotranspiration, Soil-water-plant relationships.

Comparisons of predawn leaf water potential were made between adults, seedlings and coppicing lignotubers of yellow mallee, Eucalyptus incrassata Labill., during a period of severe drought between December 1981 and March 1983. Measurements were made on plants from areas which were one year, four years, and more than twenty years unburnt. Seedlings and coppice regrowth from sites burnt one year previously had significantly higher leaf water potentials than plants from older sites. Little change in water status of long-established plants occurred, despite the drought. There was no difference in the water potentials of plants from sites which were more than four years unburnt. Seedlings of both the one year old and four year old cohorts suffered mortality rates of more than 50% during the summer season towards the end of the drought when leaf water potentials had decreased to -4 MPa. The difference in plant water status, observed between sites which were one year unburnt and older sites, may be due to a temporary cessation of the depletion of soil moisture reserves by the vegetation. Fire results in complete defoliation of established vegetation and it is some years before community evapotranspiration returns to pre-fire levels. (Author's abstract)
W85-03512

SOME ASPECTS OF THE WATER RELATIONS BETWEEN DIFFERENT ORGANS OF THE SAME PLANT,
Institut National de la Recherche Agronomique, Clermont-Ferrand (France). Lab. de Bioclimatologie.
P. Cruizat.
Wissenschaftliche Zeitschrift der Humboldt-Universitat zu Berlin, Mathematisch-Naturwissenschaftliche Reihe. Vol. 33, No. 4, p 356-359, 1984. 2 Fig, 14 Ref.

Descriptors: *Plant physiology, *Plant tissues, *Plant water potential, Vascular tissues, Leaves.

The vascular structure of a plant and especially of the stem must be accounted for in any serious reliable attempt to model water flow through plants. In many cases, the stem has a definite organizational pattern that determines which are the most closely related in their water exchanges. In the same way, the degree of integration of the water connections between roots and leaves are an important factor of the water behavior of a plant, especially a woody plant. The water relations between organs of the same plant is an aspect of plant water relations which has not received much attention; it is an important aspect of the water physiology of plants which are able to maintain a relative water homeostasis in a variable environment. There is probably a continuous adjustment of the internal fluxes to satisfy at any time the water demand of every part of the plant. This adjustment supposes variable fluxes between organs, depending on climatic conditions, availability of water in soil, state of organs, etc. The description and explanation of these internal fluxes and of their regulation may well constitute the most specific aspect to the water relationships of a plant as being a living organism. (Author's abstract)
W85-03609

RELATIVE LEAF WATER CONTENT AND STRESS INDEX AS A CRITERION OF THE STATE OF THE WATER SUPPLY IN SUGAR BEET UNDER FIELD CONDITIONS (RELATIVER BLATTWASSERGEHALT UND STRESSINDEX ALS KRITERIUM DES WASSERVERSORGUNGSZESTANDES BEI ZUCKERRUBEN UNTER FELDBEDINGUNGEN),
Forschungszentrum fuer Bodenfruchtbarkeit Muencheberg (German D.R.). Abt. Ertragssteuerung.
H. Kretschmer.
Wissenschaftliche Zeitschrift der Humboldt-Universitat zu Berlin. Mathematisch-Naturwissenschaftliche Reihe, Vol. 33, No. 4, p 381-382, 1984. 1 Fig, 14 Ref.

Descriptors: *Leaves, *Water content, *Water stress, *Sugar beets, Plant tissues, Soil water, Carbon dioxide, Respiration.

A three-year field study (1979-1981) at the Muncheberg intensive measurement field in the German Democratic Republic showed that the relative leaf water content (RWC) of south-facing sugar-beet leaves was a good indicator of plant water deficiency. Accurate and rapid determination of the water-supply conditions in crop plants is important for high yields and to ensure consumption of the least amount of soil water and irrigation water possible. RWC was measured continuously by the beta-absorption method, and measurements were transmitted as hourly figures. RWC varied greatly throughout the day even when soil moisture was high: at a soil moisture of $> 60\%$ of usable field capacity, UFC (at depths ranging from 0 to 60 cm), RWC ranged from 90 to 97% in the early morning to as low as 70% in the afternoon, depending on transpiration and temperature. At a soil moisture of $<$ 35-45% UFC, meteorological factors influenced RWC significantly more than the amount of soil water available. Only when soil moisture fell below this level was a linking of meteorological factors and usable soil water content necessary to determine RWC. A stress index (STI) was therefore devised whereby STI = (alpha + (beta x evaporation in a standard tank) - UFC)/10; where alpha = 100% and beta = 8%/mm/day. Daily STI values were closely correlated to the daily minimum for RWC at low soil moisture. Measurements of net carbon dioxide assimilation (NCDA) showed that the unstable daily water balance in sugar-beet leaves is not associated with NDCA instability. STI could be improved be taking into account plant adaptation behavior through making the constants alpha and beta more precise. (Gish-IVI)
W85-03610

THERMAL AND WATER RELATIONS OF ROOTS OF DESERT SUCCULENTS,
California Univ., Los Angeles. Dept. of Biology.
P. W. Jordan, and P. S. Nobel.
Annals of Botany, Vol. 54, No. 5, p 705-717, November, 1984. 7 Fig, 1 Tab, 34 Ref. DOE DE-AM03-76-SF00012.

Descriptors: *Succulents, *Desert plants, *Roots, *Drought, Agave, Ferocactus, Soil temperature, Plant growth, Osmotic potential, Rainfall, Hydraulic conductance.

Two succulent perennials from the Sonoran Desert, Agave deserti Engelm. and Ferocactus acanthodes (Lem.) Britton and Rose, lose little

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water through their roots during drought, yet respond rapidly to light rainfall. Their roots tend to be shallow, although absent from the upper 20 mm or so of the soil. During 12-15 d after a rainfall, new root production increased total root length by 47% to 740 m for A. deserti and by 27% to 230 m for F. acanthodes; root dry weight then averaged only 15% of shoot dry weight. The annual carbon allocated to dry weight of new roots required 11% of shoot carbon dioxide uptake for A. deserti and 19% for F. acanthodes. Elongation of new roots was greatest near a soil temperature of 30 C, and lethal temperature extremes (causing a 50% decrease in root parenchyma cells taking up stain) were 56 C and -7 C. Soil temperatures annually exceeded the measured tolerance to high temperature at depths less than 20 mm, probably explaining the lack of roots in this zone. Attached roots immersed in solutions with osmotic potentials above -2.6 MPa could produce new lateral roots, with 50% of maximum elongation occurring near -1.4 MPa for both species. Non-droughted roots lost water when immersed in solutions with osmotic potentials below -0.8 MPa, and root hydraulic conductance decreased markedly below about -1.2 MPa. Pressure-volume curves indicated that, for a given change in water potential, non-droughted roots lost three to five times more water than droughted roots, non-droughted leaves, or non-droughted stems. Hence, such roots, which could be produced in response to a rainfall, will lose the most tissue water with the onset of drought, the resulting shrinkage being accompanied by reduced root hydraulic conductance, less contact with drying soil, and less water loss from the plant to the soil. (Author's abstract)
W85-03698

CARBON BALANCE FOR TWO SPHAGNUM MOSSES: WATER BALANCE RESOLVES A PHYSIOLOGICAL PARADOX,
State Univ. of New York at Binghamton. Dept. of Biological Sciences.
J. E. Titus, and D. J. Wagner.
Ecology, Vol. 65, No. 6, p 1765-1774, December, 1984. 7 Fig, 3 Tab, 29 Ref. NSF grants DEB 79-22634 and DEB 80-22731.

Descriptors: *Sphagnum, *Mosses, *Water balance, *Plant physiology, Water level, Water table, Photosynthesis, Respiration, Model studies, Simulation, Carbon balance, Bogs, Ecological distribution.

Plant carbon balance is commonly regarded as an integrative measure of a plant's adaptations to particular environmental circumstances. Carbon balance was estimated for two species to gain insight into the vertical zonation patterns of Sphagnum mosses growing along hummock-hollow gradients within bogs of the Adirondack Mountains. Sphagnum fallax is generally found closer to the water table than S. nemoreum along the hummock-hollow gradient. At low water contents, however, S. fallax unexpectedly fixes carbon at higher rates than S. nemoreum. This apparent paradox was investigated. S. nemoreum was found to maintain a more favorable water balance by virtue of its greater water holding capacity, lower rates of water loss from moist plants, and apparently more effective capillary conduction of water. This results in a significantly higher tissue water content in the field compared to adjacent patches of S. fallax for a wide range of dates and heights above the water table. PEATMOSS, a simulation model, was used to evaluate the relative importance of contrasting physiological relationships and water balances of the two species. PEATMOSS estimated a greater carbon gain for S. fallax at a low water site, where it is a clear dominant over S. nemoreum, and a markedly more favorable carbon balance for S. nemoreum at the hummock site, where S. nemoreum is common but S. fallax is infrequent. (Baker-IVI)
W85-03729

2J. Erosion and Sedimentation

ULTRASTRUCTURE OF LACUSTRINE SEDIMENTING MATERIALS IN THE COLLOIDAL SIZE RANGE,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
G. G. Leppard.
Archiv fur Hydrobiologie, Vol. 101, No. 4, p 521-530, October, 1984. 6 Fig, 1 Tab, 22 Ref.

Descriptors: *Lake sediments, *Ontario, *Colloids, Water pollution, Sediments, Lakes, Organic matter, Particulates.

The ultrastructure of fine sedimenting particles and colloids, sampled from two large and two small Ontario lakes, was investigated by transmission electron microscopy. Colloidal coatings on POC and, also, the apparent adhesives of aggregated particles are described in detail in terms of the ultrastructural units comprising them, with a focus on fibrils having diameters in the range of 0.003 and 0.020 micrometers. Four general features are demonstrated for fine aggregated sediment particles by transmission electron microscopy. These are: a high internal porosity not normally visualized by scanning electron microscopy; specific electron-opaque surface extensions; high interpenetration of particle surface and aquatic milieu; the common occurrence of colloidal organic fibrils as the units of apparent adhesive bridges and as the units of patchy coatings. These features illustrate the tenuousness of many fine particles. Using the new structural information, an argument is presented for considering organic colloids as a separate fraction of natural surface waters, independent of the conventional DOC and POC fractions, particularly in binding studies used for interpreting the redistribution and fate of particle-bound toxic substances. (Baker-IVI)
W85-03232

SIZE STRUCTURE AND SEDIMENTATION OF BIOGENIC MICROPARTICULATES IN A SUBARCTIC ECOSYSTEM,
Oceanic Inst., Waimanalo, HI.
P. K. Bienfang.
Journal of Plankton Research, Vol. 6, No. 6, p 985-995, 1984. 3 Fig, 4 Tab, 40 Ref. NSF grants DPP-8121477 and OCE-8100679-01.

Descriptors: *Resurrection Bay, *Alaska, *Particle size, *Sedimentation, Bays, Particulates, Chlorophyll, Photosynthesis, Sinking rate, Subarctic zone, Nutrients, Primary productivity.

Data describing sinking rates and size structure of microparticulate material were collected from Resurrection Bay, Alaska during the summer. Spring conditions were inferred from similar data obtained from a large outdoor pond supplied with nutrient-rich deep water. Size structure of chlorophyll and photosynthesis were clearly different in the two assemblages. In the summer assemblage, the majority of particulate chlorophyll, carbon, phosphorus, nitrogen, silica, and photosynthesis occurred in the < 5 micro-m fraction. Average sinking rates of the various constituents of the total suspended material differed substantially and ranged from 0.07 to 0.63 m/d. The total downward flux of carbon was 13% of daily primary production and the sinking of material greater than 20 micro-m accounted for nearly all of the downward flux. Sinking rates of actively growing spring assemblages differed from the smaller summer assemblages by only a few tenths of a meter per day. (Author's abstract)
W85-03244

INFLUENCE OF WAVES AND SEAGRASS COMMUNITIES ON SUSPENDED PARTICULATES IN AN ESTUARINE EMBAYMENT,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2L.
W85-03347

SEDIMENT TRANSPORT AND MORPHOLOGY AT THE SURF ZONE OF PRESQUE ISLE, LAKE ERIE, PENNSYLVANIA,
Louisiana State Univ., Baton Rouge. Dept. of Geology.
D. Nummedal, D. L. Sonnenfeld, and K. Taylor.
Marine Geology, Vol. 60, No. 1/4, p 99-122, August, 1984. 11 Fig, 4 Tab, 26 Ref.

Descriptors: *Presque Isle, *Lake Erie, *Pennsylvania, *Sediment transport, *Sedimentation, Peninsulas, Erosion control, Shore protection.

A four-year investigation of surf zone sedimentation at Presque Isle, in Lake Erie, Pennsylvania, was undertaken in preparation for the design of a segmented breakwater system. Sediment transport calculations were based on hind-cast annual wave power statistics and 'calibrated' by known accretion rates at the downdrift spit terminus. 30,000 cu m of sediment reaches the peninsula annually from updrift beaches. The transport volume increases downdrift due to shoreface erosion and retreat of the peninsular neck. At the most exposed point on Presque Isle (the lighthouse) the annual transport is 209,000 cu m. East of the lighthouse is a zone of net shoreface accretion as the longshore transport rate progressively decreases. The downdrift variation in sediment supply, combined with increasing refraction and attenuation of the dominant westerly storm waves produce a systematic change in prevailing surf zone morphology. Storms produce a major longshore bar and trough along the exposed peninsular neck. The wave energy during non-storm periods is too low to significantly alter the bar which consequently becomes a permanent feature. The broad shoreface and reduced wave energy level east of the lighthouse produce a morphology characterized by large crescentic outer bars, transverse bars, and megacusps along the beach. At the sheltered and rapidly prograding eastern spit terminus the prevalent beach morphology is that of a ridge and runnel system in front of a megacuspate shore. The morphodynamic surf zone model developed for oceanic beaches in Australia is used as a basis for interpretation of shoreface morphologic variability at Presque Isle. In spite of interference by major shoreline stabilization structures, and differences between oceanic and lake wave spectra, the nearshore bar field at Presque Isle does closely correspond to the Australian model.
W85-03349

GULLIES OF IMO,
Ibadan Univ. (Nigeria). Dept. of Agricultural Engineering.
G. E. Osuji.
Journal of Soil and Water Conservation, Vol. 39, No. 4, p 246-247, July/August, 1984. 3 Fig, 3 Ref.

Descriptors: *Erosion control, *Gully erosion, *Nigeria, *Imo, Runoff, Rainfall, Soil erosion, Gullies, Rain forests.

Gully erosion is a severe problem in the State of Imo, Nigeria, with almost 14.3 million tons of soil lost annually in this area of 3,500 square miles, located in the rain forest zone of southeastern Nigeria. Some gullies are an estimated 2 miles long, 1.2 miles wide and 400 feet deep. A study of 16 gullies throughout the state was made. Although gullies are not a recent development, their growth has been rapid in the past 10 years. Generally, a gully begins as a channel for rainwater runoff. If viewed in the direction of flow, the initial cut appears 'S' shaped. The channel grows larger because of undercutting. Until recently, no serious efforts had been made to check the development and growth of the gullies. During the 1940s attempts were made to introduce crop rotation, contour cropping, and cover cropping but these failed because of farmers' conservatism. Local people have made most of the efforts to stop the gullies. Communities sponsor earthern dam construction, as well as ditches and contour banks, but the great depth of the gullies presents a problem too great for local efforts alone. Some government aid is on the way. (Baker-IVI)
W85-03350

IMPROVED SOIL EROSION CLASSIFICATION FOR CONSERVATION POLICY,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
R. E. Heimlich, and N. L. Bills.

ournal of Soil and Water Conservation, Vol. 39, lo. 4, p 261-266, July/August, 1984. 2 Fig, 5 Tab, 5 Ref.

)escriptors: *Soil conservation, *Erosion control, Soil erosion, Sheet erosion, Rill erosion, Gully rosion, Erosion, Universal soil loss equation, Croplands.

A classification system is proposed to characterize heet from rill erosion, with emphasis of such rosion from cropland. Implications of this new olicy for soil conservation are drawn. To the xtent that erosion from wind and gully processes ccurs separately from sheet and rill erosion, the onclusions reached here must be modified. This lassification system partitions the universal soil oss equation (USLE) into physical and managerial omponents of soil loss and applies the classifica- on to a national data base to produce results seful to policy makers. If a field were continuous- in clean-tilled fallow, the average annual soil oss would equal the product RKLS. Because the JSLE is a multiplicative relationship, the manage- ient needed on a particular field to achieve a soil oss goal is derived by dividing the goal by the roduct RKLS. The proposed classification system rovides a useful perspective on opportunities for hanging management to control erosion. This per- pective is a necessary prelude to altering existing rosion control programs or designing new one hat will efficiently match available resources to esolvable problems. Characterization of cropland heet and rill erosion according to physical and anagerial components allows a more meaningful nalysis of erosion problems than alternative sys- ems. Such a classification provides insights useful or policy formulation and abstracts from physical onditions that are not amenable to conservation rograms. (Baker-IVI)
W85-03351

EDIMENT TRAP EFFICIENCY OF A SMALL RESERVOIR,
Agricultural Research Service, Oxford, MS. Sedi- ientation Lab.
F. E. Dendy, and C. M. Cooper.
ournal of Soil and Water Conservation, Vol. 39, lo. 4, p 278-280, July/August, 1984. 7 Fig, 1 Tab, Ref.

)escriptors: *Sedimentation, *Reservoirs, *Sedi- ient traps, *Mississippi, Silt, Sediments, Clay, Storm runoff, Sediment load.

The amount of sediment trapped in a reservoir lepends upon the quantity of inflowing sediment nd the sediment trapping efficiency of the struc- ure. The sediment trap efficiency of a 2.7 acre eservoir in the northern Mississippi's Goodwin Creek drainage basin was measured during a 2 yr eriod. While the overall trap efficiency was about 7%, monthly trap efficiencies ranged from 9% to 0%. Trap efficiency was generally much higher or storms accompanied by high sediment loads nd high sediment concentrations. Trap efficiency vas generally low for storms producing low sedi- ient concentrations. High variable flow detention imes may explain part of the variation in storm rap efficiencies. Although the overall sediment rap efficiency of small reservoirs may be relative- y high, short-term and individual storm trap effi- iencies may vary widely. A much greater propor- ion of the inflowing sediment is trapped from torms with high sediment loads and high sediment concentrations. Average flow detention time in mall reservoirs may vary from a few hours to a ew days. (Baker-IVI)
W85-03352

EROSION FROM SIMULATED RAINFALL ON MOUNTAIN RANGELAND IN UTAH,
Utah State Univ., Logan. Dept. of Forest Resources.
G. E. Hart.
Journal of Soil and Water Conservation, Vol. 39, No. 5, p 330-334. 1 Fig, 4 Tab, 6 Ref.

Descriptors: *Utah, *Rangeland, *Rainfall impact, *Erosion, Soil erosion, Soil water, Rainfall intensity.

Simulated rainfall was applied to large runoff plots that were bare or covered with sagebrush and grass. Soil erosion on the vegetated plots was negligible; on the bare plots soil loss averaged 1.9 t/ha from lower intensity rain on dry soil and 16.6 t/ha from higher intensity rain on prewet soil. Antecedent soil moisture condition had a pronounced effect on erosion. The universal soil loss equation greatly overestimated measured loss on dry soils, but was within 13 to 51% of measured losses on prewetted plots with a 10% slope. Comparison of predicted and measured soil losses on a 32% slope suggested that overestimation was due partly to the USLE's slope value. (Author's abstract)
W85-03354

MATHEMATICAL MODEL OF EROSION AND DEPOSITION ON A WATERSHED,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
R. M. Khanbilvardi, and A. S. Rogowski.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 73-83, January/February, 1984. 12 Fig, 3 Tab, 30 Ref.

Descriptors: *Erosion control, *Model studies, *Pennsylvania, *Nebraska, Watershed management, Erosion, Mathematical studies, Rill erosion, Grain size, Sedimentation.

Properly posed, an erosion-deposition model can be used as a design tool to develop plans for control of erosion as well as a transport model for a number of soil sorbed chemicals and pollutants. A recently developed erosion-deposition model (Khanbilvardi, R.M., A.S. Rogowski, and A.C. Miller, 1983. Water Resources Bulletin, Vol. 19, No. 1, p 29-35) was used to predict erosion and deposition on watersheds in Nebraska and Pennsylvania. Sorptivity (S) and A-value in Philip's infiltration equation were not available for the selected sites, but were approximated using procedures available from literature. In a further modification of the original model the procedure for finding rill sources and contribution interrill areas was adjusted to accommodate the watershed size and varying topography. Using the model, parameters of sediment and water flow as well as the amounts of soil lost from interrill and rill areas were calculated for each 100 x 100 m subarea on both watersheds. The flow patterns and sediment yield rates as predicted by the model for one of the watersheds, were in general agreement with observed experimental data. To evaluate the influence of median particle size on stripmine erosion the model was executed for particle size of 6, 9, and 12 mm for a watershed in Pennsylvania. There was a nonlinear increase in relative interrill erosion as the particle size decreased. (Baker-IVI)
W85-03366

EFFECT OF SOIL AIR ENTRAPMENT ON EROSION,
Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W85-03369

INTERRILL EROSION AS AN INDEX OF MINED LAND SOIL ERODIBILITY,
Montana State Univ., Bozeman.
K. J. Lang, L. Prunty, S. A. Schroeder, and L. A. Disrud.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 99-109, January/February, 1984. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Slopes, *Runoff, *Interrill erosion, *Erosion control, *Land reclamation, Mine wastes, Erosion, Soil loss, Rainfall-runoff relationship, Mulch, Soil water, Slope, Topsoil.

A rainfall simulation technique was used to evaluate the influence of slope steepness (3 and 9%), mulch rate (0, 1.12, and 2.24 t/ha), and antecedent soil moisture condition (dry and wet runs), on runoff, splash, soil loss in runoff and the primary particle composition of soil in splash and sediment from interrill areas on two mined land topsoils. On cohesive soils that have received appreciable rainfall within a 24 hr period, surface mulch rates of 2.24 t/ha or less are ineffective in reducing interrill runoff and subsequently are less effective in reducing interrill erosion. Interrill sediment eroded from loam and clay loam soils is enriched in primary particles of clay and fine silt while surface seal material is enriched in primary particles of coarse silt and sand. Primary particle size enrichment ratios are useful in the evaluation of variables (soil and condition, slope and cover) which influence interrill erosion. Stockpiled topsoils apparently maintain some of the properties which influence erodibility (aggregate stability, dispersion and crusting) found in the soils before they were disturbed. Stockpiled topsoils which were cultivated prior to stockpiling are potentially more erodible after respreading than topsoils which were in native vegetation, other factors being equal. Interrill erosion data are potentially useful as a reclamation management tool. (Baker-IVI)
W85-03370

MODELING APPROACH TO DETERMINING THE RELATIONSHIP BETWEEN EROSION AND SOIL PRODUCTIVITY,
Texas Agricultural Experiment Station, College Station.
J. R. Williams, C. A. Jones, and P. T. Dyke.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 129-144, January/February, 1984. 36 Ref.

Descriptors: *Soil erosion, *Productivity, *Crop yield, *Model studies, Mathematical models, Sedimentation, Nutrients, Plant growth, Tillage, Temperature effects, Economic aspects.

A mathematical model called EPIC (Erosion-Productivity Impact Calculator) was developed to determine the relationship between soil erosion and soil productivity throughout the US. EPIC continuously simulated the processes involved simultaneously and realistically, using a daily time step and readily available iputs. Since erosion can be a relatively slow process EPIC is capable of simulating hundreds of years if needed. EPIC is generally applicable, computationally efficient, and capable of computing the effects of management changes on outputs. The model must be comprehensive to define the erosion-productivity relationship adequately. EPIC is composed of physically based components for simulating erosion, plant growth, and related processes and economic components for assessing the cost of erosion, and determining optimal management strateges. The EPIC components include weather simulation, hydrology, erosion-sedimentation, nutrient cycling, plant growth, tillage, soil temperature, economics, and plant environment control. Typical results are presented for 15 of the 163 tests performed in the continental US and Hawaii. EPIC is generally capable of simulating erosion and crop growth realistically. (Baker-IVI)
W85-03374

LABORATORY STUDY OF RILL HYDRAULICS: I. VELOCITY RELATIONSHIPS,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
For primary bibliographic entry see Field 2E.
W85-03387

LABORATORY STUDY OF RILL HYDRAULICS: II. SHEAR STRESS RELATIONSHIPS,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
G. R. Foster, L. F. Huggins, and L. D. Meyer.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 797-804, May/June, 1984. 6 Fig, 5 Tab, 22 Ref.

Descriptors: *Rill erosion, *Shear stress, Soil erosion, Erosion control, Roughness, Hydraulics, Flow discharge, Slope.

A flush mounted hot film sensor and anemometer were used to measure shear stress attributed to grain roughness. This shear stress around a cross

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section was highly irregular in contrast to the smooth distributions for shear stress around prismatic and semicircular channels. The shear stress was highly variable in time because the flow was turbulent. The ratio of maximum to minimum section average shear stress from grain roughness along a 3 m reach of the rill was 2.4 to 1. Average shear stress from grain roughness for the rill varied with discharge rate to the 0.63 power and slope to the 1.38 power. The probability distribution of instantaneous shear stress from grain roughness was described either by a Pearson Type III or a log-normal distribution. (Baker-IVI)
W85-03388

SYSTEMS APPROACH FOR AGRICULTURAL LAND MANAGEMENT AND WATER QUALITY CONTROL,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
S. M. Trapanese, M. D. Smolen, and T. M. Younos.
Transactions of the ASAE, Vol. 27, No. 3, p 817-821, May/June, 1984. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Land management, *Erosion control, *Crop production, *Cultivation, *Model studies, Cost analysis, Agricultural runoff, Water pollution control, Virginia, Corn.

The Finite Element Storm Hydrograph Model (FESHM) (Ross, B.B., M.L. Wolfe, V.O. Shanholtz, M.D. Smolen, and D.N. Contractor, 1982. Model for Simulating Runoff and Erosion in Ungaged Watersheds. Virginia Water Resources Research Center, Blacksburg, VA. Bulletin 130.) was used to simulate the impact of alternative land management strategies on the average annual sediment yield in Cunningham Creek watershed in the southeastern piedmont section of Virginia. The sediment yield output from the hydrologic simulation was used to estimate activity coefficients for a linear programming model to identify the management strategy with the least sediment yield at acceptable farm income levels. The analysis showed that substitution of conservation management practices could be highly cost-effective if they produce profit levels near those of conventional, more erosive practices. In one example, a 50% reduction of sediment yield could have been obtained with no loss of income by substituting no-till corn for conventional tillage corn; a government income subsidy should not have been necessary to improve water quality because a more profitable, less erosive, alternative was available. In another example, where the conventional practice allowed a slightly higher profit, but substantially higher erosivity, government cost sharing or income subsidy should be a more cost-effective approach. (Collier-IVI)
W85-03390

PLANT NUTRIENT YIELDS IN RUNOFF FROM A MISSISSIPPI DELTA WATERSHED,
Agricultural Research Service, Oxford, MS.
L. L. McDowell, G. H. Willis, and C. E. Murphree.
Transactions of the ASAE, Vol. 27, No. 4, p 1059-1066 and 1073, July/August, 1984. 12 Fig, 9 Tab, 30 Ref.

Descriptors: *Mississippi Delta, *Runoff, *Sediments, *Nutrients, Clay soils, Nitrogen, Phosphorus, Ammonium, Nitrate, Tillage, Erosion control, Agricultural runoff.

Plant nutrients and sediment concentrations in surface runoff from a 15.6-ha watershed, planted to continuous cotton (Gossypium hirsutum L.), were measured from July 1972 through June 1978 to determine the nutrient and sediment yields. The watershed, consisting of Sharkey silty clay soil (Vertic Haplaquepts), had been land-formed to a mean slope of 0.2%. The 6-yr average annual rainfall, runoff and sediment yields were 1355 mm, 550 mm and 16.3 t/ha, respectively. Nitrogen (N) fertilizer was applied at the rate of 171 kg N/ha-yr during calendar years 1972 through 1978. Phosphorus (P) fertilizer was not applied because cotton growing on this soil does not respond to P fertilization. The discharge-weighted ammonium-nitrogen (NH4-N), nitrate-nitrogen (NO3-N), and soluble P concentrations were 0.15, 3.2, and 0.26 mg/L, respectively, for the study period. The 6-yr average soluble N (NH4-N plus NO3-N) and P yields were 18.7 and 1.4 kg/ha-yr, respectively, compared with sediment N and P yields of 31.0 and 18.3 kg/ha-yr. Thus, about 38 and 7% of the total (sum of solution and sediment) N and P yields were transported in solution; the remainder was transported by the sediments. Sediment and nutrient yields were much greater than expected from these flat lands. Reduced fall and winter tillage, which is gaining acceptance in the Delta, will probably help reduce sediment and associated nutrient yields, but improved erosion control practices are needed during the spring tillage period to significantly reduce sediment and chemical yields from these croplands. (Author's abstract)
W85-03397

SOIL EROSION POTENTIAL OF RECLAIMED MINED LANDS,
Hydroeco-System Research Group, Fort Collins, CO.
D. M. Hartley, and G. E. Schuman.
Transactions of the ASAE, Vol. 27, No. 4, p 1067-1073, July/August, 1984. 4 Fig, 5 Tab, 19 Ref.

Descriptors: *Soil erosion, *Land reclamation, *Mulching, *Runoff, Rainfall, Simulation models, Soil water, Erosion, Design storms.

Runoff and erosion from three mulch treatments were measured on a surface coal mine near Hanna, Wyoming. Treatments included no mulch, standing grain mulch and crimped straw mulch. Treatments were subjected to artificial rainfall generated by a portable rainfall simulator during three successive growing seasons. Soil loss data indicate a peak in erosion hazard during the summer following seeding of the perennial species. Soil losses were initially least on the straw mulch and greatest on the no mulch treatments although soil loss differences declined by the third season. Generally, soil loss amounts varied directly with ground cover. Runoff data from all treatments indicate a general decline in infiltration rates during the study period. Vegetation, soil loss and runoff data were used to calibrate a computer simulation model of runoff and erosion. Results obtained indicate small amounts of soil loss even for very infrequent, intense one-hour design storms on moderate slopes regardless of mulching method. Simulations indicated that erosion hazards are highly dependent upon antecendent soil moisture conditions and the time distribution of storm intensities. (Author's abstract)
W85-03398

DYNAMIC SIMULATION OF SEDIMENT DISCHARGE FROM AGRICULTURAL WATERSHEDS,
Agricultural Research Service, Columbia, MO.
M. W. Van Liew, and K. E. Saxton.
Transactions of the ASAE, Vol. 27, No. 4, p 1087-1092, July/August, 1984. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Sediment discharge, *Agricultural watersheds, *Watersheds, *Soil erosion, *Simulation analysis, Runoff, Model studies, Erosion.

Soil erosion and sediment transport from small agricultural watersheds in southwestern Iowa were estimated by applying a modified version of the SEDLAB simulation model. The effects of crop canopy, ground cover, and subsurface land use effects were represented by revised and newly developed functions. The results showed that the revised SEDLAB model will provide reasonably accurate estimates to the erosion and sediment discharge of upland agricultural watersheds for different hydrologic, vegetative, and cultural conditions. Tests with data from an adjacent watershed showed that the model may be transferred to similar uncalibrated watersheds. (Author's abstract)
W85-03401

TILLAGE, RESIDUE AND EROSION ON MODERATELY SLOPING SOILS,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
E. C. Dickey, D. P. Shelton, P. J. Jasa, and T. R. Peterson.
Transactions of the ASAE, Vol. 27, No. 4, p 1093-1099, July/August, 1984. 7 Fig, 2 Tab, 11 Ref.

Descriptors: *Tillage, *Residue, *Soil erosion, Silt loam soil, Silty clay loam, Runoff, Sediment, Land management, Erosion.

Soil loss from various tillage systems used on silty clay loam having a 5% slope and a silt loam soil having a 10% slope was evaluated using rainfall simulation techniques. The moldboard plow treatment always had the greatest soil loss while the no-till treatment had the least. Tillage treatments leaving 20% or more of the soil surface covered with residue reduced soil erosion by at least 50% of that which occurred from a moldboard plow system. No-till tended to have the lowest cumulative runoff. Because the runoff rate tended to be the same for all tillage treatments, differences in erosion were primarily due to differences in sediment concentration in the runoff. The sediment concentration was always highest for the no-till treatments. The soil loss and sediment concentration data were highly correlated with with the percent of soil surface covered with residue. For both the 5 and 10% slopes, tillage systems leaving 20% or more of the soil surface covered with residues reduced soil loss by at least 50% of that which occurred from cleanly tilled, residue free conditions. (Collier-IVI)
W85-03402

REMEDIAL MEASURES FOR DEBRIS FLOW AT THE AGASSIZ MOUNTAIN INSTITUTION, BRITISH COLUMBIA,
Piteau (D.R.) and Associates Ltd., Vancouver (British Columbia).
D. C. Martin, D. R. Piteau, R. A. Pearce, and P. M. Hawley.
Canadian Geotechnical Journal, Vol. 21, No. 3, p 505-517, August, 1984. 12 Fig, 8 Ref.

Descriptors: *Mount Agassiz, *British Columbia, *Debris fan, *Erosion, Alluvial fan, Streambeds, Slopes, Mountains.

On the evening of January 23, 1982 a debris flow having an estimated volume of 11,000 cu m occurred in a stream channel on the south slope of Mount Agassiz adjacent to the Mountain Institution of the Correctional Services of Canada. The debris flow was one of many that have contributed to the formation of a large debris fan at the base of the mountain. Debris flow, large rockfalls, and other events can be expected to occur intermittently as a part of the ongoing natural erosional processes in steep mountainous terrain. This paper describes the site investigation and analyses carried out and the design and construction of remedial measures to control future debris flows and rockfalls. Remedial measures consisted of improvement of stability of two large rockfall blocks in the debris flow channel using grouted dowels. In addition, two berms and a containment basin were constructed on the debris fan to control future debris flows and rockfalls. (Author's abstract)
W85-03426

DENUDATION AND RESERVOIR SEDIMENTATION IN MIDDLE EUROPE (FESTSTOFABTRAG UND STAURAUMVERLANDUNG IN MITTELEUROPA),
Technische Hochschule Darmstadt (German F.R.). Inst. fuer Wasserbau.
W. Schroder, and C. Theune.
Wasserwirtschaft, Vol. 74, No. 7/8, p 374-3 July/August, 1984. 2 Fig, 1 Tab, 26 Ref.

Descriptors: *Denudation, *Sedimentation, *Reservoirs, Silting, Erosion, Reservoir silting.

Denudation rates, reported in several more or less reliable sources, for about 180 catchment areas between 2.4 and 160,000 sq km were classified for four geographically similar regions and plotted over the surface area. The four regions can

separated by lines without contradiction. Thus a rough estimation of the denudation rate and consequently of the silting velocity of a projected reservoir is possible by considering global basin characteristics only. This could be improved by taking into account additional important influences of more dominant parameters. (Author's abstract)
W85-03439

SEDIMENT TRANSPORT MEASUREMENTS OF TWO NORTHERN GERMAN CREEKS (MESSUNGEN DES FESTSTOFFTRANSPORTS VON ZWEI NORDDEUTSCHEN BACHEN),
Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Wasserbau.
W. Schroder, W. Albert, and R. Schafer.
Wasserwirtschaft, Vol. 74, No. 10, p 480-486, October, 1984. 10 Fig, 3 Tab, 9 Ref.

Descriptors: *Germany (Federal Republic), *Sediment transport, *Geeste Creek, *Lune Creek, *Bremerhaven, Suspended load, Bed load, Flow discharge, Bottom resistance.

Suspended-load and bed-load transport were measured in the Geeste and the Lune, two creeks on the northern plain of the Federal Republic of Germany that enter the Weser River at Bremerhaven. The irregular cross-section of the Geeste was measured at approximately 20 m intervals starting 400 m above and ending 450 m below the 100 m measurement section to calculate a regular substitute cross-section; for the Lune, 12 cross-sections were averaged over a 760 m stretch of the creek. In order to determine discharge resistance, a vane-type meter was used to measure discharge, while hydraulic and geometric data were calculated for the substitute cross-sections and energy head for each creek. Equations are given to calculate the Darcy-Weisbach factor (total resistance), bottom resistance (composed of roughness of grains of bottom material + bed-shape resistance), and bank resistance. Collection of bottom material for bed-load measurement using a basket proved unsatisfactory, so supplementary sand traps fashioned from two baking pans placed one inside the other and set into the bed, were added. Grain-size distribution was approximately 17% fine sand (0.026-0.20 mm in diameter) for the Geeste and 7% for the Lune, and 5% coarse sand (0.6-2.0 mm diameter) for both creeks, with the remainder being medium-grain sand. Total transport for the Geeste ranged from 0.0079 to 0.0612 cu m/day and 0.0398 to 0.2445 cu m/day for the Lune. Various collection devices for suspended load were used, the best of which was a 12-V submersible pump on a track. Suspended load in mg/l ranged from 2.9 to 56.1 for the Geeste and from 3.7 to 14.6 for the Lune depending on discharge depth, flow speed, and water temperature. (Gish-IVI)
W85-03448

CARBON CYCLE AND THE RATE OF VERTICAL ACCUMULATION OF PEAT IN THE MISSISSIPPI RIVER DELTAIC PLAIN,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W85-03487

MODERN SEDIMENTATION AT FALLS DAM, UPPER MANUHERIKIA RIVER, CENTRAL OTAGO, NEW ZEALAND,
New Zealand Geological Survey, Dunedin.
D. G. Bishop, J. K. Lindqvist, D. D. Ritchie, and I. M. Turnbull.
New Zealand Journal of Geology and Geophysics, Vol. 27, No. 3, p 305-312, 1984. 8 Fig, 10 Ref.

Descriptors: *Falls Dam, *Manuherikia River, *Central Otago, *New Zealand, *Sedimentation, Silting, Lakes, Erosion rate, Reservoir silting.

Up to 60,000 t of sediment has been deposited on the floor of the lake behind Falls Dam, Central Otago, since 1935. The sediment is predominantly silty clay and clay, with associated sand near the sublacustrine river channel. No steep, foreset delta is developed, and the sediment thickens towards the dam. The accumulation rate is 10-15 mm/a over much of the lake floor. The volume of wet sediment is 61,000 cu m, which, assuming a trap efficiency of 80%, is equivalent to the annual removal of 44 t/sq km of greywacke and a mean erosion rate of 0.02 mm/a. (Author's abstract)
W85-03488

SUFFICIENT CONDITIONS FOR RIVER MEANDERING: A SIMULATION APPROACH,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2E.
W85-03566

UNIFYING THE CONCEPTS OF SCALE, INSTRUMENTATION, AND STOCHASTICS IN THE DEVELOPMENT OF MULTIPHASE TRANSPORT THEORY,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
J. H. Cushman.
Water Resources Research, Vol. 20, No. 11, p 1668-1676, November, 1984. 1 Fig, 1 Tab, 44 Ref.

Descriptors: *Stochastic process, *Multiphase transport, *Scale, *Measurement instrumentation, Time series, Mathematical equations, Autocorrelation, Ergodic process.

An attempt is made to present a generalized theory of mutiphase transport which combines the concepts of scale, instrumentation, stochastics, and time series with the development of transport equations. Physical instruments are associated with a mathematical representation of the instrument as an abstract measure. By defining the filtering process as a convolution of a measure P with a field property, the Fourier transform can be used to place plausible restrictions on an instrument in frequency space so as to make its measurement relevant to its physical environment. An ideal instrument is defined which filters out high-frequency noise and yet does not alter the structure of low frequencies. Using ideal instruments, lower frequency noise is successively filtered out in a multiscale, multiphase environment. The general context of physical settings possessing multiple scale was studied in detail. Formulas are developed to relate the autocorrelation of a field property on one scale of motion to that on any other scale while taking into account the types of instruments used in the measuring process. An equation relating the integral scale on one scale of motion to the integral scale on any other scale of motion is developed by exploiting the relationships between the autocorrelations on different scales of motion. Power spectra are developed which relate spectra on different scales to the measuring instrument used. By successively applying filtering theorems, a hierarchy of multiscale transport equations is developed. Filtered properties in the transport equations are mass averages. Different properties are allowed to be measured by different instruments and different instruments are allowed on different scales of motion and for different phases. The concept of a wide sense stationary, ergodic process is introduced to develop mass average autocorrelations and spectra over scales of motion as a function of measuring devices. (Baker-IVI)
W85-03567

SEDIMENT PRODUCTION FROM FOREST ROAD SURFACES,
Washington Univ., Seattle. Dept. of Geological Sciences.
L. M. Reid, and T. Dunne.
Water Resources Research, Vol. 20. No. 11, p 1753-1761, November, 1984. 8 Fig, 5 Tab, 13 Ref.

Descriptors: *Sediments, *Logging, *Forests, *Roads, *Soil erosion, Erosion, Paving, Road construction, Rainfall, Hydrographs.

Erosion on roads is an important source of fine-grained sediment in streams draining logged basins of the Pacific Northwest. Runoff rates and sediment concentrations from 10 road segments subject to a variety of traffic levels were monitored to produce sediment rating curves and unit hydrographs for different use levels and types of surfaces. These relationships are combined with a continuous rainfall record to calculate mean annual sediment yields from road segments of each use level. A heavily used road segment in the field area contributes 130 times as much sediment as an abandoned road. A paved road segment, along which cut slopes and ditches are the only sources of sediment, yields less than 1% as much sediment as a heavily used road with a gravel surface. (Author's abstract)
W85-03576

EFFECT OF SEDIMENT-TRANSPORTING FLOW ON THE DESIGN OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8B.
W85-03582

QUANTIFICATION OF WOOD HABITAT IN SUBTROPICAL COASTAL PLAIN STREAMS,
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 2H.
W85-03601

DISTRIBUTION OF RIVER DISCHARGED SUSPENDED MATTER IN COASTAL WATER (IN JAPANESE),
Hokkaido Univ., Sapporo (Japan). Research Inst. of North Pacific Fisheries.
M. Kajihara, Y. Fujiyoshi, and M. Kawakita.
Bulletin of the Faculty of Fisheries Hokkaido University, Vol. 35, No. 3, p 161-170, August, 1984. 9 Fig, 2 Tab, 4 Ref.

Descriptors: *Suspended sediment, *Coastal waters, *River discharge, Sedimentation, Flocculation.

Behavior of suspended matter (SM) discharged from a small river was studied in coastal water. The mean diameter of the suspended particles increases near the river mouth due to flocculation, when the SM in the river water comes in contact with the seawater and contour lines of the mean diameter extend along an axis of the river water 'plume'. On the other hand, the contour lines of the beam attenuation coefficient, which is lower farther away from the river mouth, are concave with respect to the plume axis, affected by the resultant removal of SM. The SM which has settled becomes resuspended again near the seabed and is transported offshore. In addition to flocculation, sinking and resuspension, changes in the time of the river discharge and the concentrations of SM have major effects on the distribution of SM in coastal regions. However, it is known that the ratio of concentration of SM in river water (Sr) to river discharge (Q) is almost constant for any given river. If we assume that the rate of decrease in the ratio of SM concentration to discharge in coastal regions (Delta(Ss/Q)), due to sinking and diffusion over the distance (Delta x) on the plume axis, is proportional to (Ss/Q), we can deduce that the ratio decreases exponentially as the distance from the river mouth increases. Approximately the same results are shown under different (Sr) and (Q). Using this method to study coastal regions, it may be of practical value in predicting the distribution of river discharged suspended matter. (Author's abstract)
W85-03608

DISPERSAL OF ZAIRE RIVER SUSPENDED MATTER IN THE ESTUARY AND THE ANGOLA BASIN,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 2L.
W85-03674

VERTICAL DISTRIBUTION OF SUSPENDED PARTICULATE MATTER IN THE ZAIRE RIVER, ESTUARY AND PLUME,
Oregon State Univ., Corvallis. School of Oceanography.
For primary bibliographic entry see Field 2L.
W85-03675

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SOURCES, STORAGES, AND SINKS OF FINE-GRAINED SEDIMENTS IN A FLUVIAL-ESTUARINE SYSTEM,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Geography.
W. H. Renwick, and G. M. Ashley.
Geological Society of America Bulletin, Vol. 95, No. 11, p 1343-1348, November, 1984. 7 Fig, 1 Tab, 25 Ref.

Descriptors: *Raritan River, *New Jersey, *Sediments, *Estuarine environment, Drainage basins, Path of pollutants, Sinks, Pollution management, Tidal effects, Channel morphology.

The Raritan River drains a highly urbanized and industrialized area of New Jersey. Fine grained sediments are placed into this waterway over extensive areas within the drainage basin and from Raritan Bay. These sediments are believed to be contaminated with pollutants. The transition from fluvial to estuarine conditions and seaward enlargement of the estuary due to increasing volume of tidal discharges result in a distinctive sequence of downstream changes in channel morphology, processes and sedimentary environments. These are mapped and classified as transport zones, temporary storage areas, and permanent sinks for fine sediments. Such designations can be used for more cost effective sampling. A sediment budget for the estuary indicates it is a sediment sink, with the largest input coming from landward sources. This analysis can serve as a guide to assessment and management of contaminated environments. (Baker-IVI)
W85-03677

2K. Chemical Processes

ACID GASES AND ACID IN RAIN MONITORED FOR OVER 5 YEARS IN RURAL EAST-CENTRAL ENGLAND,
Institute for Atmospheric Physics, Budapest (Hungary).
For primary bibliographic entry see Field 5B.
W85-03290

COMPOSITION AND ACIDITY OF PRECIPITATION IN HUNGARY,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
For primary bibliographic entry see Field 5B.
W85-03291

EPISODIC NATURE OF WET DEPOSITED SULPHATE AND ACIDITY,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W85-03292

SOURCE APPORTIONMENT OF RAIN WATER IMPURITIES IN CENTRAL ILLINOIS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W85-03293

ACID DEPOSITION IN RAIN OVER HILLS,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 5B.
W85-03294

CHEMICAL COMPOSITION OF RAINFALL AND WET DEPOSITION OVER NORTHERN BRITAIN,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
For primary bibliographic entry see Field 5B.
W85-03295

ESTIMATED WASHOUT COEFFICIENTS FOR SULPHUR DIOXIDE, NITRIC OXIDE, NITROGEN DIOXIDE AND OZONE,
Central Electricity Generating Board, Ratcliffe-on-Soar (England). Scientific Services Dept.
A. Martin.
Atmospheric Environment, Vol. 18, No. 9, p 1955-1961, 1984. 4 Fig, 1 Tab, 23 Ref, 1 Append.

Descriptors: *Washout, *Sulfur dioxide, *Nitric oxide, *Nitrogen dioxide, *Ozone, *Precipitation chemistry, Rain, Nitrites, Nitrates, Acid rain, Wind.

The washout coefficient of a gas in air is the fraction of it removed in unit time by rain below cloud base. The 'apparent' coefficients were estimated by statistically comparing hourly ground-level concentrations just before and at the onset of heavy, non-frontal rain. The concentrations were obtained from 5 y of continuous monitoring at a rural site. The coefficient (1/s) estimated for SO2 was (2.61 +/- 0.14) x 10 to the 5th times the rate of rainfall (mm/h). This is completely consistent with a previously published value derived from the data from 10 rural sites for one year, and both estimates are consistent with published values of dissolved SO2 in rainwater at another rural site, giving some confidence in the technique. The values of the coefficients estimated for NO and NO2 were about 40 and 80%, respectively of that for SO2. Some nitrite is found in rainwater, but not enough to explain the washout found. However, the analysers used would measure HNO3 aerosols as NO2, and these are very soluble. In addition, fast reactions are known which can convert oxides of nitrogen into soluble nitrates, present in sufficient concentration in rainwater. The statistical process leads to the coefficient estimated for O3 being negative, implying that O3 is produced at the time of rain. This is most probably due to the strong winds and turbulence which accompany heavy rain, giving replenishment of low-level O3 from upper air levels where O3 is normally produced. No systematic changes in the other gas concentrations accompany the changes in O3 values. (Author's abstract)
W85-03296

INORGANIC NITROGEN UPTAKE IN OLIGOTROPHIC LAKE TAUPO, NEW ZEALAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
J. C. Priscu, and L. R. Priscu.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, p 1436-1445, 1984. 4 Fig, 6 Tab, 67 Ref.

Descriptors: *Nitrogen uptake, *Lake Taupo, *New Zealand, Oligotrophic lakes, Carbon uptake, Ammonia, Nitrates, Isotopic tracers, Polysaccharides, Proteins, Photosynthesis, Nitrogen isotopes, Carbon radioisotopes, Phytoplankton.

To determine nitrogen and carbon uptake in the surface waters of oligotophic Lake Taupo, New Zealand, isotope tracer methods were used. Time-course measurements of NH4(+) and NO3(-) uptake at near saturating concentration revealed about a fourfold greater uptake during the first hour of incubation relative to averaged 1-6 h uptake rates. This enhanced uptake was most apparent during the first 5-10 min of incubation. Uptake kinetics experiments indicated that the N assimilation rate was generally limited by low ambient concentrations of inorganic N. The half-saturation constants for N uptake were low (< or = 10 micro-g N/L) and comparable with ambient levels of NH4(+) and NO3(-); NO3(-) uptake was always lower than NH4(+) uptake and was inhibited strongly (about 60%) in the presence of about 5 micro-g NH4(+)-N/L. Carbon to N uptake ratios averaged (+/- SD) 20.9 +/- 11.7 (grams C to grams N) and were correlated with seston compositional ratios. Polysaccharide was the major end product of photosynthesis (as measured by C-14 incorporation) in measurements made at 100 micro-E/sq m/s whereas protein was the primary end product during dark incubations. Samples enriched with NH4(+) and incubated at 100 micro-E/sq m/s showed a significant increase in the C-14 incorporated into protein, at the expense of that incorporated into polysaccharide and low molecular weight metabolites. No differences in the pathway of C flow were observed in NH4(+)-enriched, dark-incubated samples. Nitrogen uptake estimates based in the percent of C-14 in the protein fraction were similar to those calculated by the N-15 technique. (Author's abstract)
W85-03307

GEOCHEMICAL REACTIONS ASSOCIATED WITH LOW-TEMPERATURE THERMAL ENERGY STORAGE IN AQUIFERS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W85-03425

DIFFUSION OF NONREACTIVE AND REACTIVE SOLUTES THROUGH FINE-GRAINED BARRIER MATERIALS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5E.
W85-03427

PRECIPITATION CHEMISTRY AT TURRIALBA, COSTA RICA,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
C. D. Hendry, C. W. Berish, and E. S. Edgerton.
Water Resources Research, Vol. 20, No. 11, p 1677-1684, November, 1984. 5 Fig, 3 Tab, 27 Ref. NSF grants DEB-7810721 and DEB-80111361.

Descriptors: *Precipitation chemistry, *Costa Rica, *Turrialba, *Acid rain, Metals, Nutrients, Nitrogen, Phosphorus, Chemical analysis, Volcanoes, Sulfates, Hydrogen ion concentration, Acidity.

Bulk precipitation samples were collected weekly at Turrialba, Costa Rica, from March 1979 through March 1981. The samples were analyzed for pH, conductivity, major cations and anions, nutrient N and P species and 12 trace metals. Precipitation was found to contain low levels of minerals, nutrients and acidity. During the spring period of low rainfall and increased agricultural activity, high levels of chemical constituents were observed. Low rainfall rates at this time resulted in relatively low depositions. The volume weighted pH over the 2 year period was 5.34 and ranged from 4.81 to 6.35. On the basis of equivalent ratios, excess sulfate was determined to be the principal acidic anion. Excess sulfate comprised 85% of the total sulfate and may result from long-range transport, biogenic emissions, or sulfurous emission from nearby volcanic fumaroles. (Baker-IVI)
W85-03568

PEROXYACETYL NITRATE SOLUBILITY AND DECOMPOSITION RATE IN ACIDIC WATER,
Battelle Columbus Div., OH.
For primary bibliographic entry see Field 5B.
W85-03594

PHOTOCHEMISTRY OF NATURAL WATERS,
Woods Hole Oceanographic Institution, MA.
O. C. Zafiriou, J. Joussot-Dubien, R. G. Zepp, and R. G. Zika.
Environmental Science and Technology, Vol. 18, No. 12, p 358A-371A, 1984. 9 Fig, 72 Ref.

Descriptors: *Photooxidation, *Natural waters, Oceans, Chemical reactions, Ultraviolet light, Photolysis, Radiation, Chromophores, Free radicals.

Photochemical reactions may affect the photic zone, the surface sunlit layer of freshwaters, oceans, and estuarine regimes. This review surveys the area for the nonspecialist and presents results, problems, and opportunities for research. The similarities between oceans and fresh waters are striking, but the differences require caution in extrapolating conclusions from one to another. A general theme that runs throughout the available evidence is one of great complexity. Care must be taken to avoid experimental artifacts, contamination problems, and erroneous conclusions. Three aspects of this complexity that are clear are the ubiquitous importance of unknown compounds and colloids as chromophores, the involvement of complex interactions involving natural particulate materials, and

ne coexistence of a variety of free radicals and ther short lived intermediates in many natural ater systems. (Baker-IVI)
/85-03660

HEORETICAL ANALYSIS OF THE ROLE OF ROUNDWATER FLOW IN THE GENESIS OF TRATABOUND ORE DEPOSITS. 2. QUANTI-ATIVE RESULTS,
ohns Hopkins Univ., Baltimore, MD. Dept. of eography and Environmental Engineering.
. Garven, and R. A. Freeze.
merican Journal of Science, Vol. 284, No. 10, p 125-1174, December, 1984. 26 Fig, 8 Tab, 63 Ref.

escriptors: *Groundwater movement, *Ore deposits, *Gravity, Mathematical models, Simulation, opography, Stratigraphy, Metals, Permeability, edimentary basins.

umerical solution of mathematical models can be sed to study the role of gravity-driven groundater flow systems in stratabound ore formation. uites of generic simulations form the theoretical asis of a sensitivity analysis used to evaluate quantatively the effects of various parameters in the ansport models. The results of a sensitivity analys indicate that gravity-driven groundwater flow stems are capable of sustaining favorable fluidow rates, temperatures, and metal concentrations r ore formation at groundwater-discharge areas ear the edge of a basin. Under a gravity drive echanism, groundwater flows from recharge eas in the elevated regions of a foreland basin to scharge areas in lower elevation regions. Flow atterns and rates are largely dependent on the asin geometry, the water table configuration, and e subsurface variation in permeability. A gentle pographic slope and continuity in stratigraphy ill allow regional flow systems to develop over a ale of several-hundred kilometers. Variations in rmeability or perturbations of the surface or asement topography can result in the formation of cal flow systems of smaller dimensions. Quantitave modeling of transport processes in a variety of ypothetical cross sections shows that gravity iven flow provides a simple yet realistic explanaon for the mechanics of epigenetic ore formation sedimentary basins. The results also infer an ldditional application to the understanding of her basin related geologic processes such as sedient diagenesis and petroleum migration and accuulation. (Baker-IVI)
/85-03673

ADMIUM IN FRESHWATERS: CONCENTRA-IONS AND CHEMISTRY,
reater London Council (England). Environmenl Sciences Div.
. P. H. Laxen.
reshwater Biology, Vol. 14, No. 6, p 587-595, ecember, 1984. 6 Fig, 2 Tab, 31 Ref.

escriptors: *Cadmium, *Chemical speciation, Adsorption, *England, Natural waters, Chemical netics, Streams, Rivers, Lakes, Physicochemical roperties, Particulate matter.

is important to have accurate information on oncentrations of cadmium in natural waters at ackground (largely unpolluted) sites to provide a ontext within which to assess the degree of anthopogenically induced pollution. Cadmium conentrations are reported for twenty largely unpolted freshwaters in north-western England. They nge from 15 to 117 ng/l total Cd in the rivers nd streams and from 18 to 51 ng/l in the lakes, ing on the low side of values reported in the terature. The total concentration is not the only easure of interest. It is equally important to have nformation on the physico-chemical forms (speciaon), as these will influence the bioavailability of e Cd and its mobility within aquatic systems. dsorption onto natural substrates, hydrous oxides f iron and manganese, clays, etc., provides one echanism whereby the speciation can be signifiantly altered. A comparison is made between the raction of Cd found to be particulate (> 0.2 icro-m) and that which is calculated to be adorbed on particulate matter. The discrepancy beween predicted and measured values is highly variable and does not appear to depend on sample pH, alkalinity or humic concentration. The adsorption model is a poor predictor of the measured fraction of particulate Cd. The poor predictive ability of the adsorption models may be accounted for by several explanations: the K' values might be in error; a major adsorption substrates may have been omitted; there may be a non-exchangeable particulate Cd phase; the adsorption may display non-equilibrium behavior due to slow exchange kinetics. (Moore-IVI)
W85-03684

SIMULTANEOUS PRECONCENTRATION OF COPPER, NICKEL AND COBALT IN WATER BY COPRECIPITATION-FLOTATION FOR ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
For primary bibliographic entry see Field 5A.
W85-03742

ANALYSIS OF TRACE METALS IN WATER BY INDUCTIVELY COUPLED PLASMA EMISSION SPECTROMETRY USING SODIUM DIBENZYLDITHIOCARBAMATE FOR PRECONCENTRATION,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5A.
W85-03743

2L. Estuaries

DISTRIBUTION AND ACTIVITY OF BACTERIA IN THE HEADWATERS OF THE RHODE RIVER ESTUARY, MARYLAND, USA,
Northeastern Univ., Boston, MA. Dept. of Biology.
P. A. Rublee, S. M. Merkel, M. A. Faust, and J. Miklas.
Microbial Ecology, Vol. 10, p. 243-255, 1984. 4 Fig, 5 Tab, 36 Ref. NSF grant DEB 7911563.

Descriptors: *Bacteria, *Estuarine environment, *Rhode River, *Maryland, Chlorophyll, Nutrients, Phytoplankton, Biomass, Seasonal variation, Tidal waters.

Samples taken from a transect along the axis of the headwaters of a tidal estuary were evaluated for microbial, nutrient and physical parameters. Chlorophyll a averaged 42 micro g/l and phytoplankton comprised an estimated 80% of the total microbial biomass as determined by adenosine triphosphate (ATP). Bacterial concentrations ranged from 300000 to 53900000 cells/ml and comprised about 4% of the total living microbial biomass. Bacterial production, determined by H3-methylthymidine incorporation was about 0.05-2.09 x 10 to the 9th power cells/l/hr. Specific growth rates of 0.26 to 1.69/day were noted. Most bacterial production was retained on 0.2 micro m pore size filters, but passed through 1.0 micro m filters. Significant positive correlations were found between all biomass measures and most nutrient measures with the exception of dissolved inorganic nitrogen nutrients where correlations were negative. Seasonal variability was evident in all parameters and variability among the stations was evident in most. The results suggest that bacterial production requires a significant carbon input, likely derived from autotrophic production, and that microbial trophic interactions are important. (Baker-IVI)
W85-03237

SIZE STRUCTURE AND SEDIMENTATION OF BIOGENIC MICROPARTICULATES IN A SUBARCTIC ECOSYSTEM,
Oceanic Inst., Waimanalo, HI.
For primary bibliographic entry see Field 2J.
W85-03244

FISH-NURSERY USE IN GEORGIA SALT-MARSH ESTUARIES: THE INFLUENCE OF SPRINGTIME FRESHWATER CONDITIONS,
Skidaway Inst. of Oceanography, Savannah, GA.
S. G. Rogers, T. E. Targett, and S. B. V. Sant.
Transactions of the American Fisheries Society, Vol. 113, No. 5, p 595-606, September, 1984. 4 Fig, 3 Tab, 40 Ref.

Descriptors: *Ogeechee River, *Ossabaw Sound, *Georgia, *Fish nurseries, Estuaries, *Seasonal variation, Salinity, Flow discharge, Spawning, Croaker, Flounder, Perch, Hogchoker, Spots, Menhaden, Mullet.

The fish assemblage using shallow nursery habitats in the Ogeechee River-Ossabaw Sound salt-marsh estuary, Georgia, was investigated during the winter and spring of two successive years. High river discharges during these periods produced fully freshwater conditions (all tidal stages and amplitudes) in the upper portion of the study area for up to 4 months. Abundances of Atlantic croaker Micropogonias undulatus, southern flounder Paralichthys lethostigma, silver perch Bairdiella chrysoura, and hogchoker Trinectes maculatus recruits were highest in the upper estuary. Spots Leiostomus xanthurus were more evenly distributed, but continued to use upper-estuary nursery areas during periods of high river discharge. Although the recruitment of several species likely was inhibited during discharge peaks, only striped mullet Mugil cephalus avoided freshwater conditions. Spots, southern flounder, Atlantic menhaden, and silver perch utilized shallow nursery areas on a size-specific basis. Recruitment and utilization patterns of fishes spawned in deeper areas generally were maintained throughout prolonged periods (up to 100 days) of freshwater conditions. The precise function of upper-estuary nursery areas is governed by the timing and magnitude of discharge events, but remains essentially intact through the seasonal encroachment of fresh water. (Author's abstract)
W85-03246

BEHAVIOUR OF SOME PAH, PCB AND ORGANOCHLORINE PESTICIDES IN AN ESTUARY, A COMPARISON - EXE, DEVON,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5B.
W85-03286

NONTIDAL WETLAND MAPPING IN SOUTH CAROLINA USING AIRBORNE MULTISPECTRAL SCANNER DATA,
South Carolina Univ., Columbia. Dept. of Geography.
For primary bibliographic entry see Field 7B.
W85-03301

PREDICTING WATER CIRCULATION IN DELAWARE BAY AND RIVER: NOAA'S NEW APPROACH,
P. M. Wolff, and D. Konop.
Sea Technology, Vol. 25, No. 9, p 18-19 and 21-22, September, 1984. 2 Fig.

Descriptors: *Water circulation, *Currents, *Delaware Bay, *Delaware River, Estuaries, Navigation, Mathematical models, Measuring instruments, Water level, Rivers, Bays.

A numerical model is being devised which is a subset of the Blumberg-Mellor 3-dimensional estuarine/shelf model. The new model is a two-dimensional model which will not take into account the vertical variations in current speed and direction. The numerical model plays the most critical role in the project because of its potential to simulate the combined effects of astronomical and meteorological influences on a waterway. In NOAA's Delaware Bay and River Circulation Modeling Project, water levels, river stages, and meteorological conditions will be the input parameters - the drivers of the model. The model will use National Ocean Service historical records of water levels, as well as water circulation data recently collected by the ship Ferrel, which is doing the field work. The locations where current data are most important are in navigational channels. A new type of cur-

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rent meter is being used to gather data for the model - a remote acoustic Doppler System, or RADs for short. This current sensing system can be mounted on the bottom of a channel out of harm's way to measure the flow in the water column from near the top to near the bottom. (Baker-IVI)
W85-03338

INFLUENCE OF WAVES AND SEAGRASS COMMUNITIES ON SUSPENDED PARTICULATES IN AN ESTUARINE EMBAYMENT,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
L. G. Ward, W. M. Kemp, and W. R. Boynton.
Marine Geology, Vol. 59, No. 1/4, p 85-103, July, 1984. 6 Fig, 3 Tab, 46 Ref. EPA contract X003248010.

Descriptors: *Suspended solids, *Waves, *Sea grasses, *Estuarine environment, *Chesapeake Bay, Bays, Resuspension, Particulates, Aquatic plants, Storm surges, Tidal effects, Sedimentation rate.

Resuspension of bottom sediments by waves, corresponding changes in suspended particulate material (SPM) concentrations in the overlying water column, and transport pathways of SPM were investigated in a shallow estuarine embayment colonized by seagrass communities in Chesapeake Bay. In shallow (< 2 m), unvegetated regions significant resuspension of bottom sediments was evident when northerly winds exceeded 25 km/h, increasing SPM concentrations up to 10-fold. High concentrations of SPM generated by resuspension dissipated rapidly (within 24 h) after winds became calm. Patterns of SPM along the embayment's depth gradient suggest that part of this resuspended material was transported offshore into deeper reaches of the estuary. In areas of the embayment colonized by seagrasses, wave energy was attenuated by the vegetation, suppressing resuspension and enhancing deposition. As a result, SPM concentrations were significantly lower inside seagrass beds than in adjacent unvegetated areas. During periods of high winds when wave induced resuspension occurred in unvegetated areas, SPM concentrations remained unchanged inside the bed at normal water levels. However, when water levels were elevated by spring tides or storm surges, plants were less effective at attenuating wave energy, and SPM concentrations increased inside the seagrass bed due to resuspension and advective processes. Calculations based on the results of this study indicate that sedimentation rates are substantially higher in seagrass communities than in unvegetated areas. (Author's abstract)
W85-03347

TURBULENCE MEASUREMENTS OVER A SAND WAVE IN LOWER CHESAPEAKE BAY, VIRGINIA,
Instituto Argentino de Oceanografia, Buenos Aires.
G. M. E. Perillo, and J. C. Ludwick.
Marine Geology, Vol. 59, No. 1/4, p 283-304, July, 1984. 10 Fig, 2 Tab, 46 Ref.

Descriptors: *Chesapeake Bay, *Virginia, *Turbulence, *Sand waves, Shear stress, Wind waves, Kinetic energy, Suspended sediments, Estuaries.

Measurements of turbulent shear stress 5 cm above a sediment bed are described for five stations distributed along a transverse profile of an estuarine sand wave in lower Chesapeake Bay, Virginia, U.S.A. Time series analyses of the velocity data reveal three kinds of constituents: (1) components of long period; (2) wind wave components; and (3) turbulence. The energy in the turbulent part of the records is highly attenuated in comparision with that of the low frequency components. Furthermore, at all except the lowermost frequencies, the energy contained in the horizontal component of the flow is less than that contained in the vertical component. The excess energy at the low frequency part of the spectrum as compared to the high frequency part is explained by: (1) the input of energy from wind waves; (2) damping of turbulence; or (3) both causes. The first evidently is the main cause. Suspended sediments and stable density stratification reduce turbulence, but they act mainly on the vertical component. A schematic model, presented here, indicates that oscillating flow over a rugose bed induces additional fluctuations in the vertical component. Estimates of Reynolds shear stress are small and most are negative. Time series plots of the Reynolds stress show: (1) small spikes in all records in which the instantaneous shear stresses are very close to zero; and (2) intermittent large spikes. In most instances, within a spike, the fluctuating horizontal component of the turbulent velocity, u, and the vertical counterpart, w, are of the same sign and (w) > (u). These results are in agreement with the proposed model of flow over rippled surfaces. The findings and concepts developed in the study indicate that even though a flow over the bed actually produces a significant boundary shear stress, it cannot be properly measured very close to the bottom based on the Reynolds stress idea. When making nearbed measurements in turbulent flows in open waters with tidal currents, surface waves, stable density structures, a rugose bed and with sediment in suspension, one may encounter a reduction in turbulence and a degradation of the usual correlation between u and w. Under these conditions the profile method for determining the shear stress, using mean flow values, may be more reliable. (Author's abstract)
W85-03348

OBSERVATIONS OF WIND-INDUCED, SUBTIDAL VARIABILITY IN THE DELAWARE ESTUARY,
Delaware Univ., Newark. Coll. of Marine Studies.
K.-C. Wong, and R. W. Garvine.
Journal of Geophysical Research, Vol. 89, No. C6, p 10589-10597, November 20, 1984. 12 Fig, 14 Ref.

Descriptors: *Estuaries, *Delaware Estuary, *Chesapeake Bay, *Water level fluctuations, *Chesapeake-Delaware Canal, *Wind effects, *Tidal effects, Water currents, Tidal waters, Bays, Water level, Forcing.

Sea level and current observations made in the Delaware estuary during autumn of 1982 were examined for evidence of wind-forced subtidal variability. Subtidal sea level fluctuations at the mouth of the Delaware estuary were forced primarily by wind stress nearly parallel to shore. A positive longshore wind stress along 050 degree T produced a drop in coastal sea level, indicating Ekman transport to the right of the wind. The subtidal sea level in the interior of the estuary could not be adequately represented by the effect of remote coastal forcing through the mouth alone. Local wind forcing was insignificant. The interior subtidal sea level was driven by the wind through a combination of two remote forcing mechanisms: one from the mouth of the Delaware through the direct estuary-shelf coupling and a second from the upper Chesapeake Bay via the Chesapeake and Delaware Canal. Remote forcing from the mouth of the estuary was the major factor in producing subtidal sea level fluctuations within the estuary. In the upper Delaware estuary predominately barotropic subtidal current fluctuations were found superimposed on a much weaker two-layer gravitational circulation field. These fluctuations were produced primarily by the local subtidal surface slope generated by the differences between the two remote forcing mechanisms. Coupling with the upper Chesapeake is especially important to the subtidal current response in the interior of the estuary. (Baker-IVI)
W85-03409

NUMERICAL NOISE IN OCEAN AND ESTUARINE MODELS,
Geological Survey, Menlo Park, CA.
R. Walters, and G. F. Carey.
Advances in Water Resources, Vol. 7, No. 1, p 15-20, March, 1984. 7 Fig, 9 Ref.

Descriptors: *Numerical noise, *Estuarine environment, *Mathematical models, *Shallow water equations, Dispersion, Wavelengths, Model studies.

Approximate methods for solving the shallow water equations may lead to solutions exhibiting large fictitious, numerically-induced oscillations. The analysis of the discrete dispersion relation and modal solutions of small wavelengths provides a powerful technique for assessing the sensitivity of alternative numerical schemes to irregular data which may lead to such oscillatory numerical noise. For those schemes where phase speed vanishes at a finite wavenumber or there are multiple roots for wavenumber, oscillation modes can exist which are uncoupled from the dynamics of the problem. The discrete modal analysis approach is used here to identify two classes of spurious oscillation modes associated respectively with the two different asymptotic limits corresponding to estuarine and large scale ocean models. The analysis provides further insight into recent numerical results for models which include large spatial scales and Coriolis acceleration. (Author's abstract)
W85-03475

MEASURING INTERTIDAL WAVE FORCES,
Washington Univ., Seattle. Dept. of Zoology.
S. R. Palumbi.
Journal of Experimental Marine Biology and Ecology, Vol. 81, No. 2, p 171-179, October, 1984. 3 Fig, 1 Tab, 30 Ref. National Academy of Sciences Joseph Henry Fund grant 199 and NSF grant 80-25578.

Descriptors: *Wave force, *Intertidal areas, *Measuring instruments, *Tatoosh Island, *Washington, Waves, Ecology, Niches.

In marine environments, wave action appears to be a potent agent determining species presence, abundance, and distribution; relative wave forces are commonly estimated by subjective categorization of sites as either 'exposed' or 'protected'. A small, inexpensive device was developed that measures forces due to wave action in the range of 2 to 20 N, allowing quantification of most accessible intertidal exposures. Maximum wave force measurements were taken at six intertidal sites, differing in wave action, from June through October, 1983 on Tatoosh Island in Washington State. Measurements using this technique agree well with subjective rankings of wave action at the study sites and with wave forces measured at these sites by other methods. (Author's abstract)
W85-03493

TIDAL VARIATIONS OF SOME PHYSICOCHEMICAL PARAMETERS IN BLANCA BAY, ARGENTINA,
Instituto Argentino de Oceanografia, Buenos Aires. Lab. de Quimica Marina.
M. S. O. Storni, R. J. Lara, and A. E. Pucci.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 4, p 485-491, October, 1984. 5 Fig, 7 Ref

Descriptors: *Estuaries, *Bays, *Blanca Bay, *Argentina, *Physicochemical properties, Tidal waters, Oxygen, Nutrients, Acidity, Temperature effects, Salinity.

The Blanca Bay is located in southeastern Buenos Aires province. Oxygen, alkalinity, nutrients, pH, temperature and salinity were measured through tidal cycles at two points in Blanca Bay. Puerto Cuatreros, located in the inner part of the estuary is fed by the fresh water of the Sause Chico river which receives food industry waste discharges. Farola 2 is situated in the principal navigation channel, in a zone with continuous dredging operations. The dependence of salinity on freshwater input at low tide was evident at Puerto Cuatreros but attenuated at Farola 2. The method for measuring primary production in flowing waters is not considered applicable in Puerto Cuatreros because of the close dependence between oxygen concentration and salinity changes during the tidal cycle. A relationship with an inverse proportionality between soluble silica concentration and salinity was obtained. A direct relation between nitrate, nitrite, phosphate and salinity was found, but the correlations were not very good. It becomes evident that the correct selection of tide conditions is critical for the different parameters to be measured, pe

ularly when studying nutrient cycling. (Baker-I)
85-03498

IYSICAL HYDROLOGY OF A LAGOON STEM ON THE PACIFIC COAST OF EXICO,
verpool Univ., Port Erin (England). Dept. of arine Biology.
H. Moore, and D. J. Slinn.
tuarine, Coastal and Shelf Science, Vol. 19, No. p 413-426, October, 1984. 4 Fig, 3 Tab, 23 Ref.

escriptors: *Hydrologic cycle, *Lagoons, lexico, Caimanero-Huizache lagoons, Evaporan, Precipitation, Saline water, Coastal waters, dal basins.

ıe annual hydrological cycle of the Caimanerouizache lagoon system on the Pacific coast of exico was investigated during 1977-1978. There a well defined wet season during which the goons fill with water derived from fluvial inputs d direct precipitation. Water is lost by evaporan and outflow to the sea, the latter process rting as the wet season progresses and being cilitated by a falling mean sea level. Evaporation ceeds in situ precipitation and during the dry ason complete desiccation may be prevented by now rising mean sea level which promotes the ow of seawater into the lagoon basin. A quantitave estimate of the magnitude of these controlling ocesses is presented and processes bringing about ixing in the lagoons discussed. A brief comparin is made with other lagoon systems on the cific coast of Mexico. (Author's abstract)
'85-03499

NALYSIS OF SEAWEED COMMUNITIES IN DISTURBED ROCKY INTERTIDAL ENVIONMENT NEAR WHITES POINT, LOS ANELES, CALIF., U.S.A.,
alifornia State Univ., Fullerton. Dept. of Biologil Science.
N. Murray, and M. M. Littler.
ydrobiologia, Vol. 116/117, p 374-382, 1984. 3 g, 1 Tab, 50 Ref. Dept. of the Interior contract A550-CT6-40.

escriptors: *Seasonal variation, *Population dyamics, *White Point, *California, Algae, Intertial waters, Ecological distribution, Intertidal zone, yanophyta.

n overview was sought of the seasonal dynamics the standing stocks of the seaweeds inhabiting ıe disturbed rocky intertidal shoreline near Vhites Point. An analysis of the composition of ıe Whites Point seaweed communities based upon cologically related functional-form groups is also resented. Seaweed cover averaged 72.5% over ıe entire rocky intertidal shoreline and ranged om 60.8% to 92.5% during the 2.5 years of study. enerally, cover was greatest during late summer nd was least during winter. Greatest algal cover as contributed by encrusting blue-green algae. Iost seaweeds exhibited variations in percent over from season to season and year to year, but igartina canaliculata, G. leptorhynchos, Egregia enziesii, Chondria californica, Laurencia sinicola nd to a lesser extent Ceramium spp., were species hat generally reached greatest cover in late ummer-fall and least cover during winter. A total f 67 different algal taxa occurred in the samples, lthough an average of only 42 seaweeds was btained per seasonal assessment. Seaweeds exhibting mean cover values over the 2.5 yr period vere categorized according to functional group. (Baker-IVI)
W85-03502

BEHAVIOUR OF DISSOLVED ARSENIC IN THE ESTUARY OF THE RIVER BEAULIEU,
Southampton Univ. (England). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W85-03631

BEHAVIOUR OF DISSOLVED SILICA DURING THE MIXING OF RIVER AND SEA WATERS IN TOKYO BAY,
Tokyo Univ. of Fisheries (Japan). Lab. of Marine Chemistry.
For primary bibliographic entry see Field 2H.
W85-03632

DISSOLVED CHROMIUM IN THE ST. LAWRENCE ESTUARY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
J. A. Campbell, and P. A. Yeats.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 5, p 513-522, November, 1984. 3 Fig, 2 Tab, 24 Ref.

Descriptors: *Chromium, *St. Lawrence estuary, *Gulf of St. Lawrence, *Trace metals, *Estuarine environment, Salinity, Turbidity, Suspended sediments, Path of pollutants.

The distribution of dissolved chromium in the St. Lawrence estuary and Gulf of St. Lawrence was studied using filtered water samples collected from 28 sites during a September 1979 research cruise. A chromium concentration of 0.7 micro g/l was found in the St. Lawerence River. In the turbidity maximum of the upper estuary, chromium is removed from solution onto fine-grained resuspended sediments and internally produced organic-rich floccules. Removal of chromium occurs in the upper estuary only between salinities of 0 and 5%. At estuarine salinities in excess of 5% and through the Gulf no discernible removal was observed. Since the removal occurs at such low salinities, it may be more meaningful to compare the removal to the river flux only. In that case, the removal amounts to 50% of the river flux. (Collier-IVI)
W85-03633

CALIBRATION STUDIES CONCERNING A ONE-DIMENSIONAL NUMERICAL TIDAL MODEL WITH PARTICULAR REFERENCE TO RESISTANCE COEFFICIENTS,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. G. Wallis, and D. W. Knight.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 5, p 541-562, November, 1984. 20 Fig, 26 Ref. Natural Environmental Research Council contract GR3/2810.

Descriptors: *Wales, *Boundary conditions, *Numerical analysis, *Model studies, *Tides, *Resistance, Shear stress, Estuaries, Tidal rivers.

Since the hydrodynamics of flow in most shallow estuaries is dominated by the boundary resistance, the selection of appropriate values for the roughness coefficients in any numerical tidal model is important. The paper describes studies involving the intra-tidal variation of resistance coefficients in twelve reaches of the Conwy estuary in North Wales. Resistance coefficients are evaluated for six water levels data sets covering the neap to spring tidal variation by cubature based and parameter estimation techniques. Results from these two inverse methods are shown to agree well despite somewhat different schematizations for the estuary. A direct check on the intra-tidal variation of resistance coefficients at one particular reach is made possible by specifically gathered field data described in an earlier paper by Knight. In general the resistance coefficients exhibit three basic trends - a strong stage dependence, a flow directional dependence due to flood or ebb dominated bed forms, and a high variability with location along the estuary, especially where sand banks are exposed at low water. The optimized resistance coefficients are then used in a one-dimensional numerical tidal model in order to ascertain the effect of particular modes of calibration. Estuary mean errors in water levels are of the order of 2, 5 and 16 cm for the three calibrations tested. (Author's abstract)
W85-03635

NUMERICAL SIMULATION OF PHYTOPLANKTON PRODUCTIVITY IN PARTIALLY MIXED ESTUARIES,
Geological Survey, Menlo Park, CA.
D. H. Peterson, and J. F. Festa.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 5, p 563-589, November, 1984. 11 Fig, 2 Tab, 109 Ref, 1 Append.

Descriptors: *Estuarine environment, *Numerical analysis, *Simulation analysis, *Mixing, *Phytoplankton, *Productivity, Light penetration, Water circulation, Turbidity, Biomass, Suspended sediment, Plankton.

A two-dimensional steady-state model of light-driven phytoplankton productivity and biomass in partially mixed estuaries has been developed. Effects of variations in river flow, suspended sediment concentration, phytoplankton sinking, self-shading and growth rates on distributions of phytoplankton biomass and productivity are investigated. Numerical simulation experiments show that biomass and productivity are particulary sensitive to variations in suspended sediment concentrations typical of natural river sources and to variations on loss rates assumed to be realistic but poorly known for real systems. Changes in the loss rate term within the range of empirical error (such as from dark bottle incubation experiments) cause phytoplankton biomass to change by a factor of two. In estuaries with adequate light penetration in the water column, it could be an advantage for phytoplankton to sink. Species that sink increase their concentration and form a phytoplankton maximum in a way similar to the formation of the estuarine turbidity maximum. When attenuation is severe, however, sinking species have more difficulty in maintaining their population. (Author's abstract)
W85-03636

DISPERSAL OF ZAIRE RIVER SUSPENDED MATTER IN THE ESTUARY AND THE ANGOLA BASIN,
Nederlands Inst. voor Onderzoek der Zee, Texel.
D. Eisma, and J. Kalf.
Netherlands Journal of Sea Research, Vol. 17, No. 2-4, p 385-411, 1984. 9 Fig, 1 Tab, 43 Ref.

Descriptors: *Estuaries, *Particulate matter, *Zaire River, *Angola Basin, Suspended solids, Plumes, Sedimentation, Turbidity, Velocity, Mixing.

During two cruises in November 1976 and May 1978, the suspended matter distribution in the Zaire estuary, on the shelf and in the adjacent ocean was studied. The concentrations decreased from about 30 g/cu m in the river to less than 0.05 g/cu m in the ocean, with higher turbidity in the surface water and near the bottom. A strong decrease in concentration was found in the estuary where the surface water looses about half its suspended matter between the head of the canyon and the river mouth in spite of current velocities of 1.5 and 2.6 m/s. In the surface water the turbidity is determined by particle supply through the river plume, mixing and particle settling, and particle aggregation in the surface water and disaggregation at greater depth down to the oxygen minimum. The particle size distribution of the suspended material shows a gradual decrease in size from the river and the estuary towards the ocean, reflecting settling out of the larger sized particles. The suspended matter supplied by the Zaire river is partly deposited on the shelf north of the river mouth and partly on the continental slope and on the ocean floor or is supplied to the ocean surface water through the river plume which extends as far as 800 km from the river mouth. Turbulent mixing of the particulate suspended matter is considered to be far more rapid than supply or settling of the particles. (Baker-IVI)
W85-03674

VERTICAL DISTRIBUTION OF SUSPENDED PARTICULATE MATTER IN THE ZAIRE RIVER, ESTUARY AND PLUME,
Oregon State Univ., Corvallis. School of Oceanography.
H. Pak, J. R. V. Zaneveld, and R. W. Spinrad.
Netherlands Journal of Sea Research, Vol. 17, No. 2-4, p 412-425, 1984. 8 Fig, 19 Ref.

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Descriptors: *Zaire River, *Zaire Estuary, *Estuaries, *Plumes, *Vertical distribution, *Suspended matter, Particulates, Salinity, Tidal waters.

Light transmission and hydrographic data were measured in situ simultaneously in the Zaire river estuary and on the shelf off the river extending to the Angola Basin. Profiles of light transmission indicate that the majority of the particles derived from the river are transported offshore into the Angola Basin through deep waters under the surface plume. The Zaire river is associated with a submarine canyon which extends well into the Zaire estuary and cuts across the shelf. Bottom nepheloid layers were well developed along the canyon axis. The sediments along the canyon axis were mostly sands, and thus the submarine canyon appears to provide an efficient transport route for finegrained material to the Angola Basin across the shelf. The surface plume is so highly stratified that vertical mixing appears very limited across the plume boundary, and downward transport of suspended prticles must be accomplished by particle settling. Profiles containing small-scale layers of turbid water under the surface plume are considered indications of settling particles from the surface river plume. (Baker-IVI)
W85-03675

PARTICULATE AND DISSOLVED ORGANIC CARBON AND CHLOROPHYLL A IN THE ZAIRE RIVER, ESTUARY AND PLUME,
Nederlands Inst. voor Onderzoek der Zee, Texel.
G. C. Cadee.
Netherlands Journal of Sea Research, Vol. 17, No. 2-4, p 426-440, 1984. 4 Fig, 4 Tab, 36 Ref.

Descriptors: *Estuaries, *Zaire River, *Chemical analysis, *Organic carbon, *Chlorophyll a, Plumes, Organic matter, Carbon, Suspended solids, Phytoplankton, Salinity, Eutrophication.

Data were collected on particulate organic carbon (POC), dissolved organic carbon (DOC), and phytoplankton in the Zaire river, estuary and plume. Mean river value of POC was 1.1 mg/l, 4.7% of the suspended matter. Average DOC content of the river water was 8.5 mg/l. These values are in accordance with the calculations of TOC input from rivers to the world's ocean. Within the estuary POC and chlorophyll decreased regularly up to a salinity of 20. Between salinities of 20 and 32 small phytoplankton bloom occurred resulting also in higher POC values. DOC mixed conservatively up to a salinity of 25; at salinities above 25, values indicate DOC production. This DOC production occurred partly in the bottomwater of the canyon where low oxygen values indicated mineralization and conversion of the accumulated POC into DOC. Another area of DOC production observed inside and outside the surface waters of the plume, was partly related to autolysis and degradation of the phytoplankton bloom. The influence of rivers on the organic carbon in the ocean is not confined to the amount introduced directly; the amounts of POC and COD resulting from enhanced phytoplankton primary production by nutrient input from rivers and by river induced upwelling must be included. (Baker-IVI)
W85-03676

SOURCES, STORAGES, AND SINKS OF FINE-GRAINED SEDIMENTS IN A FLUVIAL-ESTUARINE SYSTEM,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W85-03677

PHYTOPLANKTON BIOMASS OF EBRIE LAGOON (IVORY COAST) (BIOMASSES PHYTOPLANCTONIQUES DE LA LAGUNE EBRIE (COTE D'IVOIRE)),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
A. Iltis.
Hydrobiologia, Vol. 118, No. 2, p 153-175, November, 1984. 13 Fig, 4 Tab, 28 Ref.

Descriptors: *Ebrie Lagoon, *Ivory Coast, *Phytoplankton, *Biomass, Brackish water, Chlorophyll a, Seasonal variation, Cyanophyta, Chlorophyta, Diatoms, Pyrrophyta, Euglenophyta, Salinity.

Ebrie Lagoon is a shallow brackish water body with a main depth of 4.8 m and an area of 566 sq km. The phytoplankton was surveyed at 43 stations in each of the three main ecological seasons (dry season, rainy season, and flood season). The salinity was very variable in space and time, reaching a maximum of 30 0/00 during the dry season near the outlet to the sea. The mean cell biomass was 3.2 mg/l during the rainy season and 2.0 during flood season and dry season. The mean chlorophyll a content was 16.4 mg/cu m during dry season, 13.3 during rainy season and 10.3 during the flood. Cyanophyceae, Chlorophyta, diatoms and Pyrrhophyta were the most common algal groups in the biomass. Euglenophyta were only well represented in the urban zone. In spite of large fluctuations in distribution of phytoplankton all during the year, five main ecological zones have been identified, according to their algal communities: a large western part, two annex lagoons, an eastern part, an urban zone and a central part. A rough estimate of the phytoplanktonic supply by the tributaries and of the phytoplanktonic loss through the Vridi Channel showed that the latter was 52 times higher for the chlorophyll a content than if the streams flowed directly to the ocean. (Moore-IVI)
W85-03693

GULF OF FOS (FRANCE): MAIN HYDROLOGICAL FEATURES (1976-1978),
Centre Univ. de Luminy, Marseille (France).
R. Arfi.
Hydrobiologia, Vol. 118, No. 2, p 187-197, November, 1984. 7 Fig, 4 Tab, 20 Ref.

Descriptors: *Gulf of Fos, *France, *Hydrology, *Estuaries, Salinity, Nutrients, Water pollution, Nitrates, Phosphates, Heavy metals, Chlorinated hydrocarbons, Wind, Water temperature.

Surrounded by a heavily industrialized area, receiving the waters of de Etang de Berre (itself situated in a large industrial zone) and partly affected by the Rhone waters, the Gulf of Fos has become increasingly polluted. Neither an estuary, nor a pure sea gulf, the Gulf of Fos is an unbalanced neritic zone. Its distrophic character is accentuated by the numerous continental discharges, although a serious attempt at purification has been made over the last few years. The climatic instability which characterizes this region (irregular periods of winds, fluvial risings) reinforces the changing ecological conditions in the gulf waters. Through a synthesis of hydrological and pollution data obtained between 1976 and 1978, the main features regulating the gulf water ecological development are described by Principal Components Analysis. Salinity and its variations appear to be the main regulator in the zone close to an estuary. A large quantity of suspended matter, nutrients and diverse polluting compounds are associated with the fresh or brackish waters. Depending on the prevailing winds, the water will either directly affect the Gulf of Fos, or be chased away to the open sea. The cold season is characterized by maximum freshwater flow and homothermous conditions; the hot season is characterized by low flow and the presence of a thermocline associated with a strong density gradient. Nitrate and phosphate concentrations in the Gulf of Fos are among the highest values observed in the northwestern Mediterranean area. Pollution by heavy metals, and organochlorine compounds seems to be the main consequence of human action on the waters of the gulf. (Moore-IVI)
W85-03695

INFLUENCE OF SULPHIDE ON THE DISTRIBUTION OF HIGHER PLANTS IN SALT MARSHES,
Birkbeck Coll., London (England). Dept. of Botany.
A. Ingold, and D. C. Havill.
Journal of Ecology, Vol. 72, No. 3, p 1043-1054, November, 1984. 5 Fig, 3 Tab, 16 Ref.

Descriptors: *Sulfides, *Salt marshes, *Plants, *Canvey Island Point, *England, Ecological distribution, Marshes, Sediments, Redox potential, Sa pans, Stream sediments.

Field work was carried out on the salt marsh Canvey Island Point on the Essex coast of t river Thames estuary (England). Soluble sulfide surface (0-5 cm) salt marsh sediments was detect ble only on the lower marsh, salt pans and cre beds. Of the vascular plant species present on t lower-marsh only Salicornia europaea was root in sulfide-containing sediments. No significant co relation was observed between soluble sulfide co centration and redox potential in soil samples fro the lower-marsh. When eight salt marshes fro around the coast of Britain were compared, six h a detectable sulfide concentration in the lowe marsh sediments. In all cases the most significa association was between S. europaea and otherwi bare ground. In two marshes where no solub sulfide could be measured, S. europaea was asso ated with other plant species rather than ba ground. Monthly observations of plant cover a sulfide concentration in sixteen permanent quadra on the lower marsh revealed a significant positi correlation between the cover of S. europaea a soil sulfide. In contrast, Puccinellia maritin showed a significant negative correlation with s fide concentration. In liquid media, the growth other marsh plants was significantly inhibited sulfide whereas there was no marked effect on th of S. europaea. S. europaea is relatively tolerant sulfide and is able to establish on areas of the low marsh from which other species are excluded the presence of sulfide. (Moore-IVI)
W85-03741

FORMS OF PHOSPHORUS AND PHOSPH RUS-IRON RELATIONSHIPS IN THE SU PENDED MATTER OF THE ST. LAWRENC ESTUARY,
McGill Univ., Montreal (Quebec). Geotechnic Research Centre.
M. Lucotte, and B. D'Anglejan.
Canadian Journal of Earth Sciences, Vol. 20, N 12, p 1880-1890, December, 1983. 6 Fig, 4 Tab, Ref.

Descriptors: *Estuaries, *St Lawrence Estua *Phosphorus, *Iron, Chemical reactions, Wa analysis, Suspended sediments, Iron hydroxi Mixing, Turbidity, Salinity, Orthophosphate.

The partition of phosphorus between the orga fraction and both the detrital and non-detrital fr tions was studied in the particulate matter of St. Lawrence Estuary and two of its tributari Between 30 and 50% of the total mass of partic late P going through the estuary annually is ma up of mineral matter that is not available for b logical use. Between 20 and 25% of the to particulate P is surface adsorbed on iron hydroxi precipitates. Continuous stirring and sediment re spension in the zone of maximum turbidity moves any clear indication of Fe flocculation a of related phosphate adsorption during early est rine mixing, as is suggested by experimental wo and field observations in other estuaries. So evidence of P removal on Fe-rich suspended pa cles in the low salinity, high turbidity region of estuary is provided by a lower atom ratio of non-detrital Fe and P fractions there, as compa with its value both in the freshwater zone below the maximum turbidity zone (MTZ). P sorption seaward of the MTZ, if it takes place all, is only minor as the ratio of particulate dissolved orthophosphate occurs everywhere c siderably above its theoretical equilibrium valu and since dissolved orthophosphate appears c servative through the estuary. The seaward crease in dissolved phosphate is due to the int sion and admixing of P-rich deep waters from Laurentian Trough into the estuary, not to deso tion. Not enough fine grained deposits may ac mulate today in the estuary to create the low re sedimentary environments favorable to the rele of surface absorbed particulate P to the wa column. (Baker-IVI)
W85-03764

. WATER SUPPLY AUGMENTATION AND CONSERVATION

B. Water Yield Improvement

ROBLEMS OF WATER VOLUME BALANCE N THE SPREE RIVER DISTRICT IMPACTED Y MINING OPERATIONS (PROBLEME DER VASSERMENGENBILANZ IM BERGBAU-EEINFLUSSTEN SPREEGEBIET),
Vasserwirtschaftsdirektion Obere Elbe-Neisse, Dresden (German D.R.).
. Winkler.
Vasserwirtschaft-Wassertechnik, Vol. 33, No. 6, p 87-190, June, 1983. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Spree River, *Coal mines, *Germany (Democratic Republic), *Groundwater hydrology, Water management, Resources management, Groundwater recharge.

Intensified mining of the Lausitz seam of brown coal in the Spree river catchment area of the German Democratic Republic since 1960 has led to a lowering of the groundwater table and large volumes of pit water. The area affected covers 1,025 sq km and is expected to increase by 1,300-1,500 sq km by the year 2000. Mining intensification has been paralleled by increased industrial and agricultural water use, presenting problems in balancing water resources. Water losses in industry task increased flow in the Spree; when these are allowed for, a flow increase of 36.2% of total pit water raised can be seen, with a pit-water increase of 19.6 cu m/sec for the years 1950-1980. This knowledge is however insufficient to effect a balancing of water volume and water control. Experience has shown that the influence of pit water is greater during low water than at high water, but proof of this is difficult because flow distribution varies from year to year while pit water increases. On the basis of comparisons of annual flow distribution between the years 1976-1979 and 1952-1965 which were influenced only slightly by pit water), which corroborated this experience, water volume balancing was carried out using data from earlier years with little pit water impact plus an added 10% to account for pit water in the current year. This procedure has the advantage that it can be used for stochastic simulation, but disadvantages include misrepresentation of river sections within the lower water-table area, non-utilization of data after 1960, and inaccuracy due to the blanket 50% figure. Balancing is currently performed by using statistics from the years since 1960 in which flow was most influenced by pit-water extraction and by allowing for both water losses and total pit water extracted for the year being balanced. Advantages of this method are use of known pit-water extraction figures, applicability within the lowered water-table area, and better knowledge of water usage and other anthropological influences. (Gish-IVI)
W85-03515

EFFORTS TOWARD A BASIC ECONOMIC STUDY AND PLANNING OF THE DRINKING-WATER SUPPLY IN THE UPPER SPREE REGION AS A BASIS FOR CAPITAL INVESTMENT (ARBEITEN ZUR GRUNDFONDS-WIRTSCHAFTLICHEN UNTERSUCHUNG UND PLANUNG DER TRINKWASSERVERSORGUNG IM OBEREN SPREEGEBIET ALS GRUNDLAGE DER INVESTITIONSTATIGKEIT),
VEB Projektierung Wasserwirtschaft, Cottbus (German D.R.).
G. Mosch, and H. Wunsche.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 6, p 191-192, June, 1983.

Descriptors: *Germany (Democratic Republic), *Upper Spree Region, *Zittau, *Economic aspects, *Long-term planning, Water requirements, Water supply development, Water resources development, Coal mining, Pit water, Groundwater potential.

In 1969, the Dresden (German Democratic Republic, GDR) water and wastewater treatment facilities charged the Cottbus section of the Water Management Planning Commission with studying the water-supply area for the Zittau region (covering the southeast GDR with 344,000 inhabitants) with the goal of developing measures to secure the water supply to the year 2000. The region was divided into subsections according to type of water supply, matching of supply and demand, and geography; and a concept for covering demand was worked out for each subsection. This resulted in timely preliminary studies toward future capital investment. Recent figures show that about 15% of the supply is lost through drinking water being used by industry, demonstrating a need for rational water use measures; an 80% increase in supply will be needed by 2000, a portion of which will have to be imported from other areas. The major part of capacity increase should occur through the expansion of the Sdier waterworks, the largest facility in the Zittau area. Three new waterworks will be constructed to utilize available groundwater, and 300 km of new pipes will be laid. The success of this study has led to a similar investigation of a brown-coal mining area within the former Spree-Oder-Neisse water district, begun in 1973. The water supply was endangered by a lowering of the water table caused by intensified mining, only 3/10 waterworks being unaffected. A solution for the Boxberg water-supply subsection was to construct a new water-treatment plant (15,000 cu m/day, start-up 1983) to utilize pit water. After the expected shut-down of the waterworks at the town of Weisswasser, which will need 22,500 cu m water/day in 2000, water will be supplied via a 20-km pipeline from a gas combine. A further similar study is being performed for the coal fields near Cottbus. (Author's abstract)
W85-03516

CHANGES IN STREAMFLOW IN AN HERBICIDE-TREATED PINYON-JUNIPER WATERSHED IN ARIZONA,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
M. B. Baker, Jr.
Water Resources Research, Vol. 20, No. 11, p 1639-1642, November, 1984. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Arizona, *Herbicides, *Forest watersheds, *Water yield improvement, *Streamflow, Watersheds, Vegetation, Watershed management, Pinyon trees, Juniper trees.

A 147-ha pinyon-juniper watershed in north central Arizona was sprayed with a herbicide mixture to kill all overstory vegetation. After 8 years of postherbicide evaluation, the dead trees were removed. The herbicide treatment induced an increase in annual streamflow of about 157%. There is an indication that after the dead trees were removed, streamflow was reduced to near-pretreatment levels. Water yields can be increased on basins with volcanic soil by chemically killing the pinyon-juniper overstory and leaving the dead trees standing. This increase can be expected about 1 out of every 2 years when precipitation equals or exceeds the winter average. Therefore a management system may be devised where dispersed upland pinyon-juniper basins could be chemically treated to provide some additional water yield. Managers, however, must recognize that these treated areas may not be esthetically pleasing to much of the public and that the use of chemicals in opposed by many people. (Baker-IVI)
W85-03563

CONVERSION OF ARIZONA CHAPARRAL TO GRASS INCREASES WATER YIELD AND NITRATE LOSS,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
E. A. Davis.
Water Resources Research, Vol. 20, No. 11, p 1643-1649, November, 1984. 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Nitrates, *Arizona, *Chaparral, *Water yield improvement, Watershed management, Grasses, Herbicides, Streamflow, Water pollution sources.

Conversion of an Arizona chaparral watershed to grass cover by using a soil application of karbutilate granules increased streamflow and the nitrate content of the water. Nitrate concentrations in streamflow from an untreated control watershed reamined less than 1 ppm throughout the study, whereas nitrate from the treated watershed increased during the first posttreatment year to a maximum concentration of 56 ppm, with an annual weighted mean concentration of 16 ppm. Maximum concentrations of 60 and 69 ppm occurred during the third and fourth posttreatment years, when annual mean concentrations were 66- and 100-fold above normal. After 11 years the annual mean concentration was still 14 fold above normal. The mean nitrate concentration of the streamflow from the treated watershed for the entire 11 year period was 29 fold greater than that for the control watershed. (Baker-IVI)
W85-03564

'TRAP-DAMS': ARTIFICIAL SUBSURFACE STORAGE OF WATER,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Land Improvement and Drainage.
G. Baurne.
Water International, Vol. 9, No. 1, p 2-9, 1984. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Trap dams, *Subsurface storage, *Water supply development, Arid regions, Developing countries, Dam construction, Sedimentation, Subsurface dams, Erosion.

In most arid and semi-arid regions of the world with uneven rainfall distribution, but sufficient yearly rainfall, the problem of water shortage can be treated as a storage problem. Construction of sediment filled dams for artificial subsurface storage of water could provide a very cost efficient solution to the problem. If there is a large runoff with a large transport of coarse sediments during at least one part of the year, one or several dams filled with such sediments can be used as storage. If there is no large runoff and sediment transport, water can be stored in the riverbed by the construction of subsurface dams. In semi-arid mountainous regions with low to high yearly rainfall and occasional flooding, dams filled with coarse sediments also serve as stream flow moderators. These dams must be constructed and protected in such a way that erosion will not cause failure of the dam. So that the dams will naturally fill with coarse sediments during the rainy season, they should be built in a stepwise fashion, where the height of each individual step should be governed by the stream flow characteristics of the stream, to ensure sedimentation of desired grain sizes. During the first construction stage, a drain can be laid inside, along the entire dam, to make the extraction of water easy. (Moore-IVI)
W85-03699

3C. Use Of Water Of Impaired Quality

USE OF SALINE WATER FOR IRRIGATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
J. D. Rhoades.
California Agriculture, Vol. 38, No. 10, p 42-43, October, 1984. 2 Fig.

Descriptors: *Irrigation water, *Saline waters, *Brackish waters, *California, Water supply development, Water conservation, Irrigation practices, Impaired water quality, Drainage water, Water reuse, Water management.

Considerable saline water is available, including drainage water from irrigated projects and shallow groundwater, for use as irrigation water. Many brackish waters, which are not now used for irrigation because they are deemed too salty, can be used effectively with properly adapted management practices. Farmers could carry reuse much further in areas where it is now practiced by successively irrigating a sequence of crops of increasing salt tolerance. Soil does not usually

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become unduly saline from use of brackish water for a part of a single irrigation season and often not when this practice is continued for several seasons. A suggested strategy for using brackish waters for irrigation is being evaluated in three US Salinity Lab experiments. Two cropping patterns are being tested at the Imperial Valley location - a successive-crop and a block rotation. It appears that greater flexibility and opportunity for crop production results if two water types are used separately in a cyclic crop/water management strategy. Once the waters are mixed, this alternative is lost. It may not always be feasible or practical to prevent such natural mixing, but intentional mixing should be carefully evaluated along with the cyclic alternative. (Baker-IVI)
W85-03658

3D. Conservation In Domestic and Municipal Use

AERIAL PHOTOGRAPHY FOR CONSERVATION INFORMATION AND EDUCATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 7B.
W85-03353

3E. Conservation In Industry

MODE OF OPERATION OF THE NEW WATER-USE CHARGES AND INDUSTRIAL PRICES THAT BECAME EFFECTIVE JANUARY 1, 1984 IN THE WATER-MANAGEMENT SECTOR (ZUR WIRKUNGSWEISE DER AB 1. JANUAR 1984 GELTENDEN NEUEN WASSERNUTZUNGSENTGELTE UND INDUSTRIEPREISE DER WASSERWIRTSCHAFT),
Ministerium fuer Umweltschutz and Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 6C.
W85-03465

ECONOMICAL WATER USE IN THE ZIELITZ POTASH PLANT (WIRTSCHAFTLICHE WASSERNUTZUNG IM VEB KALIBETRIEB ZIELITZ),
VEB Kalibetrieb Zielitz (German D.R.).
R. Schroter, and A. Engelmann.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 6, p 128-129, August, 1984.

Descriptors: *Potash industry, *Water conservation, *Zielitz, *Germany (Democratic Republic), Water use, Industrial water, Well rehabilitation, Water supply, Computers, Water reuse, Water management.

The Zielitz potash plant (ZPP) is the youngest (start-up 1973) and most modern such plant in the German Democratic Republic (GDR). The design of ZPP incorporated the principles of economical water use, and projected parameters for water use have been improved upon, making ZPP the potash plant with the lowest specific water demand in the GDR. ZPP has its own industrial-water supply, a gallery of wells from bank filtrate. Salt-containing wash water resulting from the purification of exhaust gas is returned to circulation and the production process. Since April 1984, wash-water dosing has been fully automatic. A microcomputer is used at ZPP for multiple applications including process control and water management. It has been use to supply data for a competition between shifts for lowest water use and for improving upon intraplant standards. Rehabilitation of the well gallery is in progress; this includes cleaning the pipes to reduce by half the number of underwater pumps needed to convey the groundwater, thereby saving electrical energy, and, in future, determining different rehabilitation measures necessary for individual pumps to increase their longevity. Drinking-water demand at ZPP dropped by 31% between 1980 and 1983, mainly due to improved measurement techniques. Water-management process analysis is brought up to date annually and is used to develop a plan for rational water use. (Gish-IVI)
W85-03467

RATIONAL WATER USE IN AGRICULTURE, FORESTRY, AND FOOD PRODUCTION (DIE RATIONELLE WASSERVERWENDUNG IN DER LAND-, FORST- UND NAHRUNGSGUTERWIRTSCHAFT),
Ministerium fuer Land-, Forst- und Nahrungsguterwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 3F.
W85-03468

STIMULATION OF RATIONAL WATER USE MEASURES (ZUR STIMULIERUNG VON MASSNAHMEN DER RATIONELLEN WASSERVERWENDUNG),
Institut fuer Wasserwirtschaft, Leitstelle fuer Rationelle Wasserverwendung, Dresden (German D.R.).
A. Dittmar.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 6, p 136-137, August, 1984.

Descriptors: *Water conservation, *Industrial water, *Germany (Democratic Republic), Political aspects, Administration, Water management, Economic aspects, Recycling, Incentives.

In the German Democratic Republic, stimulation of rational water use in industry is effected by the use of political, economic, and administrative instruments as well as close cooperation between industry, water-management authorities and their central and local controlling organs, and scientific institutions. Political measures involve establishing careful use and protection of water resources as a social behavioral norm and include competition for the title of 'Exemplary Company in the Area of Water Management' (there are currently 275 titleholders). Economic stimulants include not only traditional means like water and wastewater taxes but also financial incentives for employees: wage bonuses; fines for employees if wastewater standards are not met; or bonuses paid to the collective responsible. Recycling of substances found in wastewater is also an important way of economizing. Administrative instruments include planning, assessment, and control of rational water use; bans and ordinances for the protection and rational use of water resources; and legal provisions. (Gish-IVI)
W85-03471

EXPERIENCE IN THE MAGDEBURG DISTRICT WITH THE IMPLEMENTATION OF RATIONAL WATER USE (ERFAHRUNGEN DES BEZIRKES MAGDEBURG BEI DER DURCHSETZUNG DER RATIONELLEN WASSERVERWENDUNG),
Wasserwirtschaftsdirektion Untere Elbe, Magdeburg (German D.R.).
For primary bibliographic entry see Field 3F.
W85-03472

RESULTS OF RATIONAL WATER USE IN THE DISTRICT OF DRESDEN (ERGEBNISSE DER RATIONELLEN WASSERVERWENDUNG IM BEZIRK DRESDEN),
Wasserwirtschaftsdirektion Obere Elbe-Neisse, Dresden (German D.R.).
R. Birkholz, and H. Ritter.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 7, p 234-236, July, 1983. 1 Tab.

Descriptors: *Water conservation, *Dresden District, *Germany (Democratic Republic), *Water demand Water supply, Water use efficiency, Water users, Industrial water, Industrial waste, Conservation.

Rational water use in the Dresden District, Germany (Democractic Republic), during the 1976-1980 five-year-plan time period resulted in a reduction in water demand from 239.9 to 238.6 million cu m/year and a 22.4% reduction in specific water demand, exceeding the goal of 20%. The 1981-1985 five-year plan calls for industry to reduce water use from the central supply to 86.3% of the 1980 level, water demand from companies' private supplies to 98.3% of the 1980 level, specific water demand by 27%, and absolute water demand by 3%. The implementation of government standards on industrial water is necessary to achieve these goals. Inadequate proposals for wastewater treatment and recycling of chemicals have been submitted to the District. However, plans of action submitted by companies and representative of the entire District showed that absolute water use in 1983 would be 5.5% less than in 1980, thereby already exceeding the five-year-plan goal. Through good management procedures, a Dresden power station has reduced water demand to the lowest level since start-up in 1967: specific water demand in cu m/MWh was 5.75 in 1967, 3.12 in 1976, 2.82 in 1980, and 2.66 in 1982. The Zeithain pipe works reduced specific water demand in 1982 by 23.3% of the 1980 level and projected 29.8% of the 1980 level in 1983. The Meissen cable works began using a private supply and by 1985 will reduce water use from the main network by 42.5% and specific demand by 3%. The Dredsen transformer and x-ray works (a section of the electrical-energy construction industry) will reduce absolute demand by 60,000 cu m/yr in 1983. (Gish-IVI)
W85-03523

RATIONAL WATER USE AND PERFORMANCE EVALUATION (RATIONELLE WASSERVERWENDUNG UND LEISTUNGSBEWERTUNG),
Institut fuer Milchwirtschaft, Berlin (German, D.R.).
H. Peschke.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 7, p 236-240, July, 1983. 8 Ref.

Descriptors: *Water use efficiency, *Water conservation, *Industrial water, Milk industry, Economic aspects, Costs.

Rational water use is the chief means of solving all water management problems in the German Democratic Republic because the water supply is limited, demand is increasing due to industrial programs and higher living standards, increasing water demand is resulting in higher water-supply costs, and water quality is deteriorating due to the increasing input of organics, making water treatment difficult and expensive. The 1981-1985 five-year plan therefore calls for an average annual increase in water demand for this time period of only 1% and for industry to reduce specific demand by 25% of the 1980 figure. In industry, water is mostly used as an auxiliary material; the coefficient of auxiliary-material cost per 100 Marks (M) of goods produced can therefore be used to evaluate performance in rational water use. Indices of water management within an industrial plant, using the example of the milk industry, can be expressed in terms of natural materials (ratio of natural materials used to amount of goods produced); value (intensity of material costs); and a combination of the two (intensity of materials usage); examples are given for applications of these indices. Water costs for the milk industry are about 0.63 M/100 M goods - about 13% of total auxiliary material costs. The relationships between water-management and production needs should be investigated by process analysis more consistently in order to develop plans of action for rational water use and performance indices. It was found that for the Milk industry, indices of natural materials provided the best reflection of water management. (Gish-IVI)
W85-03524

3F. Conservation In Agriculture

MODIFICATION OF COTTON WATER RELATIONS AND GROWTH WITH MEPIQUAT CHLORIDE,
Texas Agricultural Experiment Station, Lubbock.
B. L. Stuart, V. R. Isbell, C. W. Wendt, and J. R. Abernathy.
Agronomy Journal, Vol. 76, No. 4, p 651-655, July/August, 1984. 5 Tab, 22 Ref.

Descriptors: *Cotton, *Mepiquat, *Water potential, Crop production, Leaves, Water use efficiency, Solute potential, Turgor pressure, Turgididty, Growth rates, Transpiration.

Manipulation of crop architecture through the use of chemical bioregulators suggests the potential to improve plant water use and production efficiency. A bioregulator, mepiquat chloride (1,1-dimethyl piperidinium chloride), was evaluated in field grown cotton (Gossypium hirsutum L.) during 1979, 1980, and 1981 to determine effects on several plant water relations parameters and crop development in a semiarid environment. All experiments were conducted on an Olton loam soil (fine, mixed, thermic family of Aridic Paleustolls). A broadcast, foliar application was made at the rate of 50 g active ingredient (a.i)/ha during the early square (young floral bud) stage. Increases in leaf water potential (Psi w), solute potential (Psi s), and turgor pressure (Psi p) in mepiquat chloride treated plants were recorded during midmorning and at daily minimum Psi w. The earliest Psi w increase was measured 12 days after application. Changes in Psi w ranged from no significant differences to a 0.63 MPa increase in treated plants, 77 days after application under a high soil water level. Increased Psi s and Psi p in treated plants occurred most frequently during the midmorning period and increases of 0.20 MPa were measured. Improvements in plant water status were not restricted to low soil water availability and occurred across a range of control Psi w from -1.43 to -3.43 MPa. Increased abaxial transpiration rate, associated with decreased diffusive resistance, was measured in treated plants, particularly during the afternoon. No difference in seasonal soil water extraction was measured between treatments, even in tests in which leaf area index (LAI) was reduced 33% by mepiquat chloride application. Leaf area index reductions were attributable to both fewer leaves per plant and reduced leaf size. Differences in the growth parameters between treated an untreated plants were most evident when conditions for growth were optimum. A maximum decrease in plant height of 25 cm was measured 43 days after application in a high soil water level experiment. Reductions of one to two mainstream nodes were measured in treated plants. The number of bolls per plants throughtout the season was not altered by mepiquat chloride application, and there were no differences in lint yield as a result of treatment. (Author's abstract)
W85-03357

MOISTURE SENSOR-CONTROLLED IRRIGATION FOR MAINTAINING BERMUDAGRASS TURF,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
B. J. Augustin, and G. H. Snyder.
Agronomy Journal, Vol. 76, No. 5, p 848-850, 1984. 6 Tab, 17 Ref.

Descriptors: *Bermudagrass, *Irrigation, *Automation, *Soil water, Turf grasses, Wetting agents, Nitrogen, Nutrients, Tensiometers, Water conservation.

The feasibility of tensiometer soil moisture sensing devices for scheduling bermudagrass (Cynodon dactylon x C. transvaalensis) turf irrigation and their impact on N fertilization practices under subtropical conditions was assessed. Irrigation water savings of 42 to 95% were obtained in sensor controlled plots over conventionally irrigated plots. The greatest benefit of the sensor system was achieved during periods of frequent but unpredictable rainfall by eliminating unnecessary irrigations. Application of a wetting agent was necessary during extended dry periods to prevent localized dry spots when irrigation was limited by the sensor system to an as needed basis. Reduced irrigation by the sensor system resulted in better turf appearance and equal effectiveness of water-soluble and slow-release N sources. (Author's abstract)
W85-03363

EFFECTS OF PUMP SELECTION AND TERRAIN ON CENTER PIVOT PERFORMANCE,
Washington State Univ., Pullman. Dept. of Agronomy and Soils.
L. G. James.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 64-72, January/February, 1984. 9 Fig, 6 Tab, 5 Ref.

Descriptors: *Irrigation practices, *Pumps, *Center pivot irrigation, Turbines, Centrifugal pumps, Sprinkler irrigation, Water conservation, Slope, Terrain analysis, Topography.

Nondimensional curves to represent the performance of 125 centrifugal and turbine pumps were developed. The James Center Pivot simulation model was modified and used with these curves to examine the effect of pump type and size, and nine terrains on the water applied, energy use, uniformity and adequacy of irrigation of center pivot (CP) systems with different sprinkler types. Fixed nozzle and constant discharge nozzle impact sprinklers were considered. There was little difference in the performance of CP systems with turbine pumps and CP systems with centrifugal pumps pumping from surface sources of water. CP systems with pumps which can not supply the design pressure of the CP system apply less water and use less energy than CP systems which are able to supply the design pressure. CP systems with undersize pumps are able to achieve adequacies of irrigation in excess of 80% with fixed nozzle impact sprinklers only on downward slopes of 2% or steeper. Conversely, CP systems with pumps which can supply significantly more than the design pressure apply more water and use more energy than do CP systems with properly sized pumps. CP systems with oversize pumps can be used with fixed nozzle impact sprinklers to achieve adequacies of irrigation in excess of 80% for most terrains. The performance of CP systems with conventional fixed nozzle impact sprinklers was most affected by terrain. Water application and the adequacy of irrigation varied widely between upward and downward sloping terrains. (Baker-IVI)
W85-03364

WINDBREAK EFFECTS ON SOIL WATER AND WHEAT YIELD,
Kansas Agricultural Experiment Station, Manhattan. Dept. of Agronomy.
L. Lyles, J. Tatarko, and J. D. Dickerson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 69-72, January/February, 1984. 2 Fig, 6 Tab, 6 Ref.

Descriptors: *Soil water, *Windbreaks, *Crop yield, *Wheat, *Kansas, Water conservation, Trees, Shrubs, Root pruning.

Windbreaks have long been recognized for protecting soils, crops, and livestock. They influence evaporation, transpiration, wind erosion, snowdrifting, and crop yields. Although generally beneficial, windbreaks also compete with crops for space and soil water. Soil profile water content was measured along perpendicular transects adjacent to single row windbreaks of tamarisk, Siberian elm, Russian-olive, honeysuckle, and Siberian peashrub near Colby, Kansas from 1978-1982. The results show the soil water content to vary significantly over distance on 6 of the 15 sampling dates. The tamarisk was the highest water user and Siberian peashrub the lowest among the species tested, omitting honeysuckle. Half the windbreak lengths were root pruned in April 1980, and winter wheat yields in the root pruned zone were 1.6 times those in the same unpruned zone. Assuming 13 cents/kg for wheat, that difference would equal about $205 more per km of pruned windbreak length. It appears that roots should be pruned every three years. (Baker-IVI)
W85-03365

EVALUATION OF COTTON CANOPY TEMPERATURE TO DETECT CROP WATER STRESS,
Agricultural Research Service, Bushland, TX.
For primary bibliographic entry see Field 2I.
W85-03368

ECONOMIC SPRINKLER SELECTION, SPACING, AND ORIENTATION,
Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
D. Chen, and W. W. Wallender.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 737-743, May/June, 1984. 6 Fig, 2 Tab, 17 Ref.

Descriptors: *Irrigation, *Sprinklers, *Spacing, *Orientation, *Economic aspects, Planning, Water management, Irrigation patterns, Simulation.

Simulation and graphical methods were developed to economically select, space, and orient sprinklers. Sprinkler uniformity response (uniformity as a function of dimensionless lateral and main line sprinkler spacing) can be used to economically compare, space, and orient sprinklers. Dimensionless infiltration and full coverage overlays on the response surface restrict the domain of possible sprinkler spacings. Response surfaces of different patterns are compared using the criteria of sprinkler performance above a target uniformity as a proportion of the response surface domain. An equipment cost-response surface is juxtapositioned over the design domain to develop a least cost function of uniformity. A profit function of yield, uniformity and depth of applied water is maximized simultaneously to find uniformity and depth of applied water. The optimum uniformity gives the design spacing through the uniformity response surface. Uniformity and depth of applied water increase as profit increases. Profit increases result from higher prices for the crop and lower cost of applied water and equipment. Optimization procedures should therefore include system cost as a function of uniformity as well as other input costs in the process of deciding depth of water applied, uniformity and spacing. (Baker-IVI)
W85-03378

CABLEGATION: IV. THE BYPASS METHOD AND CUTOFF OUTLETS TO IMPROVE WATER DISTRIBUTION,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
D. C. Kincaid, and W. D. Kemper.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 762-768, May/June, 1984. 13 Fig, 1 Tab, 4 Ref.

Descriptors: *Water distribution, *Surface irrigation, *Automation, *Cablegation, Infiltration, Gravity.

Two techniques for improving the water distribution characteristics of cablegation systems were explored. The bypass method largely eliminated the problem of nonuniform inflow-time distributions at the upper and lower ends of the pipe. The bypass can be accomplished by directing flow over a weir into a parallel pipe to divert the flow around the initial section to the lower end where it is distributed upstream from a stationary plug. An overflow weir is used to control the bypass flow. Alternatively, a flow through plug with a variable orifice can be used to accomplish the bypass, eliminating the need for the bypass pipe. Model simulations show that both of these methods eliminate the upstream end effect and can provide uniform net application with constant outlet sizes at the upstream end. The downstream end effect is reduced, but variations of about 15% of net application still occur. Small adjustments in orifice size near the lower end can reduce these variations to less than 10%. The bypass method simplifies system operation because the plug can be started moving from the first orifice and no initial stationary set time is needed. When the plug reaches the end of the pipe, the irrigation is complete. The design and operation of cablegation systems is simplified since less attention is needed to varying orifice sizes, and intial and final set times are eliminated. (Baker-IVI)
W85-03382

CABLEGATION: V. DIMENSIONLESS DESIGN RELATIONSHIPS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
D. C. Kincaid.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 769-778, May/June, 1984. 6 Fig, 3 Ref.

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Descriptors: *Irrigation practices, *Infiltration, *Cablegation, Runoff, Furrow irrigation, Mathematical equations, Design criteria, Constant flow irrigation.

Dimensionless equations were developed to approximate the maximum furrow stream size and the number of flowing outlets for cablegation system with constant outlet size. The maximum outlet pressure head can also be determined directly without computing the entire distribution. If the desired maximum stream size is known, the required outlet size can be determined directly. Using the two parameter time-based Kostiakov infiltration equation, dimensionless relationships were developed to determine the required maximum stream size for the cablegation system given the intake parameters, furrow length, and spacing, gross water application, percent runoff, and uniformity coefficient. Curves are also presented for the case of constant furrow inflow rate. These relationships comprise a simplified design method for rectangular fields with constant pipe slope. The equations can be used to quickly determine the effect of changing the total inflow rate on the outlet head and stream sizes, and uniformity and runoff. The cablegation pipe flow equations were developed for specific ranges of the input variables and the user is cautioned to limit use of the equations to those ranges. The infiltration relationships can be used to design systems for a minimum specified efficiency or uniformity if the intake characteristics are known. The constant inflow rate curves can be used independently to determine the required stream size for constant flow surface irrigation systems. They can also be used to make comparisons between cablegation and constant flow systems to determine which system should be used for given soil water intake characteristics. (Baker-IVI)
W85-03383

SYSTEMS APPROACH FOR AGRICULTURAL LAND MANAGEMENT AND WATER QUALITY CONTROL,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 2J.
W85-03390

SUBSOIL CHARACTERISTICS INFLUENCE HYDROLOGIC RESPONSE TO NO-TILLAGE,
Agricultural Research Service, Coshocton, OH.
W. M. Edwards, and C. R. Amerman.
Transactions of the ASAE, Vol. 27, No. 4, p 1055-1058, July/August, 1984. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *No-tillage, *Tillage, *Subsoil, *Soil types, *Hydrologic response, Runoff, Agricultural hydrology, Drainage, Corn, Land management, Water conservation.

Runoff was measured from two watersheds having similar top-soils. The subsoil of one watershed contained 20% clay with 40 to 60% sandstone fragments and was well-drained. Subsoil in the other watershed had < 15% coarse fragments with up to 40% clay content, which restricted drainage through the profile. In the 7 yr that corn was grown with conventional tillage practices, runoff from summer storms was high and similar for both watersheds. Dormant season runoff from the watershed with the heavy subsoil was much greater than that from the well-drained one. With 5 yr of continuous no-tillage corn production, summer runoff was nearly eliminated from both watersheds. Dormant season runoff, however, was not affected by tillage practice. Therefore, the effect of the no-tillage treatment on reducing total annual runoff was greater on the well-drained soil than it was where internal drainage was restricted. (Author's abstract)
W85-03396

OPTIMAL DRAIN DESIGN FOR ARID, IRRIGATED AREAS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
D. S. Durnford, T. H. Podmore, and E. V. Richardson.
Transaction of the ASAE, Vol. 27, No. 4, p 1100-1105, July/August, 1984. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Irrigation design, *Drainage design, *Model studies, Crop yield, Costs, Arid climates, Computer models.

A methodology and computer model are presented that can be used to identify economically optimum subsurface drainage systems in arid, irrigated regions. A simple optimization scheme is used to determine the least cost drain layout which will satisfy a specified design requirement. This optimization routine is imbedded in a larger simulation model of an irrigation-drainage system that evaluates the physical effects of installing this least cost drain system and predicts the resulting crop yield. By varying the design requirement systematically and comparing drain costs with the predicted values of increased crop yields, an optimum level of drainage and the minimum cost drain layout corresponding to this optimum level are determined. (Author's abstract)
W85-03403

CONSTANT AND VARIABLE OPERATING-ANGLE SPRINKLERS FOR TRAVELER IRRIGATORS,
Auburn Univ., AL. Dept. of Agricultural Engineering.
T. W. Grant, W. C. Anderson, and E. W. Rochester.
Transactions of the ASAE, Vol. 27, No. 4, p 1106-1110, July/August, 1984. 9 Fig, 11 Ref.

Descriptors: *Irrigation, *Sprinklers, *Travel irrigators, Simulation analysis, Sprinkler irrigation, Sprinkling, Water use efficiency.

Digital simulations were used to determine the amount of water applied by a traveler irrigation system. The simulations included an initial stationary set (travel delay) to provide additional water behind the start position of the traveler. A comparison of two series of simulations was made to determine the potential of utilizing an alternate sprinkler operating angle during the initial delay period. This was accomplished by conducting one series of simulations with a constant sprinkler operating angle and a second series with differing sprinkler angles for the delay and travel periods. Required delay time, uniformity of application and the volume of water applied beyond the effective field boundary were the performance criteria used in the comparison. Under certain conditions, uniformity can be improved in this initial set area if the angle of rotation during the initial delay period is smaller than the angle of rotation at which the sprinkler travels through the field. (Author's abstract)
W85-03404

RATIONAL WATER USE IN AGRICULTURE, FORESTRY, AND FOOD PRODUCTION (DIE RATIONELLE WASSERVERWENDUNG IN DER LAND-, FORST- UND NAHRUNGSGUTERWIRTSCHAFT),
Ministerium fuer Land-, Forst- und Nahrungsguterwirtschaft, Berlin (German D.R.).
G. Pallmann.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 6, p 131, August, 1984.

Descriptors: *Water conservation, *Food processing industry, *Forestry, *Germany (Democratic Republic), Irrigation water, Recycling, Water use, Meat processing industry, Dairy industry, Wastewater treatment, Water demand.

Rational water use is an important component of the current effort in the German Democratic Republic toward intensification in agriculture, forestry, and food production. A goal was set to produce the highest yields ever in these industries in 1984. It was necessary to optimize use of existing irrigation facilities (these cover 930,000 ha), to create new facilities, and to reconstruct old facilities on 300,000 ha. New control procedures allowed overhead irrigation using 100-150 cu m/ha less water than previously. In animal husbandry, efforts are being made to reduce water use and to create 650,00 cu m of storage space for liquid and solid manure. In dairy farming, rational water use standards are being exceeded. Goals of the food-production industry include reducing specific water consumption by 20-25% and recycling products from wastewater. Standards for water demand and rationalization measures are being developed. Good progress in decreasing water use is being made in cooling processes in the food-storage industry and in recycling in the milk- and meat-processing industries. Improvements have been made in recycling products from wastewater in the slaughtering and butchering industry. (Gish-IVI)
W85-03468

EXPERIENCE WITH RATIONAL WATER MANAGEMENT IN ANIMAL RAISING (ERFAHRUNGEN BEIM RATIONELLEN UMGANG MIT WASSER IN DER TIERPRODUKTION),
O. Naumann.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 6, p 133-137, August, 1984.

Descriptors: *Water conservation, *Animal breeding, *Pigs, *Hermstedt, *Germany (Democratic Republic), Water management, Water demand, Water reuse, Manure, Water conveyance.

Rational water use at the Hermstedt (German Democratic Republic) pig-breeding facility (HPF) is described. The facility can accomodate 12,500 pigs and produces 41,000 dt pork/yr. Design and construction of HPF (completed in 1975) took regional planning in water management into consideration. HPF financed a 5-km-long water-supply line and an overhead reservoir to which 4 parishes have also been connected. A goal at HPF is to use water sparingly, thereby also reducing the amounts of wastewater and liquid manure produced. Process analysis was used to determine where savings could be made to reduce specific water demand. Water demand in 1983 was 65.5% that in 1979 in terms of 1,000 Marks worth of goods produced and 69.0% less in terms of dt of pork. In order to prevent water losses, the 1,200 water dispensers are inspected twice daily for leaks. The installation of high-pressure cleaning devices for animal stalls resulted in a 50% saving in water over the conventional hose-and-pump procedure. No savings can be made in water needed to feed the animals, and this comprises 75% of total water consumption. A recycling facility for water used to clean root crops was constructed which doubles the amount of roots that can be processed with the same amount of water. The sedimentation basin was reconstructed at a cost of 100,000 Marks. An 8-km-long pipeline and additional storage space for liquid manure is planned, which will cost 1.5 million Marks. (Gish-IVI)
W85-03469

EXPERIENCE IN THE MAGDEBURG DISTRICT WITH THE IMPLEMENTATION OF RATIONAL WATER USE (ERFAHRUNGEN DES BEZIRKES MAGDEBURG BEI DER DURCHSETZUNG DER RATIONELLEN WASSERVERWENDUNG),
Wasserwirtschaftsdirektion Untere Elbe, Magdeburg (German D.R.).
B. Christelsohn.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 6, p 138-140, August, 1984. 1 Fig.

Descriptors: *Water conservation, *Magdeburg District, *Germany (Democratic Republic), Agriculture, Industrial water, Water demand, Irrigation water, Wastewater disposal.

Rational water use (RWU) is the only means of covering water demand in the Magdeburg District (German Democratic Republic) where in dry months demand exceeds supply by 26%. The RWU program for 1981-1985 includes concrete plans and goals for agriculture; in 1985, agricultural water demand will comprise 41% of total demand, and the irrigation program will require a 56.5 million cu-m/yr increase in supply. The Third District Seminar for RWU set goals including a 28% reduction of specific water demand by 1985

ubstitution of 500,000 cu m/yr drinking water hrough companies using their own supply or witching to industrial water, reducing water consumption in factory farming to raise dry matter in iquid manure to 5-7%. Process analysis within ompanies and the role of the government waters upervisory board in planning, evaluation and organization are important. Positive results of RWU nclude, comparing 1983 to 1980, a 6-million cu m/ r reduction in total water demand to 473 million u m/yr, a total reduction in absolute water lemand for industry of 24 million cu m/yr, a 5.8% decreased in specific water demand, and a eduction in wastewater discharged into surface vaters of 117,000 population equivalents. (Gish-VI)
W85-03472

NOMOGRAPHIC ESTIMATION OF PERFORMANCE PARAMETERS IN SPRINKLER IRRIGATION,
Demokritos Univ. of Thrace, Xanthi (Greece). Dept. of Civil Engineering.
G. P. Tsakiris, and G. C. Terzis.
Advances in Water Resources, Vol. 7, No. 1, p 35-38, March, 1984. 5 Fig, 7 Ref.

Descriptors: *Sprinkler design, *Sprinkler irrigation, *Nomographs, *Performance evalution, Irrigation design, Statistical analysis, Sprinklers, Application pattern.

The normal practice in designing sprinkler irrigation systems is to express the uniformitiy of water distribution by means of empirical coefficients. Instead of calculating the irrigation deficit based on real data, which rarely exist, it is simpler to fit a standard statistical distribution to the precipitation data and calculate the performance measures as a function of its parameters. Nomographic estimation of the main performance parameters in sprinkler irrigation was obtained on the assumption that water distribution over the irrigated area is simulated by a Normal distribution. The prepared generalized nomographs offer a quick estimation of mean deficit, adequacy of application and deep percolation efficiency for any depth and degree of uniformity applied. Similar procedures may be adopted using more general asymmetric distributions. In this case particular attention should be taken for limiting the number of characteristic parameters of the distribution. (Collier-IVI)
W85-03478

MINIMIZING SALT IN DRAIN WATER BY IRRIGATION MANAGEMENT - ARIZONA FIELD STUDIES WITH CITRUS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
G. J. Hoffman, J. D. Oster, E. V. Mass, J. D. Rhoades, and J. Van Schilfgaarde.
Agricultural Water Management, Vol. 9, No. 1, p 61-78, June, 1984. 7 Fig, 5 Tab, 17 Ref. EPA Interagency Project EPA-IAG-D6-0370.

Descriptors: *Drainage, *Salts, *Irrigation practices, *Arizona, *Oranges, Orchards, Leaching, Flood irrigation, Crop yield, Evapotranspiration, Environmental protection.

A field experiment was conducted for 5 years in the Wellton-Mohawk Irrigation and Drainage District of southwest Arizona to investigate the potential for reducing the salt load in irrigation return flow by decreased leaching in citrus. Leaching treatments of 5, 10, and 20%, replicated nine times, were established on mature Valencia orange trees (Citrus sinensis L.) and compared with conventional flood irrigation management. The annual evapotranspiration was found to be about 1470 mm. The leaching fractions, determined indirectly by several techniques, were close to those intended. The leaching fraction for the flood check was 0.47. During the first 4 years, the leaching treatments had no observable influence on fruit or quality or on tree growth. During the last year of the study, however, the yield of the 5% leaching treatment was significantly lower than the other treatments. Thus, with some uncertainty, the leaching requirement for Valencia orange irrigated with Colorado River water exceeds 5% but is less than 20%. Results verify that water applications could be reduced substantially below typical commercial practice without loss of crop yield. At the conclusion of the experiment reducing the leaching fraction to 0.20 for the 3000 ha of citrus in the District would reduce the salt load in the irrigation return flow by 127,000 Mg annually. After steady state conditions are reached at 20% leaching the annual reduction would be 425,000 Mg. (Author's abstract)
W85-03481

MINIMIZING SALT IN DRAIN WATER BY IRRIGATION MANAGEMENT - LEACHING STUDIES WITH ALFALFA,
Agricultural Research Service, Riverside, CA. Salinity Lab.
G. J. Hoffman, J. D. Oster, E. V. Maas, J. D. Rhoades, and J. Van Schilfgaarde.
Agricultural Water Management, Vol. 9, No. 2, p 89-104, September, 1984. 6 Fig, 5 Tab, 10 Ref. EPA Interagency Project EPA-IAG-D6-0370.

Descriptors: *Salts, *Drainage, *Irrigation practices, *Alfalfa, *Arizona, Colorado River, Spray irrigation, Flood irrigation, Evapotranspiration, Crop yields.

An alfalfa experiment was conducted in the Wellton-Mohawk Irrigation and Drainage District of Southwest Arizona to determine the potential for minimizing the salt load in irrigation return flow by decreased leaching. Three leaching treatments of 5, 10, and 20%, replicated five times, were imposed on a 2-ha field. The crop was irrigated with Colorado River water (electrical conductivity of 1.3 dS/m) through a lateral-move, spray-type irrigation system. Results were compared with those of an adjacent area irrigated with level basin flooding. The average annual evapotranspiration during the 4-year study was 1930 mm. Several indirect measures of the leaching fractions attained gave average values of 6.4, 9.3, and 13.1% for the three leaching treatments. Mean annual yields were 21.5 and 22.9 Mg/ha for 1977 and 1978 in the experimental plots, with no significant differences among leaching treatments, and 25.7 and 20.8 Mg/ha in the adjacent flooded check. The results suggest that full yields could be attained with as little as 5% leaching. Estimates based on average on-farm irrigation efficiency for alfalfa in the District in 1979, indicate that 5% leaching, if attainable, would reduce the salt load in the irrigation return flow by 39,000 Mg/year on 8000 ha of alfalfa. (Author's abstract)
W85-03483

COMPARISON AND SELECTION OF FURROW IRRIGATION MODELS,
Concepcion Univ. (Chile).
E. A. Holzapfel, M. A. Marino, and J. Chavez-Morales.
Agricultural Water Management, Vol. 9, No. 2, p 105-125, September, 1984. 9 Fig, 3 Tab, 26 Ref.

Descriptors: *Furrow irrigation, *Model studies, *Irrigation management, Hydrodynamics, Zero-inertia models, Kinematic-wave models, Volume-balance models, Slopes, Infiltration, Roughness, Design criteria.

The capability of hydrodynamic, zero-inertia, kinematic-wave and volume-balance models to predict advance and recession phases in furrow irrigation were compared against two sets of field data, providing a wide range of soil conditions and field slopes. The input parameters required for each model were studied, and a simple sensitivity analysis was performed for field slope, furrow geometry, roughness coefficient, infiltration constants, time step, and discharge. The accuracy of the models' prediction depends on the precision of the measurements and the estimation of the input parameters. Excellent prediction of the advance and recession phases were obtained with hydrodynamic, zero-inertia and kinematic-wave models. Those models therefore are preferred in design and management in furrow irrigation. (Author's abstract)
W85-03484

SOLUTION OF THE KINEMATIC-WAVE EQUATIONS FOR BORDER IRRIGATION,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and R. S. Ram.
Agricultural Water Management, Vol. 9, No. 2, p 127-138, September, 1984. 7 Fig, 1 Tab, 10 Ref. NSF project NSF-ENG-79-23345.

Descriptors: *Kinematic waves, *Mathematical equations, *Border irrigation, Irrigation, Model studies, Infiltration.

A method was developed to obtain solutions to the kinematic-wave equations for border irrigation. The accuracy of this method was assessed by comparing the results with the kinematic-wave train (KWT) method previously reported to be accurate. Experimental data on freely draining borders were utilized for comparison and evaluation of these methods. The prediction error for advance time resulting from the two methods was comparable: it was below 25% for three sets of data but as high as 50% for one set of data. The prediction error for recession time was also comparable: below 6% for the same three sets of data but 14.0% for one set. (Author's abstract)
W85-03485

CLOSED BORDER IRRIGATION EVALUATIONS,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
R. B. Hulsman.
Agricultural Water Management, Vol. 9, No. 2, p 139-148, September, 1984. 1 Fig, 5 Tab, 12 Ref.

Descriptors: *Closed border irrigation, *Percolation efficiency, *Irrigation, Runoff, Soil water, Soil moisture retention, Crop yield, Irrigation efficiency, Surface irrigation.

One hundred and thirty-four irrigations were evaluated, on 16 on-farm closed borders in southern New Mexico, over a 3-year period. Storage efficiencies, deep percolation efficiencies and loss ratios were the major performance parameters evaluated in the study. Soil moisture storage efficiencies ranged from a low of 6% to a high of 100% with a seasonal average of 63%. Percolation efficiencies were generally higher varying from 20% to 100% with a seasonal average of 93%. Percolation and runoff ratios were grouped together and were in the range of 4-79% with an annual average of 37%. Distribution uniformities calculated for several irrigation runs were between 79 and 99 percentage points. The significance of crop rooting depth and length of run were also studied. Total yields associated with each of the crops are presented, as well as average county yields, over the test period. (Author's abstract)
W85-03486

MANAGEMENT ALTERNATIVES: CROP, WATER, AND SOIL,
California Univ., Riverside. Dept. of Soils and Water.
J. D. Oster, G. J. Hoffman, and F. E. Robinson.
California Agriculture, Vol. 38, No. 10, p 29-32, October, 1984. 4 Fig, 1 Tab.

Descriptors: *Irrigation, *Salinity, *Soil properties, *California, Crops, Drainage systems, Soil management, Salt tolerance, Drainage, Salinity management.

Breeding more salt-tolerant crops, transferring salinity tolerance from other organisms to crop plants, building regional drainage systems, and devising improved irrigation and management techniques are the prinicipal options available for dealing with salinity. The threat of salinity is always present in irrigated argiculture. But with proper management, appropriate crop selection, and adequate drainage, full crop productivity is possible throughout California using most present water supplies. Options in managing irrigation water and soil become more limited with increasing salinity or sodicity. The general procedures followed in preventing or alleviating problems include: verifi-

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cation that drainage is adequate; measurement of initial salinity and sodicity of the soil and reclamation if necessary; determination of the chemical composition of the irrigation water and assessment of potential soil and crop hazards associated with its use; and leaching, using only as much water as is needed to prevent salt accumulation. (Baker-IVI)
W85-03656

USE OF SALINE WATER FOR IRRIGATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3C.
W85-03658

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

NEW APPROACH TO CANAL AND WATERWAY MAINTENANCE,
Virginia Beach Public Works Highway Div., VA.
J. D. Russell, and O. B. Schockley.
Public Works, Vol. 115, No. 10, p 72-73, October, 1984. 4 Fig.

Descriptors: *Waterways, *Canals, *Maintenance, *Virginia Beach, *Virginia, Siltation, Storm runoff, Dredging, Access.

The topography of Virginia Beach is extremely flat with numerous lakes, bays, rivers, and other estuaries. The prohibitive cost associated with constructing very large piped outfall systems for housing developments have resulted in a proliferation of large open drainage canals and waterways designed to carry storm water runoff from the residential storm systems to their ultimate outfalls. Maintenance of these canals is a major problem. A recent survey indicated that about 29% of the canals can be maintained through a dragline operation, 11% can be maintained with a Gradall, 51% require dredge work, and the remaining 8%, or 15.4 miles, would have to be maintained through manual labor. This 15.4 miles is the difficult section as it goes through populated areas where homeowners have totally restricted maintenance access by placing fences, trees, shrubs, storage sheds, and the like along the tops of the waterway slopes. Two manufactures of digging machines were found whose units could maneuver into the ditch and work wholly within its confines, even in water up to 5 to 6 ft deep. The city purchased a Menzi Muck Model 5000T2. The unit has a 25 ft reach and a digging depth of 17 ft. It works inside a ditch as narrow as 7 ft and can straddle other ditches. Measurements indicate an anticipated production of 750 cu yd of siltation removed per day. (Baker-IVI)
W85-03274

SEDIMENT TRAP EFFICIENCY OF A SMALL RESERVOIR,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2J.
W85-03352

CHECK WEIR AT KEHL/STRASSBURG AND THE LATERAL POLDERS OF THE RIVER RHINE NEAR ALTENHEIM (DAS KULTURWEHR KEHL/STRASSBURG UND DIE SEITENPOLDER DES RHEINS BEI ALTENHEIM),
Wasser- und Schiffahrtsamt Freiburg (Germany, F.R.).
D. Kuhl.
Wasserwirtschaft, Vol. 74, No. 7/8, p 361-365, July/August, 1984. 8 Fig, 4 Ref.

Descriptors: *Weirs, *Polders, *River Rhine, *Germany (Federal Republic), Flood control.

The check weir at Kehl/Strassburg will be instrumental in supporting the ground water level. Together with the two lateral polders of the river Rhine near Altenheim, it will serve to reduce the danger of flood below that stretch of the river Rhine that is regulated by weirs. The reasons leading to the construction of the check weir and the polders, the construction measures and the intended mode of operation are described. (Author's abstract)
W85-03437

STUDIES ON SECURING AND INCREASING THE EFFECTIVENESS OF OLDER DAMS (BEITRAGE ZUR SICHERUNG UND ERHOHUNG DER EFFEKTIVITAT ALTERER TALSPERREN),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
P. Losel.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 4, p 77-79, May, 1984.

Descriptors: *Dams, *Germany (Democratic Republic), *Reservoir operation, Mathematical models, Planning, Maintenance, Dam safety, Concrete, Monitoring, Computers.

In the field of dam management, control, maintenance, and surveillance, mathematical simulation models have been in use in the German Democratic Republic (GDR), since 1975 for water management covering large areas; use of these models for reservoir control has recently resulted in an 8% increase in the availability of water resources. Basic techniques and general procedural principles for dam reconstruction were studied: rehabilitation procedures have been evaluated for suitability of application in the GDR, and out of the chosen basic techniques certain preferred procedures were selected; procedural principles and methodology for setting up an analysis of existing conditions for older dams were developed; and principles of planning and ordering of repair and reconstructive measures are being prepared. Research on the repair of drainage pipelines in masonry dams was concluded in 1980, and its conclusions have been put into practice; operational tests of cleaning procedures resulted in chemical methods (application of inhibited hydrochloric acid at concentrations of up to 15%) being used further at other dams. The problem of concrete corrosion has been studied in order to determine the causes of aging; an investigation of the joint face of upstream concrete facing at a masonry dam revealed that the damaged facing need not be removed but that a new facing should be attached by doweling down to the original wall and that the bottom joint should receive a horizontal seal. Five dams were evaluated using 34 measurement procedures with the aid of computer programs for the statistical analysis of dam-monitoring data. (Gish-IVI)
W85-03451

INCREASE OF CAPACITY OF THE WEIDATAL DAM SYSTEM (DIE STEIGERUNG DER LEISTUNGSFAHIGKEIT DES SYSTEMS DER WEIDATALSPERREN),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
W. Schirmer, D. Schmidt, and U. Bartelt.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 4, p 89-91, May, 1984. 5 Fig.

Descriptors: *Weidatal Dam System, *Germany (Democratic Republic), *Water supply development, Reservoir capacity, Water supply, Drinking water, Dams, Flood-control storage, Reservoir operation.

There is an ongoing program to increase the water-supply capacity of the Weidatal dam system in the German Democratic Republic. The dam system must ensure the water supply for a population of 320,000 in the Gera district until the start-up of a remote supply from the Schwarza river. The Weida dam (completed in 1956) attained its projected capacity (132 l/sec mean drinking-water output) only in 1972 after the start-up of the Dortendorf waterworks in 1969. The Zeulenroda dam, while reducing flood-protection storage capacity, produced an increase in output to 535 l/sec. Capacity has already been raised by diverting water through a tunnel from the Wisenta river and will be raised further to 851 l/sec when the new Lossau dam on the Wisenta is completed in 1985. Another capacity increase was achieved by incorporating the Hohenleuben dam on the Leuba river into the Weidatal system. Industry in the city of Zeulenroda will use a reservoir to be constructed outside the Weidatal system for its water instead of on the Zeulenroda dam. In 1983-1984, a reservoir-management computer program aided in the implementation of intensification measures, resulting in a 5 l/sec capacity increase, raising total output capacity to 960 l/sec. This total increase of 36,000 cu m/day was achieved with a saving in investment costs of 41,800 Marks. (Gish-IVI)
W85-03455

CONTROLLABILITY CONDITIONS FOR RESERVOIR FLOOD CONTROL SYSTEMS WITH APPLICATIONS,
Vrije Univ., Brussels (Belgium). Center for Statistics and Operations Research.
J. L. Marien.
Water Resources Research, Vol. 20, No. 11, p 1477-1488, November, 1984. 11 Fig, 3 Tab, 11 Ref.

Descriptors: *Flood control, *Reservoirs, Floods, Flooding, Mathematical equations, Controllability, Multireservoir networks.

A number of theoretical results are presented concerning the necessary and sufficient conditions under which there exists a regulation for a multireservoir flood control system with given deterministic inflows such that no flooding occurs at a flood damage center situated downstream. These controllability conditions have a very simple form for a large variety of multireservoir systems. They can be reduced to the existence of a no-flood control for a number of simple single reservoirs associated with the original system. The use of these findings as an aid in planning and operating structural flood control systems is suggested. A practical example is given with numerical results that are impossible to obtain without the use of the theoretical findings on controllability. The major result of this study consists of the fact that the question with regard to the existence of a no-flood regulation for a given complex multireservoir flood control system can be answered by checking a number of easily verified conditions. In discrete time, formal proofs were found for systems with undelayed and purely delayed releases. To extend the method to systems with linearly attenuated releases, further research concerning systems in continuous time seems necessary. (Baker-IVI)
W85-03549

STOCHASTIC DYNAMIC PROGRAMMING MODELS FOR RESERVOIR OPERATION OPTIMIZATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 2E.
W85-03551

MIN-MAX APPROACH TO RESERVOIR MANAGEMENT,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
S. Orlovski, S. Rinaldi, and R. Soncini-Sessa.
Water Resources Research, Vol. 20, No. 11, p 1506-1514, November, 1984. 7 Fig, 6 Ref.

Descriptors: *Reservoir operation, *Optimization, Systems analysis, Water management, Planning, Multipurpose reservoirs, Reservoir releases, Simulation.

A deterministic approach to real time operation of a multipurpose reservoir is presented. The method is particularly useful in cases where the attention and effort of the manager are focused on avoiding substantial failures of the system during severe hydrological episodes. Complex algorithms and on-line optimization are not required by this approach, since all efficient operating rules can

imply be obtained by off-line repetitive simula-
ions of the reservoir behavior for different values
f the initial storage. These efficient operating
ules can be interpreted in terms of storage alloca-
ion zones which are not predetermined but
epend upon the forecast of the inflows. The
ethod also suggests, in cases when the reservoir
s not too full or too empty, that a whole range of
ossible releases exists instead of a single value.
his introduces some flexibility into the decision
aking process. The analysis of a real case shows
hat this deterministic approach is quite powerful
n pointing out the possibility of improving the
erformance of a reservoir already in operation
Baker-IVI)
V85-03552

HISTORICAL PERSPECTIVE ON SALINITY AND DRAINAGE PROBLEMS IN CALIFORNIA,
California Univ., Santa Barbara. Dept. of History.
. L. Kelley, and R. L. Nye.
California Agriculture, Vol. 38, No. 10, p 4-6, October, 1984. 1 Fig.

Descriptors: *Salinity, *Drainage, *Irrigation effects, *Calfornia, Salton Sea, Imperial Valley, San Joaquin Valley, Farming, Reviews, Soil saturation.

Salinity and drainage problems have plagued agriculture in California from the time irrigation was introduced in the second half of the nineteenth century. The Imperial Valley has had difficulties with salinization for several decades at the same time as it has become one of the most productive farming regions in the world. Shortly after 1901 serious salt and soil saturation problems became evident. Not until the 1940s was a solution found. About 100,000 acres were underlain with a network of concrete and clay tile by 1949, and for the first time since measurement were begun in 1943, more salt was removed from the Valley than was brought in. Another set of salt related problems in the Valley that may worsen in the near future involves both the surface elevation and the saltiness of the Salton Sea. The San Joaquin Valley, situated in the southern two-thirds of California's great Central Valley is another area with a long history of salinity problems. From the late 1870s to about 1915, there was a parallel development of salinity and drainage problems. From 1915 to 1950 an agricultural boom and proliferation of irrigation district elevated drainage from an individual to a community undertaking. A solution that revolutionized drainage methods was the introduction of deep-well pumping in 1920. From the mid-1950s and continuing to the present, serious drainage problems have developed on the west side of the Valley trough. In the mid-1960s the federal and state governments began planning for a jointly constructed $86 million master drain that would eventually traverse 280 miles from Bakersfield to an unspecified point in the Delta. This plan ran into complications and only about 82 miles are completed. Delay in completing the Drain may result in major production loses for many Westlands farmers in the near future. (Baker-IVI)
W85-03655

EFFECTS OF INCREASING DRAINAGE IN THE SAN JOAQUIN VALLEY,
California Univ., Davis. Dept. of Land, Air and Water Resources.
B. R. Hanson.
California Agriculture, Vol. 38, No. 10, p 40-41, October, 1984. 2 Fig.

Descriptors: *Drainage, *Irrigation, *Salinity, *San Joaquin Valley, *California, Water tables, Saline soils, Leaching, Evaporation ponds.

Most soil salinity problems in the San Joaquin Valley are directly related to shallow saline water tables. Clay lenses underlying irrigated land in the Valley restrict the downward movement of both deep percolation from irrigation and seepage from ditches, canals, and rivers. A shallow saline water table causes soil salinity problems by a combination of upward flow of saline water and inadequate leaching. The traditional method of coping with water table problems is to install a subsurface drainage system. The most positive effect of increased drainage is the preservation of one of California's natural resources, the soil of the San Joaquin Valley, an area unique in its capacity for agricultural production. The negative effects of increased drainage lie in the disposal problem. The San Joaquin Valley Interagency Drainage Committee, in an attempt to develop a suitable disposal plan, concluded that a valleywide master drain discharging into the Sacramento-San Joaquin Delta would be the most feasible disposal method. Until the discharge problems of a master drain are ironed out, evaporation ponds, both on-farm and district wide, will increase. Another negative effect of evaporation ponds is their long-term accumulation of salts. Minimizing the negative effects while maintaining an acceptable level of productivity means reducing the volume of drainage water and at the same time controlling soil salinity. Improved irrigation efficiency is one method for minimizing drainage problems. Another approach is better irrigation scheduling to reduce the number of irrigations. One means of reducing the volume of drainage water is to use this water for irrigation. (Baker-IVI)
W85-03657

1983 HIGH FLOWS ON THE COLORADO RIVER AND THEIR AFTERMATH,
Colorado River Board of California, Los Angeles.
M. B. Holburt.
Water International, Vol. 9, No. 3, p 99-105, September, 1984. 1 Fig.

Descriptors: *Colorado River, *Flood control, *Water management, Floods, Weather forecasting, Flood forecasting, Decision making, River flow, Reservoir releases, Hoover Dam.

The Colorado River is a major water resource for seven western states and a portion of northwestern Mexico. Its drainage basin encompasses an area of 244,000 sq mi. The annual virgin flow at Lee Ferry has ranged from a low of 5.5 million acre-ft (maf) to a high of 24.0 maf. The preliminary estimate of the virgin flow in 1983 is 23.9 maf. In its management of the near record runoff of 1983, the Colorado River Board was able to limit the maximum Hoover monthly release to less than 42,000 cfs, just slightly above the 40,000 cfs monthly release objective of the flood control regulations, an event that has a frequency of occurrence of between 1 in 200 and 1 in 333 years. This demonstrates that sufficient operational flexibility is provided in the flood control regulations to not only accommodate a near record runoff but to accommodate its occurrence late in the runoff season. The completed and planned improvements in collection of weather data, in procedures for forecasting runoff, and in river operation should enable similar runoff events to be better handled within the maximum Hoover Dam release objective of 40,000 cfs. Improvements in the river operating and runoff forecasting procedures will further ensure the safety and well being of inhabitants along the lower Colorado River without jeopardizing the water supply aspects of the river developments, which will become more critical in the near future as the water demands soon equal and surpass the available water supplies. (Baker-IVI)
W85-03704

NEEDED ECONOMIC FRAMEWORK FOR FLOOD PLAIN MANAGEMENT,
Florida Univ., Gainesville. Bureau of Economic and Business Research.
J. W. Milliman.
Water International, Vol. 9, No. 3, p 119-126, September, 1984. 1 Fig, 17 Ref.

Descriptors: *Flood control, *Flood plain management, *Economic aspects, Planning, Decision making, Water management, Flood damage, Risk assessment, Public policy, Institutional constraints, Cost-benefit analysis, Developing countries.

Flooding is by far the most serious natural hazard problem in the US in terms of property damage and loss of life. Similar conditions exist in most developing countries where adequate management of flood hazards is particularly critical. The basic challenge of the flood problem is the development of a set of management strategies which can permit more intensive use of flood plains and yet minimize expected losses. Six management issues are outlined. First is the task of reformulation of the problem of flood hazard mitigation from an emphasis on hazard reduction per se to one of an efficient use of flood-prone lands and development of socially acceptable levels of residual risk. Second, there is need to specify more clearly what is the economic rationale for public action in flood hazard mitigation in relation to the role of markets and private choice. Third, analysis is needed to specify in theoretical and in operational terms the efficient level of mitigation. Fourth, the question of what constitutes a proper measure of loss is of critical importance. Fifth, economic evaluation of existing institutions and policies in the flood hazard field is clearly needed. Finally, benefit-cost studies of selected mitigation measures are proposed. An overlying concern throughout the paper is that present institutional arrangements may act as barriers to efficient policy and obscure the rationale for other kinds of economic analysis. (Baker-IVI)
W85-03707

REAL-TIME FLOOD FORECASTING TECHNIQUE,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. Mimikou, H. Skaltsas, and T. Methanis.
Water International, Vol. 9, No. 3, p 127-135, September, 1984. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Flood control, *Flood forecasting, *Greece, *Kalamas River, Forecasting, Flood plain management, Rainfall, River basins, Flood warnings, Water level.

A simple hydrologic technique has been developed which is successfully being applied to short term forecasting and warning of floodflows in real time at the outlet of a river basin by using rainfall information and water levels of the flood events at an upstream index station of the basin. The time of occurrence of the forecasted flood flow is also estimated. Rainfall has not been used as the basic input to the model, but as a parameter explaining changes in the flood water level relationship and thus, in the river basin's response during floods. These changes are consequences of differentiations in the hydrometeorological regime of the basin. This type of usage of the rainfall has simplified the model very much. The forecasting model has been implemented into a simple nomogram, which can be used even by nonspecialists utilizing the upstream input information which is transferred to the outlet by telephone. The basic advantages of the forecasting technique are: its applicability to real time forecasting, the lack of any requirements for automatic network or for in field computer facilities, its simplicity and its accuracy. The technique is very useful in solving specific engineering problems, such as flood warning during dam construction, especially in a country such as Greece with a conventional hydrometeorological network and limited financial resources. The successful application of the flood forecasting technique to the middle course of the Kalamas river in Northwestern Greece has shown that it is satisfactory and operationally reliable. (Baker-IVI)
W85-03708

UK DROUGHT 1984,
British Meteorological Office, Bracknell (England).
S. D. Burt.
Weather, Vol. 39, No. 11, p 350-351 and 347, November, 1984, 4 Fig, 3 Ref.

Descriptors: *Drought, *England, *Scotland, *Wales, *Water management, Restrictions, Rationing, Rainfall, Water supply.

The British Isles have experienced considerable restrictions in water supply for the second time in eight years resulting from prolonged dry weather. In 1976 the greatest shortfall of rain occurred in southern England with values over the five month period of April to August reading below 20% of

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1941-1970 normal levels. In 1984 the worst hit area was Glasgow experiencing its driest April to August period since records began in 1869. The 500 mbar flow shows evidence of a weak ridge to the west of Britain, and a trough over Europe. By late August some 23 million people were affected by some form of restrictions on the use of water, mostly hosepipe bans, with rationing imminent in parts of south-west England, many parts of Wales, parts of north-west England, and in south-west Scotland. Fortunately, widespread heavy rains in September alleviated the situation to a great extent, as they had done in the previous drought of 1976. (Baker-IVI)
W85-03731

APPLICATION OF A PHYSICALLY-BASED DISTRIBUTED PARAMETER MODEL FOR ARID-ZONE SURFACE-GROUNDWATER MANAGEMENT,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W85-03752

4B. Groundwater Management

SALINE-SEEP RECLAMATION IN THE NORTHERN GREAT PLAINS,
Agricultural Research Service, Akron, CO.
A. D. Halvorson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 773-778, May/June, 1984. 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Saline seeps, *Land reclamation, *Great Plains, Saline soils, Irrigation effects, Planning, Water management, Crop yield, Soil management, Groundwater recharge.

Dryland soil salinity (salinity-seep) develops when percolating soil water from upslope recharge areas accumulates above nearly impermeable geologic strata and seeps to the soil surface at a downslope position. A study was conducted in order to determine changes in soil salinity with time, to evaluate the effectiveness of soil ridges, straw mulch, gypsum, fallow, and check (natural revegetation) in accelerating the reclamation process, and to determine potential crop yields in arrested saline-sweep areas. Soil salinity of the 0-30 cm soil depth was reduced sufficiently 2 years after the seep was arrested to allow many crops to be successfully grown. Crop yields in the arrested saline-seep areas generally equalled average county yields after 3 to 4 years of hydrologic control. Treatment with a straw mulch was most effective in reducing soil salinity in the 0-90 cm soil depth. The check (revegetated) treatment was the least effective. Gypsum application did not accelerate the reclamation process. Seven years after hydrologic control was obtained, soil salinity was still higher in the arrested saline-seep areas than in that of adjacent non-seep areas. Rate of salt removal from arrested dryland saline-seep areas depends on distribution and amount of precipitation received. Hydrologic control in the recharge area must be maintained to prevent reactivation of an arrested saline seep. (Baker-IVI)
W85-03384

PROBLEMS OF WATER VOLUME BALANCE IN THE SPREE RIVER DISTRICT IMPACTED BY MINING OPERATIONS (PROBLEME DER WASSERMENGENBILANZ IM BERGBAU-BEEINFLUSSTEN SPREEGEBIET),
Wasserwirtschaftsdirektion Obere Elbe-Neisse, Dresden (German D.R.).
For primary bibliographic entry see Field 3B.
W85-03515

KRAFLA GEOTHERMAL FIELD, ICELAND; 1. ANALYSIS OF WELL TEST DATA,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W85-03553

KRAFLA GEOTHERMAL FIELD, ICELAND; 2. THE NATURAL STATE OF THE SYSTEM,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W85-03554

KRAFLA GEOTHERMAL FIELD, ICELAND; 3. THE GENERATING CAPACITY OF THE FIELD,
California Univ., Berkeley. Lawrence Berkeley Lab.
G. S. Bodvarsson, K. Pruess, V. Stefansson, and E. T. Eliasson.
Water Resources Research, Vol. 20, No. 11, p 1545-1559, November, 1984. 20 Fig, 1 Tab, 30 Ref. DOE contract DE-AC03-76SF00098.

Descriptors: *Krafla Geothermal Field, *Geothermal resources, *Iceland, *Geothermal power, Wells, Model studies, Porosity, Groundwater recharge, Electric power production.

The Krafla geothermal field can be divided into two sections, the old wellfield west of Hveragil, and the new wellfield to the east where some of the more recently drilled wells are located. Analytical and numerical studies of the generating capacity of the Krafla field are reported. A general lumped parameter model that can be used to obtain rough estimates of generating capacities of geothermal systems is developed. The model is applied to the old wellfield at Krafla, and the results show the effects of parameters such as porosity and recharge on the generating capacity. To obtain more reliable estimates of the generating capacity of the wellfield, several areal two-dimensional distributed parameter models are developed. In these models the wellfield is simulated using a single block, but the recharge into the well field is modeled in detail. The generating capacities of the old and new wellfields at Krafla are 30 and 20 MW for 30 years, respectively. Consequently, several additional wells can be drilled in the old and new wellfields. (Baker-IVI)
W85-03555

KRAFLA GEOTHERMAL FIELD, ICELAND; 4. HISTORY MATCH AND PREDICTION OF INDIVIDUAL WELL PERFORMANCE,
California Univ., Berkeley. Lawrence Berkeley Lab.
K. Pruess, G. S. Bodvarsson, V. Stefansson, and E. T. Eliasson.
Water Resources Research, Vol. 20, No. 11, p 1561-1584, November, 1984. 30 Fig, 7 Tab, 35 Ref. DOE contract DE-AC03-76SF00098.

Descriptors: *Krafla Geothermal Field, *Iceland, *Geothermal resources, Model studies, Wells, Reservoirs, Resources development, Geothermal power, Well injection.

A detailed distributed parameter model, in which all wells are represented individually, is reported for the Krafla geothermal system. The model is based on a synthesis of geological, geophysical, geochemical, and reservoir engineering data from the field. The utility of the model as a tool for evaluating future field performance is illustrated by examining a number of alternative production and injection scenarios. The behavior of individual wells is strongly dependent on local conditions. Flow rate declines are generally slow (1-4% per year) with substantial interference expected in the longer term of 10 years. Future exploitation will give rise to extended vapor zones in the reservoirs. If long-term benefits are to be achieved, it is necessary to locate new wells outside the presently producing areas. Effects of injection on usable steam output at the separators will be small in the short term (a few years). Injection will improve well deliverabilities after extended single-phase steam zones have formed (10 years). One of the primary uncertainties in the prediction of future well deliverabilities lies in the relative permeability functions, which are not well known at the present time. Future studies should also attempt to quantify the effects of vertical flow and of fluid and heat flow between rock matrix and fractures, as suggested by the present model. (Baker-IVI)
W85-03556

RESTORING WELL YIELD IN THE NETHERLANDS,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
C. G. E. M. van Beek.
Journal of the American Water Works Association, Vol. 76, No. 10, p 66-72, October, 1984. 7 Fig, 1 Tab, 25 Ref.

Descriptors: *Water supply, *Well yield, *Clogging, *Netherlands, Wells, Iron hydroxides, Calcium carbonate, Microorganisms, Biomass, Well rehabilitation.

Water well clogging in the Netherlands was investigated. The causes, symptoms characteristic of the various causes, methods of regenerating production and preventive measures are discussed. Well clogging is considered to be present if a well must be rehabilitated once or more within 15 years after it has been put in service. Well clogging is characterized by a continuous decrease in the specific volume of flow, defined as the discharge volume per meter of drawdown, where drawdown is the difference between the water level in the well during operation and inaction. Well clogging can be caused by an accumulation of iron hydroxides and biomass, by anaerobic microbiological processes, or by the accumulation of calcium carbonate. One method of treatment involves the injection of an acid with a chemical resistant pump. Methods of mechanical rehabilitation also exist. In many cases a combination of the mechanical and chemical methods are used. (Baker-IVI)
W85-03620

DESIGN OF A PHYSICALLY-BASED DISTRIBUTED PARAMETER MODEL FOR ARID-ZONE SURFACE-GROUNDWATER MANAGEMENT,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W85-03751

APPLICATION OF A PHYSICALLY-BASED DISTRIBUTED PARAMETER MODEL FOR ARID-ZONE SURFACE-GROUNDWATER MANAGEMENT,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
T. H. Illangasekare, H. J. Morel-Seytoux, and E. J. Koval.
Journal of Hydrology, Vol. 74, No. 3/4, p 233-257, November, 1984. 4 Fig, 4 Tab, 15 Ref.

Descriptors: *Conjunctive use, *Arid zone, *Saudi Arabia, *Wadi Jizan, Mathematical models, Surface water, Flood control, Simulation, Suplemental irrigation, Groundwater managment, Flood-spreading.

A previously developed distributed parameter model was used to conduct a case study in the Wadi Jizan aquifer in Saudi Arabia, to investigate the conceptual feasibility of implementing a good development strategy of surface- and groundwater in the region. Four development strategies based on three surface-water development schemes and two groundwater development schemes were designed. The model simulated the physical and operational behavior of the system for a 17-yr. study period. The strategies were evaluated with respect to their effects on the surface-water system which consists of the wadi, distribution canals and farms, the groundwater system which consists of the unsaturated and saturated zones of the aquifers, the agronomic system which includes all the components which deals with the use of water for crop production. The development strategies investigated demonstrated real improvements to the agronomic system through the use of groundwater for supplemental irrigation (along with the traditional flood-spreading system). Improvements were also demonstrated through an improved flood-spreading system relying on attenuated wadi inflows with a large but filled storage structure. The largest improvements to the agronomic system would be

ossible by the combination of these strategies. Moore-IVI)
V85-03752

3C. Effects On Water Of Man's Non-Water Activities

OIL PROPERTIES OF SURFACE MINED LAND,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W85-03392

3D. Watershed Protection

GULLIES OF IMO,
Ibadan Univ. (Nigeria). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W85-03350

IMPROVED SOIL EROSION CLASSIFICATION FOR CONSERVATION POLICY,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W85-03351

MATHEMATICAL MODEL OF EROSION AND DEPOSITION ON A WATERSHED,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 2J.
W85-03366

EFFECT OF SOIL AIR ENTRAPMENT ON EROSION,
Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.
J. L. Suhr, A. R. Jarrett, and J. R. Hoover.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 93-98, January/February, 1984. 8 Fig, 1 Tab, 10 Ref.

Descriptors: *Erosion control, *Infiltration, *Plow pan, *Soil air, Conservation, Erosion, Soil loss, Grass, Venting.

When water is present at the soil surface, as a result of rainfall, irrigation, or overland flow, the water will either infiltrate into the soil or become runoff. The infiltration rate is reduced when the soil air contained in the unsaturated soil cannot escape from the zone ahead of the wetting front. The effects of soil air entrapment on erosion and infiltration were investigated by two laboratory studies, one with a fallow soil and one with a grass cover. Both the fallow soil and the grass cover experiment had a zone which restricted the downward movement of soil air. Soil air was trapped between the restrictive zone and an advancing wetting front produced by applying overland flow for the air-trapped treatments. Vent tubes permitted soil air to escape at the restrictive layer during the air-vented treatments. When the soil air was trapped by the plow pan the erosion rates were greater for both flow rates. The erosion rates for both trapped and vented treatments decreased with time during each run. The simulated plow pan was effective in trapping the soil air; the vented treatments had a small, positive pressure. Infiltration rates were decreased by entrapping the soil air, thus increasing runoff and aiding, to a small degree, the erosion process. The treatments on the established grass cover exhibited random erosion rates because of the disturbance of the lower end of each plot by adjustment of the plot ends to match the soil surface. The infiltration rates for these treatments were not adversely affected by plot end adjustments. Air trapping decreased the infiltration rate the most during the treatments with the lowest bulk densities. The influence of entrapped air on infiltration rates decreased as the bulk densities increased during the growing season. (Baker-IVI)
W85-03369

INTERRILL EROSION AS AN INDEX OF MINED LAND SOIL ERODIBILITY,
Montana State Univ., Bozeman.
For primary bibliographic entry see Field 2J.
W85-03370

SOIL EROSION POTENTIAL OF RECLAIMED MINED LANDS,
Hydroeco-System Research Group, Fort Collins, CO.
For primary bibliographic entry see Field 2J.
W85-03398

TILLAGE, RESIDUE AND EROSION ON MODERATELY SLOPING SOILS,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W85-03402

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DETERMINATION OF CADMIUM AND LEAD IN NATURAL WATERS,
Trieste Univ. (Italy). Ist. di Merceologia.
L. G. Favretto, G. P. Marletta, and L. Favretto.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 318, No. 6, p 434-435, July, 1984. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Water analysis, *Cadmium, *Lead, Heavy metals, Trace metals, Atomic absorption spectroscopy, Mine drainage,.

Water samples containing clay particles with < 4 micro-m equivalent spherical diameter, were analyzed after shaking for a few seconds. In the atomic-absorption spectroscopic analysis of trace metals by electrothermal atomization in a graphite tube, cadmium and lead show non-linear calibration graphs, with a pseudo-linearity when the amount of metal vaporized is near to the detection limit. Non-linear plots result from standard additions of the metal to the sample solution. The function is applied in this research to analyze water samples from mine drainages. Although the procedure seems to require a significant amount of time, it has the advantage of drawing the calibration line with the real matrix, avoiding the use of matrix modifiers. If the matrix does not change among samples, the multiple standard addition line made with the analyte-containing sample at the lowest level, can be directly used as a calibration curve for other samples with higher levels of analyte, provided that all experimental conditions remain unchanged. (Baker-IVI)
W85-03278

CERTIFICATION OF THE CONTENTS OF SOME HEAVY METALS (CD, CO, CU, MN, HG, NI, PB, AND ZN) IN THREE TYPES OF SEWAGE SLUDGE,
Community Bureau of Reference, Brussels (Belgium).
B. Griepink, H. Muntau, and E. Colinet.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 318, No. 7, p 490-494, August, 1984. 7 Tab, 6 Ref.

Descriptors: *Heavy metals, *Sludge, *Wastewater analysis, Cadmium, Copper, Zinc, Mercury, Nickel, Lead, Copper, Manganese.

Three different souces of systematic and random errors exist in trace analysis: i) sample preparation, ii) final measurement, and iii) the general laboratory attitude. To avoid any systematic error to the best state of the art one should certify in such a way that more sample treatment techniques are applied, that more techniques of final determination are used and that more and independent laboratories are involved in the application of the different sample treatments and techniques of final determination. A working group of select laboratories was established to carry out the various determinations. Sludge samples came from a sewage treatment plant in a rural area, a plant where industrial and rural wastewaters are treated, and a mainly industrial source. After the analyses the results and the pertinent methods were critically examined by the participants. The technical discussion is an integral part of the certification. Results accepted for technical reasons were then processed statistically. The certified contents as well as values for Cd, Co, Cu, Mn, Hg, Ni, Pb and Zn are given. (Baker-IVI)
W85-03279

DETERMINATION OF TRACES OF MERCURY IN WATERS IN THE PPT-RANGE (ZUR BESTIMMUNG VON QUECKSILBERSPUREN IN WASSERN IM PPT-BEREICH),
Bezirks-Hygieneinspektion und -Institut, Magdeburg (German D.R.).
P. Neske, A. Hellwig, L. Dornheim, and B. Thriene.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 318, No. 7, p 498-501, August, 1984. 4 Fig, 19 Ref.

Descriptors: *Mercury, *Water analysis, Atomic absorption spectrometry, Heavy metals, Spectrometry, Pollutant identification.

The determination of extreme low amounts of mercury in waters is described. The procedure comprises an enrichment step, in which the mercury is collected by direct contact of the sample with a gold collector, as well as high sensitive atomic absorption spectrometric detection. A detection limit of 300 pg was obtained. Concentrations below 0.5 ppt are detectable with a sample volume of 1 l. Organo-mercury compounds are determined, too. The advantages in comparison with other enrichment techniques are discussed. (Author's abstract)
W85-03280

ENVIRONMENTAL FATE AND MONITORING OF ORGANIC MICROPOLLUTANTS,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
A. Opperhuizen, E. H. G. Evers, and O. Hutzinger.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 2, p 137-140, September, 1984. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Monitoring, *Fate of pollutants, *Organic compounds, Sampling, Water analysis, Pollutant identification, Data analysis, Bioindicators.

The primary objective in monitoring of micropollutants is to register variations of concentration in time and over geographical areas. Monitoring is thus not only a compilation of sample data, but the result of a well designed scheme. Ambient concentrations of organic pollutants in various environmental compartments are largely determined by the compounds' fate and their release rate. For sophisticated monitoring programs suitable environmental fate models must be available, in addition to advanced techniques and methods for the collection of useful data. The analytical steps are: sampling; sample preparation; analysis; and data processing. To reduce the problems associated with physical sampling, active biological monitoring can be used. In the analysis of organic micropollutants in water, special attention must be given to the real concentration of dissolved pollutants and to pollutants adsorbed onto particulate matter. (Moore-IVI)
W85-03284

SPATIAL AND TEMPORAL CONCENTRATION GRADIENTS OF PAH (FLUORANTHENE, BENZO(A)PYRENE), GAMMA-BHC AND 2,4-D IN SAMPLES OF SOIL, SOIL

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WATER AND GROUND WATER IN AN AGRICULTURAL RESEARCH AREA,
Central Electricity Generating Board, Ratcliffe-on-Soar (England). Scientific Services Dept.
For primary bibliographic entry see Field 5B.
W85-03289

APPLICABILITY OF THE FLUORESCEIN DIACETATE METHOD OF DETECTING ACTIVE BACTERIA IN FRESHWATER,
Texas Univ. at Arlington. Dept. of Biology.
T. H. Chrzanowski, R. D. Crotty, J. G. Hubbard, and R. P. Welch.
Microbial Ecology, Vol. 10, No. 2, p 179-185, 1984. 2 Fig, 1 Tab, 16 Ref. University of Texas at Arlington Organized Research Fund grants 15-216 and 15-222.

Descriptors: *Fluorescein diacetate, *Bacterial analysis, Fluorescein, Dyes, Metabolism, Gram-negative bacteria, Eucaryotes, Gram-positive bacteria.

Fluorescein diacetate (FDA) is a nonfluorescent derivative of fluorescein. FDA hydrolysis was evaluated as a means to detect actively metabolizing bacteria in freshwater. FDA can be transported across cell membranes and deacetylated by nonspecific esterases to fluorescein. Fluorescein, which fluoresces brilliant green when irriadiated with blue light, is polar and resists extrusion from cells. Fluorescein accumulates within cells and allows direct visualization by epifluorescent microscopy. Estimates of active cells were 49-61% lower than estimates of active cells obtained from measures of electron transport activity. The low proportions of FDA-active bacteria in freshwater habitats result from the inability of FDA to penetrate the outer membrane of the gram-negative cell envelope in some species. Cells faded quickly making observation and counting difficult and unreliable. Despite improvement of the permeability in both cultures and natural samples through the use of EDTA, FDA staining of gram-negative cells remained weak. FDA hydrolysis as a means of detecting active bacteria may be limited to environments rich in eucaryotes and gram-positive cells. (Moore-IVI)
W85-03306

RELATIONSHIPS BETWEEN THE PARTITIONING OF TRACE METALS IN SEDIMENTS AND THEIR ACCUMULATION IN THE TISSUES OF THE FRESHWATER MOLLUSC ELLIPTIO COMPLANATA IN A MINING AREA,
Quebec Univ., Sainte-Foy.
For primary bibliographic entry see Field 5B.
W85-03308

MICRODETERMINATION OF SILICIC ACID IN WATER BY GEL-PHASE COLORIMETRY WITH MOLYBDENUM BLUE,
Kyushu Univ., Fukuoka (Japan). Dept. of Chemistry.
K. Yoshimura, M. Motomura, T. Tarutani, and T. Shimono.
Analytical Chemistry, Vol. 56, No. 13, p 2342-2345, 1984. 6 Fig, 3 Tab, 13 Ref.

Descriptors: *Colorimetry, *Silicic acid, *Molybdenum blue, Water analysis, Water treatment, Industrial water, Silicon compounds, Gel-phase colorimetry.

Electronic grade industrial water of high purity is used as a washing agent in the production of integrated circuits. The production of higher integrated circuits demands pure water of higher quality and results in the necessity of trace determination of silicic acid. The blue species of molybdosilicic acid is strongly adsorbed on Sephadex gels. About 70% of the species in a 100-cu cm sample solution is concentrated in 0.20 g of Sephadex G-25 within a half an hour. A sensitive method, gel-phase colorimetry, is based on the direct measurement of light absorption by a gel phase, which has adsorbed the blue species. The colored gel beads are packed into a 5-mm cell, the absorbances at 805 and 450 nm are measured, and the absorbance difference is used for the determination of traces of silicic acid. In the gel-phase colorimetry, concentration of the molybdenum blue species and the color development take place simultaneously. As a result, silicic acid at parts-per-billion or lower levels can be determined in a conveniently short time. (Moore-IVI)
W85-03340

ANOMALIES IN THE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF DIQUAT IN WATER SAMPLES,
Ruakura Agricultural Research Center, Hamilton (New Zealand).
D. R. Lauren, and M. P. Agnew.
Journal of Chromatography, Vol. 303, No. 1, p 206-210, October, 1984. 1 Tab, 6 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Herbicides, Drinking water, Lake water, Diquat, Paraquat, High-performance liquid chromatography.

A series of tests using different flush volumes to fill the 10 micro liter sample loop with diquat standards of 1 mg/l made in solutions of different ionic strength suggested that anion exchange type adsorption of diquat on the stainless-steel loop was occurring. Injections made with two solutions of low ionic strength showed a steadily increasing peak height as the flush volume increased. With a 1000 micro-l flush, the peak height was over three times that achieved when the loop was flushed with 25 micro-l. Peak heights obtained with all other solutions were less affected by flush volume. Only 10 mg/l of an ionic compound needed to be added to pure water to bring the behavior in line with solutions in tap, river, and lake water. Injections made in the strongly ionic HPLC eluent solutions showed the least effect from flush volume. In view of the strongly ionic nature of the eluent, adsorption within the flowing part of the system should be minimal, but may increase peak tailing. The major problems arise from sample transfer and injection. The most obvious effect caused by diquat adsorption onto the sample loop was non-reproducibility, but two less obvious effects noted were non-linearity and carryover. To reduce carryover, the injector should be kept in the inject position through the analysis and flushed with the HPLC eluent between samples. The HPLC method for diquat analysis is satisfactory for the direct determination of low levels in environmental samples providing certain precautions are observed. The method should be suitable for paraquat as well. (Baker-IVI)
W85-03405

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC ANALYSIS OF ROTENONE AND ROTENONONE IN WATER BY DIRECT INJECTION,
Maine Univ., Orono.
R. J. Bushway.
Journal of Chromatography, Vol. 303, No. 1, p 263-266, October, 1984. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Pollutant identification, *High-performance liquid chromatography, *Insecticides, *Rotenone, *Rotenonone, Organic compounds, Water analysis, Drinking water.

A technique is described whereby rotenone and rotenonone (a degradation product of rotenone in water) can be detected at the low ppb level by direct injection into a high-performance liquid chromatography system. Results are given from the direct injection of two types of spiked water samples, pond and drinking. Spiked samples varied in concentration from 15 to 60 ppb for rotenone and 17 to 68 ppb for rotenonone. The precision was fine for rotenone with percent coefficients of variation ranging from 3.17 to 7.58%. The percent coefficients of variation for the rotenonone were much higher, 4.72 to 16.50%. A typical analysis of pond water sample spiked at the second lowest ppb level was 11 min with rotenone eluting first. The lowest concentration of each substance detected was 15 ppb for rotenone and 17 ppb for rotenonone, but it should be possible to quantify levels of 7.5 ppb and 8.5 ppb, respectively. Both compounds were linear over a wide range, rotenone from 15 to 300 ppb while rotenonone was linear from 17 to 415 ppb. (Baker-IVI)
W85-03406

SPECTROPHOTOMETRIC DETERMINATION OF CYANIDE BY UNSEGMENTED FLOW METHODS,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
A. Rios, M. D. Luque de Castro, and M. Valcarcel.
Talanta, Vol. 31, No. 9, p 673-678, September, 1984. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Pollutant identification, *Cyanide, *Flow injection analysis, Water analysis, Spectrophotometry, Industrial wastes, Wastewater analysis.

Photometric methods for cyanide determination by normal and reversed flow-injection analysis (FIA) techniques and by completely continuous monitoring are proposed. Three variants are proposed, for analysis of scarce or valuable samples (use of normal FIA), wastewaters (use of reversed FIA), and a continuous stream (completely continuous method). The sampling rates for the first two techniques are 20 and 28/hr, respectively. The flow techniques have clear advantages over the traditional photometric one except that the sensitivity and the detection limit are more favorable in the traditional technique. The highest sensitivity and lowest detection limit here were obtained by conventional FIA. The most significant interference came from species with cyanide groups such as thiocyanate, ferrocyanide and ferricyanide (positive interferences) and cations that form complexes with cyanide such as silver, copper, cobalt, and nickel (negative interferences). (Baker-IVI)
W85-03408

DETERMINATION OF MUNITIONS COMPONENTS IN WATER BY RESIN ADSORPTION AND HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY-ELECTROCHEMICAL DETECTION,
Oak Ridge National Lab., TN.
M. P. Maskarinec, D. L. Manning, R. W. Harvey, W. H. Griest, and B. A. Tomkins.
Journal of Chromatography, Vol. 302, No. 1, p 51-63, October 19, 1984. 5 Fig, 3 Tab, 22 Ref. DOE contract DE-AC05-840R22400.

Descriptors: *Pollutant identification, *Munitions, *Chromatography, *Nitroorganic compounds, *Electrochemical detection, *Resin adsorption, Nitramines, Nitrotoluenes, Nitroaliphatics, Water analysis.

A resin-based isolation scheme is presented for a wide range of munitions components and munitions by products in surface and groundwater. For the most part these compounds are non-volatile and sparingly soluble in water. The method is based on Porapak resin adsorption of the munitions components from aqueous samples. Following desorption with acetone, the nitro compounds are measured by high performance liquid chromatography with electrochemical detection at a gold-mercury electrode, which is maintained at -1.0 V vs. a silver-silver chloride reference electrode. This technique provides a high degree of selectivity and sensitivity for these compounds in actual samples. Detection limits approach 1 micro-g/l for many components. Analysis time is approximately two hours per sample for isolation and quantitation although many samples can be prepared simultaneously. (Baker-IVI)
W85-03410

SAMPLE ENRICHMENT FOR GAS CHROMATOGRAPHIC MASS SPECTROMETRIC ANALYSIS OF POLYNUCLEAR AROMATIC HYDROCARBONS IN WATER AND IN ORGANIC MIXTURES,
Urbino Univ. (Italy). Ist. di Scienze Chimiche.
F. Bruner, G. Furlani, and F. Mangani.

urnal of Chromatography, Vol. 302, No. 1, p 7-172, October, 19, 1984. 2 Fig, 2 Tab, 9 Ref.

escriptors: *Chromatography, *Pollutant identiation, *Graphitized carbon black, *Polynuclear omatic hydrocarbons, Mineral oil, Carbon black, xtraction, Preconcentration.

nong the extraction and preconcentration steps ed for polynuclear aromatic hydrocarbons, xhlet extraction is largely used for atmospheric st or other solid material, while liquid-liquid traction is the method which has been suggested r extraction from water. The use of graphitized rbon black for liquid-solid extraction and prencentration from water was explored. The propties of different kinds of graphitized carbon black traps for the extraction and preconcentration of lynuclear aromatic hydrocarbons from water d mineral oil were determined. The best results ere obtained with Carbopack F, eluted with tolue at 100 C. Graphitized carbon black is preferred cause of its thermal and chemical stability and its gh purity, exhibiting no bleeding and possessing gh sensitivity. (Baker-IVI)
85-03411

ETERMINATION OF ARSENITE AND ARSEATE BY DIFFERENTIAL PULSE POLAROGAPHY,
exas A and M Univ., College Station. Dept. of hemistry.
. Chakraborti, R. L. Nichols, and K. J. Irgolic.
resenius's Zeitschrift fur Analytische Chemie, ol. 319, No. 3, p 248-251, October, 1984. 3 Fig, 2 ab, 16 Ref. EPA grant R804774010.

escriptors: *Differential pulse polarography, Arsenic, *Arsenite, *Arsenate, *Chemical analys, Mannitol, Detection limits, Polaragraphy.

rsenate was determined by differential pulse porography in acidic solutions in the presence of olyhydroxy compounds. The best medium was und to be 2.0 M aqueous HClO4 containing 4.5 g -mannitol in 50 ml solution. The peak heights easured at -0.55 V gave linear calibration curves the concentration range 20 micro g/l to 160 mg/ As. Arsenite was similarly determined with mantol at -0.34 V or without mannitol at -0.42 V. hen arsenite and arsenate were present in soluon, the simultaneous determination of these comunds in the presence of mannitol was generally ot possible because the peak heights at -0.34 V nd -0.55 V were influenced by arsenite as well as senate. In these cases arsenite was determined at .42 V in the absence of mannitol. After oxidation arsenite to arsenate by chlorine water and addion of mannitol, total inorganic arsenic was deterined as arsenate at -0.55 V. The arsenate concenation in the sample was found as the difference etween the concentrations of total inorganic arnic and arsenite. The detection limit for arsenite nd arsenate was found to be approximately 10 icro g/l As. This method was successfully used o determine arsenite and arsenate in a synthetic ver sample and some arsenic-containing drinking ater samples. (Author's abstract)
85-03412

INGLE SPECTROPHOTOMETRIC DETERMINATION OF K-SURFACTANTS IN THE RESENCE OF A-AND N-SURFACTANTS EINFACHE SPEKTROPHOTOMETRISCHE ESTIMMUNG VON K-TENSIDEN IN GEGENART VON A- UND N-TENSIDEN),
. Hellmann.
resenius's Zeitschrift fur Analytische Chemie, ol. 319, No. 3, p 272-276, October, 1984. 5 Fig, 4 ab, 6 Ref.

escriptors: *Spectrophotometry, *Surfactants, Ammonium compounds, Dragendorff reagent, Niotensides, Chemical analysis.

ation-active surfactants in the form of quaternary mmonium compounds may be transformed by the o-called modified Dragendorff reagent in aqueous olution into the k-Ba (Bi I4)2 complex which is xtracted with tetrachloromethane. Anionic suractants do not interfere. Niotensides are also precipitated, however not extracted with CCl4. The adsorbance of the colored k-complex is measured at 500 nm. The limit of determination is about 10 micro g. The method was tested on surface waters, municipal wastes and extracts both from purely organic activated sludge and from sewage sludge. (Author's abstract)
W85-03414

FREE FLUORIDE OF THE PAMLICO RIVER IN NORTH CAROLINA; A NEW METHOD TO LOCALIZE THE DISCHARGE OF POLLUTED WATER INTO AN ESTUARY,
East Carolina Univ., Greenville, NC. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W85-03539

USE OF SECOND ORDER DERIVATIVE SPECTROSCOPY IN THE INVESTIGATION OF SOURCES OF COLOURED POLLUTANTS IN WATER,
North West Water Authority, Warrington (England). Rivers Div.
W. A. McCrum.
Water Research, Vol. 18, No. 10, p 1249-1252, 1984. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Water analysis, *Derivative spectroscopy, *Color, Spectroscopy, Monitoring, Water pollution control, Water quality control.

Derivative spectroscopy in the uv-visible region of the spectrum is a technique which records variations in the rate of change of absorbance with wavelength. Different methods are available for obtaining derivative spectra, the most common of which are numerical differentiation by means of digital electronics, analogue differentiation by means of special electronic circuits, and wavelength modulation methods. The most useful characteristic of derivative spectroscopy is the increase in resolution and detail produced. The analytical advantages of the technique are that since small features such as shoulders in the spectrum appear as well defined maxima and minima, it is possible to measure more accurately wavelength positions of the features and derive better qualitative information. Quantitative information can also be derived from these features and also from samples which are turbid or which contain broad background absorbance or the spectrum of an interfering substance. Some examples are provided to quantify the technique where second order derivative spectroscopy has proved useful in the investigation of colored pollutants in water. (Baker-IVI)
W85-03541

PREDICTION OF BIOCONCENTRATION IN FISH,
Building Research Establishment, Princes Risborough (England). Princes Risborough Lab.
R. P. Davies, and A. J. Dobbs.
Water Research, Vol. 18, No. 10, p 1253-1262, 1984. 3 Fig, 5 Tab, 80 Ref.

Descriptors: *Biological magnification, *Fish, *Organic compounds, Solubility, Physicochemical properties, Environmental effects, Water pollution effects.

All chemicals newly marketed within the European economic community must first be assessed for potential environmental hazard. Among the potential hazards is that of bioconcentration. Fish bioconcentration factors (BCF) are used for the prediction of the environmental effects of new chemicals and some studies have proposed that they can be predicted from physico-chemical properties of the chemical. Values were taken from the literature for octanol:water partition coefficients (P) and water solubilities (WS) of chemicals and their correlations with BCF assessed. The BCF correlations with both P and WS were highly significant statistically and similar to those obtained in other studies; however, they are based on a restricted range of chemical types, mainly organochlorines of relatively low molecular weight. There does not appear to be any consensus of opinion as to the degree of precision that BCF tests should achieve. A high level of precision would be illusory. Nevertheless, comparisons of chemical behavior will have to be made. (Baker-IVI)
W85-03542

TOXICITY WARNING MONITOR USING THE WEAKLY ELECTRIC FISH, GNATHONEMUS PETERSI,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
W. Geller.
Water Research, Vol. 18, No. 10, p 1285-1290, 1984. 3 Fig, 1 Tab, 26 Ref.

Descriptors: *Bioindicators, *Toxicity, *Electric fish, *Gnathonemus, *Monitoring, Fish, Water quality, Biomonitoring, Water pollution effects.

Early warning monitors for the detection of hazardous acute toxicity in water should be automatically working systems with short response times. A new type of fish monitor is presented which uses the weakly electric fish Gnathonemus petersi as the test organism. The characterisic electric organ discharges (EOD) of this fish make it possible to use a very simple, low-cost monitor thus avoiding the disadvantages of other systems. The test system consists of a plexiglass test chamber with a flow-through of 4-5 times the chamber volume per hour. The spontaneous EOD are recorded as activity signals. EODs which have a potential of about 500 mV last 0.3 ms and they can be converted to computer-compatible signals by a simple amplifier. The EOD-activity is analyzed by a low cost desk top computer. Two different modes of analysis which represent two levels of response sensitivity are possible either alternatively or simultaneously. The toxicity response of Gnathonemus petersi was measured in experiments with the toxicants mercury, copper, NaAsO2, and cyanide in lake water of pH 8 and conductivity of 295 micromho/cm. The sensitivity to acutely toxic concentrations was found to be as high as that of trout or minnows. (Baker-IVI)
W85-03546

EFFECT OF HIGH CHLORIDE ION CONCENTRATIONS ON THE QUANTITATIVE SPECTROPHOTOMETRIC DETERMINATION OF TRIBROMAMINE IN AQUEOUS MEDIA (INFLUENCE DES IONS CHLORURE SUR LA DETERMINATION QUANTITATIVE DE LA TRIBROMAMINE EN MILIEU AQUEUX PAR SPECTROPHOTOMETRIE D'ABSORPTION ELECTRONIQUE),
Brest Univ. (France). Lab. de Chimie Analytique.
C. Madec, B. Trebern, and J. Courtot-Coupez.
Water Research, Vol. 18, No. 10, p 1291-1297, 1984. 5 Fig, 17 Ref.

Descriptors: *Pollutant identification, *Chemical reactions, *Seawater, *Chlorine, Bromine, Industrial wastes, Biofouling, Chlorination, Cooling water, Salinity.

Use of seawater in the condenser cooling systems of plants such as those of electric power stations poses serious problems due to marine biofouling in the cooling circuits. Chlorination at the condenser inlet has proved to be the most reliable and effective method of preventing the growth of common biofoulers such as mollusks. This process leads to the discharge of toxic chlorinated and brominated effluents around the outlet. A great number of reactions occur when chlorine or hypochlorite is added to seawater. In addition to organic matter, bromine and ammonium ions must be taken into account not only because of their reactivity towards chlorine but also because of their relatively high concentration levels. The effect of salinity, a specific seawater parameter on the formation and decomposition reactions which can be expected is discussed. The quantitative determination of tribromamine in chlorinated seawater by using uncorrected values of the spectrophotometric parameters measured in fresh water leads to wrong results. The higher the chloride concentration is the higher the absorption spectra are modified. Chloride interferences can only be neglected when the halide concentration is lower than 0.1 M which is

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not the case with most seawater. Chloride ions promote hydrolysis of tribromamine as bromide ions do. To investigate this reaction quantitatively, the kinetic model is used as described in the literature. The nature of the ionic species seems to have a more important effect on the tribromamine decomposition than the ionic strength. (Baker-IVI)
W85-03547

STRIPPING TEST FOR ESTIMATION OF THE REMOVAL OF ORGANIC SUBSTANCES BY AERATION (STRIPBARKEITSTEST ZUR ABSCHATZUNG DER ENTFERNBARKEIT ORGANISCHER SUBSTANZEN AUS DEM WASSER DURCH BELUFTEN),
ESWE-Inst. fuer Wasserforschung und Wassertechnologie G.m.b.H., Weisbaden (Germany, F.R.).
K. Haberer, and F. Schredelseker.
Zeitschrift fur Wasser and Abwasser Forschung, Vol. 17, No, 5, p 206-209, October, 1984. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Air stripping, *Aeration, *Chemical analysis, Gas chromatography, Wastewater treatment, Stripping, Organic compounds, Henry constant.

A test was developed which allows predictions for the possible removal of organics by aeration. The velocity constant k, describing the aeration process, was determined in a testing apparatus similar to that of Grob, (Grob, K. and Grob, G. (1974). J Chromatography, Vol. 90, p 303-313) but without a closed loop system. Two L of water are aerated for defined times by blowing nitrogen through the sample. Either the part blown out and adsorbed on activated carbon or the part remaining in the water is measured by use of gas-chromatographic methods. Various methods are possible to evaluate k such as applying the equation for a first order reaction to the aeration process. As the values for k calculated in this way are nearly proportional to the Henry-constants, the efficiency of an aeration plant must be estimated with sufficient precision by use of corresponding comparisons. (Author's abstract)
W85-03593

RAINWATER PH IN THE VICINITY OF HADERA POWER PLANT, ISRAEL DURING THE WINTER SEASON OF 1981-1982,
Hadera Association of Towns for Environmental Protection (Israel).
R. Kolton-Shapira, Y. Lakritz, and M. Luria.
Atmospheric Environment, Vol. 18, No. 6, p 1245-1248, 1984. 2 Fig, 9 Ref.

Descriptors: *Acid rain, *Precipitation chemistry, *Israel, Hadera, Hydrogen ion concentration, Sulfur dioxides, Nitrogen oxides, Powerplants, Soil alkalinity, Buffering, Water pollution sources.

A new method for the continuous pH measurement of rainwater is discussed. The method, applied at a site near a new coal-fired power plant (prior to its operation) showed a pH variation of 4.3 to 9.2 as compared to 6.5 observed using conventional methods which measure pH at the end of each rain episode. The alkalinity of top soil in the vicinity, and hence natural aerosols act as a buffer, reducing the acidity of the rain. This buffering effect disappears after 30-40 mm of rainfall. A pH of more than 7.5 was noted at the early stages of rainfall. After 30-40 mm of rain, the pH decreased to less than 5.6. A complete washout of the atmosphere varied with the aerosol mass load and the time period between two rain events. In six of the 22 rain episodes recorded, a pH lower than 5.6 was noted for anthropogenic reasons. During the night, winds tend to blow north westward, so pollutants from the coastal sources are transported towards the sea. The daytime flow pattern is nearly reversed. As the sun rises, this air is transported eastward and photooxidizes. Sulfur dioxide and nitrogen oxides are converted to acid aerosols over the eastern Mediterranean Sea. When the return of this air parcel coincides with a rain storm, these acidic aerosols are washed from the air. Only partial information is provided by measuring bulk quantities of rain after each precipitation period. The detection of the extreme pH levels which exist is only possible by continuous monitoring using the flow system as described. (Baker-IVI)
W85-03597

ESTIMATING MEAN COLIFORM DENSITIES OF WATER DISTRIBUTION SYSTEMS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
W. O. Pipes, and R. R. Christian.
Journal of the American Water Works Association, Vol. 76, No. 11, p 60-64, November, 1984. 2 Tab, 18 Ref. EPA grant R805637.

Descriptors: *Water quality control, *Monitoring, *Coliforms, Pennsylvania, New Jersey, Water distribution systems, Drinking water, Bacteria.

The average coliform colony count, using the membrane filter technique, of the samples examined in any month is one of the parameters specified in the National Interim Primary Drinking Water Regulations to determine whether water in a distribution system meets the microbiological maximum contaminant level. Evidence suggests that the average number of coliforms in monitoring samples is a poor estimate of the mean coliform density of the distribution system. The evidence presented includes variance in coliform counts, data truncation caused by limitations of the examination methods, changes in coliform densities during transport of the samples to the laboratory, and false results. A regulation based on the fraction of monitoring samples with coliform densities greater than a preselected limit may be a feasible alternative to the current microbiological maximum contaminant level. Data used in this study were derived by sampling nine small community water sytems in eastern Pennsylvania and southern New Jersey. (Baker-IVI)
W85-03628

NEW METHOD OF WET DENSITY AND SETTLING VELOCITY DETERMINATION FOR WASTEWATER EFFLUENT,
Ozturgut Oceanographics, Seattle, WA.
E. Ozturgut, and J. W. Lavelle.
Environmental Science and Technology, Vol. 18, No. 12, p 947-952, 1984. 8 Fig, 1 Tab, 26 Ref.

Descriptors: *Wastewater discharge, *Effluents, *Settleable solids, *Density, Suspended solids, Water analysis, Flocculation, Size spectra, Settling velocity.

A new method to measure wet density/size spectra of wastewater particles in the density range 1,.0 to 1.4 g/cu cm and the size range 1-64 micro-m has been presented. No density data other than bulk density have been available for wastewater effluent in the past. This information is important in assessing what fractions of the discharge will raft on ocean density surfaces. Together the wet density/size spectra have been used to calculate a settling velocity spectrum for the fraction of the discharge with diameters less than 64 micro-m. In contrast to conventional methods, the method described permits working at particle concentrations of a few milligrams per liter. The mass concentration of particles employed was considerably more than needed. Initial concentrations of 1-2 mg/L can probably be analyzed. Comparison of the wet density/size spectral characteristics of the effluent, before and after discharge, will provide data to establish the significance of flocculation in the natural environment where concentrations and fluid shear are quickly reduced away from the diffuser. (Baker-IVI)
W85-03666

ACUTE TOXICITY SCREENING OF WATER POLLUTANTS USING A BACTERIAL ELECTRODE,
Colorado State Univ., Fort Collins. Dept. of Chemistry.
E. J. Dorward, and B. G. Barlsas.
Environmental Science and Technology, Vol. 18, No. 12, p 967-972, 1984. 5 Fig, 1 Tab, 28 Ref.

Descriptors: *Bacterial electrode, *Pollutant identification, *Toxicity, *Escherichia, Bacteria, Carbon dioxide, Cadmium, Lead, Copper, Cyanide, Arsenite,.

An instrumental bioassay of the acute toxicity of substances in water was conduced using Escherichia coli electrodes. Potentiometric measurement of carbon dioxide production by E. coli cells immobilized at the surface of a carbon dioxide sensing electrode formed the basis of the method. The net rate of carbon dioxide production by the bacteria reflects the complex series of biochemical reactions which constitutes the respiratory processes of the cells. A measureable decrease in bacterial carbon dioxide production will be registered through the inhibition of any part of the respiratory process by some pollutant. The acute toxicity of a broad range of substances, including metals, anions, gases, and organic compounds, is measured by the E. coli electrode. Dose-effect curves obtained by this method are compared with results reported for the Beckman Microtox bioassay and for rainbow trout 96-hr LC50 values. Acute toxicity values measured with the E. coli electrode for cadmium, lead, copper, cyanide, and arsenite are comparable to those obtained with the 15 min Microtox bioassay. (Baker-IVI)
W85-03668

SCREENING FOR ORGANIC CONTAMINATION OF GROUNDWATER: ETHYLENE DIBROMIDE IN GEORGIA IRRIGATION WELLS,
L. R. Marti, J. de Kanel, and R. C. Dougherty.
Environmental Science and Technology, Vol. 18, No. 12, p 973-974, 1984. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Groundwater pollution, *Water analysis, *Ethylene dibromide, *Georgia, *Pollutant identification, Groundwater protection, Mass spectrometry, Gas chromatography, Pesticides, Organic compounds, Irrigation water.

Southwest Georgia is an area of intensive agriculture where two to four crops per year are harvested from a given field, and extensive use is made of groundwater for irrigation and of pesticides for control of plant and insect pests. Methods have been developed for assessing the impact these agricultural practices have on groundwater quality. A screening procedure is described for organic contaminants of groundwater. The method is based on purge-and-trap concentration followed by gas chromatography and mass spectrometry. For pesticides with low volatility, liquid-liquid extraction followed by gas chromatography-mass spectrometry or electron capture gas chromaography was used. The methods were validated for a series of pesticides that have been used extensively in agricultural areas of the southeastern United States. The only detected organic pesticide in groundwater studied over a three year period was ethylene dibromide. The concentration of EDB was determined by calibration against benzene-d6, and varied between 1 and 94 micro-g/L. (Baker-IVI)
W85-03669

COMPARISON OF SOLVENT REDUCTION METHODS FOR CONCENTRATION OF POLYCYCLIC AROMATIC HYDROCARBON SOLUTIONS,
Connecticut Univ., Storrs. Dept. of Chemistry.
D. J. C. Constable, S. R. Smith, and J. Tanaka.
Environmental Science and Technology, Vol. 18, No. 12, p 975-978, 1984. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Water analysis, *Solvent reduction methods, *Pollutant identification, *Polycyclic aromatic hydrocarbons, Aromatic compounds, Hydrocarbons, Organic compounds, Solvents.

The concentration of polycyclic aromatic hydrocarbons (PAH) in water systems ranges from 1 ppt in pure groundwater systems to 1 ppm in heavily contaminated sewage, so the identification and quantitative analysis of PAH requires extraction and concentrations steps prior to gas chromatographic or gas chromatographic/mass spectroscopic analysis. The performance of several volume reduction methods for the determination of polycyclic aromatic hydrocarbons in water systems was

aluated using a seven component standard PAH lution diluted in methylene chloride, n-pentane, ıyl ether, acetone, and acetonitrile. Volume re- ction methods evaluated included rotary evapo- ion, nitrogen evaporation, and four different stillation columns, Vigreaux, Snyder, stainless el gauze, and a spinning band column. Approxi- ately equivalent recovery factors for high molec- ır weight PAH were obtained from all solvent duction methods. Recoveries ranged from a low 41% for naphthalene in methylene chloride by rogen evaporation to a high of 140% for pyrene ethyl ether by rotary evaporation. (Baker-IVI) 85-03670

ETHOD FOR ESTIMATION OF SLIMING F NETS IN LAKE WATERS,
ational Board of Waters, Helsinki (Finland).
Heinonen, S. Herve, and S. Yli-Karjanmaa.
qua Fennica, Vol. 14, No. 1, p 59-64, 1984. 1 Fig, Tab, 9 Ref.

escriptors: *Slime, *Nets, *Eutrophication, *Fin- nd, Lake fisheries, Fishing gear, Chlorophyll a, iatoms, Algae, Phytoplankton, Water pollution fects.

n early effect of eutrophication on fisheries is the ming of fishing equipment, in particular of gill- ts. Sliming of gillnets makes fishing more diffi- lt, probably reduces the catch and may also crease the useful life of the nets. A method was veloped for the quantitative measurement of ming, using nylon netting with a spacing of 12 m, incubated in a special frame at a depth of 1.0- 5 m for 24 +/- 2 h. Nets were incubated in trophic and oligotrophic lakes in Finland during e summer of 1983. The nets were not incubated the littoral area but only in regions with a depth ceeding 6 m. After the incubation the amounts of lorophyll a and solids adhering to the netting ere measured and reported per milligram of net aterial. The dominant algal species were identi- ed by direct microscopy. In eutrophic waters the nount of solids adhering to the netting increased to 30-50 mg per gram and the amount of lorophyll a to 60-200 micro-g/g. In oligotrophic mic waters the corresponding values were 2-8 g/g and 3-20 micro-g/g. The most important gae causing sliming were diatoms. All the domi- nt diatoms are abundant in the phytoplankton of innish inland waters during the summer. (Moore- VI) 85-03679

CCURRENCE OF FAECAL COLIFORMS, AECAL STREPTOCOCCI AND SALMONEL- A IN THE WASTE WATER OF THREE ABAT- OIRS IN FINLAND 1980-1983,
altion Elainlaaketieteellinen Laitos, Helsinki Finland).
. Aho, H. Korkeala, and J. Hirn.
qua Fennica, Vol. 14, No. 1, p 77-85, 1984. 2 Fig, Tab, 41 Ref.

escriptors: *Salmonella, *Streptococcus, *Coli- rms, *Meat processing industry, *Finland, Bacte- a, Industrial wastewater, Cattle, Pigs, Abattoirs, easonal variation.

ome 200 waste water samples were collected rom both pig lines and cattle lines in two abattoirs the city of Helsinki and in one abattoir in the ity of Vantaa. Fecal coliforms and fecal strepto- occi were detected by a membrane filter method n mFC and KF streptococcus agars. The fecal oliforms:fecal streptococci ratio was calculated. almonella were detected qualitatively by a tetra- hionate enrichment method. The bacterial con- amination of waste water was quite high and the uantity of bacteria varied considerably. The FC/ S ratio could not be used directly as an indicator f the origin of the pollution. Differences between olony counts in winter and in summer and be- ween colony counts from samples collected from ig lines and cattle lines were not statistically ignificant. Salmonella typhimurium was identified n one sample collected from one cattle line and Salmonella infantis was identified from samples collected from pig lines five times and from cattle ines four times. Of 225 small red and reddish colonies on KF streptococcus agars, which were inoculated with waste water from pig lines and which were not considered as typical fecal streptococci, 26% were fecal streptococci. The corresponding percentage for cattle lines was 80% out of 108 colonies. (Author's abstract)
W85-03681

DIFFERENTIAL PULSE STRIPPING-VOLTAMMETRY FOR ROUTINE HEAVY-METAL ANALYSIS OF DRINKING WATER (DIFFERENTIELLE PULSINVERSVOLTAMMETRIE FUR DIE SCHWERMETALLANALYTIK VON TRINKWASSER),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz.
W. Arts, H.-J. Bretschneider, H. Buschhoff, and B. Rickert.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 5, p 501-505, November, 1984. 2 Fig, 3 Tab, 7 Ref.

Descriptors: *Heavy metals, *Voltammetry, *Water analysis, Drinking water, Automation, Metals.

The experiences in running the PAR 384A Polarograph, coupled with two PAR 303 electrodes have shown that the differential pulse stripping-voltammetry is also suitable for a large number of samples. Nevertheless, for a wide spread use of this method for routine analysis, it is necessary to improve the following points: complement of the software; and installation of automatic sample-changing with cell-cleaning. This means a further improvement of hardware and software to guarantee automatic operation, with a high output of results. At present, neither the new Metrohm polarograph nor the new PAR 384B can guarantee automatic operation. (Author's abstract)
W85-03719

DETERMINATION OF NITRATE IN NATURAL WATERS BY FLOW-INJECTION ANALYSIS,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
S. Nakashima, M. Yagi, M. Zenki, A. Takahashi, and K. Toei.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 5, p 506-509. November, 1984. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Nitrates, *Pollutant identification, *Water analysis, *Flow-injection analysis, Water pollution control, Nitrogen, Spectrophotometry, Natural waters.

The determination of nitrate in water by the flow injection method was evaluated. Nitrate was determined in natural water samples by flow injection spectrophotometry. It was reduced to nitrite with copperized cadmium and the nitrite thus produced reacted with p-aminoacetophenone and m-phenylenediamine. The limit of detection was about 1.5 micro-g for sample injections of 650 micro-l. The sample rate was about 40 samples/hr and the relative standard deviation was above 1% for 0.1 - 0.3 mg/liter nitrate-nitrogen. Nitrite present in the sample was determined separately and subtracted. To investigate the applicability of this method to natural waters, recoveries of known amounts of nitrate added to natural water samples were examined. The method is satisfactory for determining low levels of nitrate in natural waters. (Baker-IVI)
W85-03720

SHORT TERM BOD TESTS,
Benin Univ., Benin City (Nigeria). Centre for Social, Cultural and Environmental Research.
C. M. A. Ademoroti.
Effluent and Water Treatment Journal, Vol. 24, No. 10, p 373-377, October, 1984. 4 Fig, 7 Tab, 4 Ref.

Descriptors: *Biochemical oxygen demand, *Mathematical equations, Wastewater analysis, Water analysis, Oxygen demand, Pollutant identification.

The BOD is one of the most significant and functional parameters generally monitored and most often used to evaluate the degree of purity/impurity of a sample of water or wastewater. The five day incubation period is often inconvenient, and may be too long for the test to be of immediate value for treatment plant control purposes. Through this study, a relationship was established between the 5-day BOD value and those of 4-day, 3-day, and 2-day BOD values in the form of a simple equation such that the BOD test may be conducted for fewer days than five and the results obtained be accurately converted to 5 days BOD by using the equation. Two types of wastewaters were used in the study, one from an institutional community and the other was effluent from a brewery. (Baker-IVI)
W85-03728

DETERMINATION OF IONIC ALKYLLEAD COMPOUNDS IN WATER BY GAS CHROMATOGRAPHY/ATOMIC ABSORPTION SPECTROMETRY,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
D. Chakraborti, W. R. A. De Jonghe, W. E. Van Mol, R. J. A. Van Cleuvenbergen, and F. C. Adams.
Analytical Chemistry, Vol. 56, No. 14, p 2692-2697, December, 1984. 7 Fig, 5 Tab, 24 Ref.

Descriptors: *Alkyllead compounds, *Water analysis, *Gas chromatography, *Atomic absorption spectrometry, Lead compounds, Rain.

A thorough understanding of the environmental behavior of organic lead compounds is not yet possible, owing to the lack of precise data on the occurrence of trialkyllead and dialkyllead species. A method is developed for the determination of ionic alkyllead coumpounds in water at environmental concentrations. Ionic alkyllead compounds are extracted from water samples into pentane by complexation with sodium diethyldithiocarbamate. Inorganic lead is complexed with EDTA. The organic phase is evaporated to dryness by vacuum distillation, after which butylation with n-butyl Grignard reagent is carried out in a microvolume of n-nonane. The analysis is performed by gas chromatography with atomic absorption spectrometric detection. Inorganic lead does not interfere with the determination of the tri- and di-alkyllead compounds at concentration levels of up to 1 mg/L. Tetraalkyllead compounds do not give rise to interferences in the measurement of the ionic alkyllead compounds. With 500 mL of water, detection limits for individual species are situated at the ng/L level. The method was applied to the analysis of rain water samples to demonstrate its applicability in environmental surveys. (Moore-IVI)
W85-03732

DETERMINATION OF BARIUM IN SEAWATER BY DIRECT INJECTION GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY,
K. K. Roe, and P. N. Froelich.
Analytical Chemistry, Vol. 56, No. 14, p 2724-2726, December, 1984. 4 Fig, 1 Tab, 23 Ref. NSF grant DPP-82-14213.

Descriptors: *Seawater, *Barium, *Water analysis, Atomic absorption spectrometry, Metals, Salinity.

Barium is determined in aqueous solution by direct injection graphite furnace atomic absorption spectrometry. NH_4NO_3 modifier eliminates seawater NaCl in a slow 1400 C char step. Atomization is at 2700 C. Detection is at 553.6 nm, and calibration is by peak area. Sensitivity is 0.2 abs s/ng (abs = absorbance unit) and is independent of matrix salinity. Detection limits are 30 pg of Ba (600 ng/L) for 50-micro-L sample injections of seawater and 10 pg of Ba (200 ng/L) for freshwaters. Precision is about +/- 13%. There are no spectral interferences due to calcium or Ba halides. Results of the analyses of seawater samples agree well with values determined by isotope dilution. (Author's abstract)
W85-03733

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Group 5A—Identification Of Pollutants

BONDED-PHASE EXTRACTION COLUMN ISOLATION OF ORGANIC COMPOUNDS IN GROUNDWATER AT A HAZARDOUS WASTE SITE,
Geological Survey, Denver, CO.
C. E. Rostad, W. E. Pereira, and S. M. Ratcliff.
Analytical Chemistry, Vol. 56, No. 14, p 2856-2860, December, 1984. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Groundwater pollution, *Organic compounds, *Extraction, *Water analysis, *Hazardous materials, Waste disposal, Creosote, Pentachlorophenol, Gas chromatography, Mass spectrometry, Pollutant identification.

A procedure for isolation of hazardous organic compounds from water for gas chromatography/mass spectrometry analysis is presented and applied to creosote- and pentachlorophenol-contaminated groundwater resulting from wood-treatment processes. This simple procedure involved passing a 50-100-mL sample through a bonded-phase extraction column, eluting the trapped organic compounds from the column with 2-4 mL of solvent, and evaporating the sample to 100 micro-L with a stream of dry nitrogen, after which the sample was ready for gas chromatography/mass spectrometry analysis. Representative compounds indicative of creosote contamination were used for recovery and precision studies from the cyclohexyl-bonded phase. Recovery of these compounds from n-octyl-, n-octadecyl-, cyclohexyl-, and phenyl-bonded phases was compared. The bonded phase that exhibited the best recovery and least bias toward acidic or basic compounds was the n-octadecyl phase. Detailed compound identification is given for compounds isolated from creosote- and pentachlorophenol-contaminated groundwater using the cyclohexyl-bonded phase. (Author's abstract)
W85-03734

SIMULTANEOUS PRECONCENTRATION OF COPPER, NICKEL AND COBALT IN WATER BY COPRECIPITATION-FLOTATION FOR ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
S. Nakashima, and M. Yagi.
Analytical Letters, Vol. 17, No. A15, p 1693-1703, September, 1984. 3 Tab, 15 Ref.

Descriptors: *Preconcentration, *Copper, *Nickel, *Cobalt, *Water analysis, Atomic absorption spectrometry, Precipitation, Flotation, Heavy metals.

There is an increasing need for a rapid and accurate method for determining low parts per billion of trace elements in water. A method is described for the simultaneous flotation separation and determination of microgram-levels of copper (II), nickel (II) and cobalt (II) in water. Copper, nickel and cobalt in a 1000-ml sample of water are coprecipitated with hydrated zirconium oxide at pH 9.1 +/- 0.1. The precipitate is floated with the aid of a surfactant solution and small air bubbles; the precipitate is readily separated from the mother liquor and dissolved in dilute hydrochloric acid for electrothermal atomic absorption spectrophotometry. The method is simple and rapid, and applicable to the simultaneous separation of copper, nickel and cobalt at microgram levels from a large volume of water. (Moore-IVI)
W85-03742

ANALYSIS OF TRACE METALS IN WATER BY INDUCTIVELY COUPLED PLASMA EMISSION SPECTROMETRY USING SODIUM DIBENZYLDITHIOCARBAMATE FOR PRECONCENTRATION,
Geological Survey, Denver, CO.
C. L. Smith, J. M. Motooka, and W. R. Willson.
Analytical Letters, Vol. 17, No. A15, p 1715-1730, September, 1984. 1 Fig, 4 Tab, 19 Ref.

Descriptors: *Trace elements, *Coprecipitation, *Plasma emission spectrometry, Natural waters, Water analysis.

Since concentrations of trace elements in most natural waters seldom exceed the micro-g/L level, analysis of trace elements in natural waters by inductively coupled plasma emission spectrometry (ICP) requires a preconcentration procedure. The elements Ag, Bi, Cd, Co, Cu, Fe, Mo, Ni, Pb, Sn, V, W, and Zn were separated and concentrated from 500 mL of water by coprecipitating them with sodium dibenzyldithiocarbamate (NaDBDTC) using nickel or silver as a carrier. The precipitated trace elements were collected on a membrane filter, redissolved from the filter with hot nitric and hydrochloric acids, and analyzed using ICP. Recoveries for all the trace elements except tungsten exceeded 80%. Coprecipitation of trace elements with NaDBDTC eliminated the use of difficult-to-inject organic solvents, and NaDBDTC coprecipitated a wider array of trace elements than ammoniumpyrrolidinedithiocarbamate (APDC), another commonly used coprecipitate. (Author's abstract)
W85-03743

ON-LINE MEASUREMENT OF ORGANIC CARBON IN WASTE WATER,
Montedison Chemical Co., Venice (Italy).
For primary bibliographic entry see Field 5D.
W85-03745

THERMOTOLERANT NON-FECAL SOURCE KLEBSIELLA PNEUMONIAE: VALIDITY OF THE FECAL COLIFORM TEST IN RECREATIONAL WATERS,
N. R. Caplenas, and M. S. Kanarek.
American Journal of Public Health, Vol. 74, p 1273-1275, 1984. 1 Tab, 10 Ref. EPA contract C3043NAEX.

Descriptors: *Klebsiella, *Fecal bacterial, *Coliforms, *Wisconsin, *Pulp wastes, Pulp and paper industry, Water quality standards, Industrial wastewater, Effluents, Bacteria, Water reuse.

Thermotolerant Klebsiella bacteria from an industrial wastewater source of non-fecal origin consistently elevate the level of fecal coliform organisms as measured by the current fecal coliform standard test. Water samples were obtained from pulp and paper mills in Wisconsin. The sampling points examined for bacterial densities included fresh water supplies, recycled water within mills treated effluent wastewater, and waters receiving effluent wastes downstream from nine pulp and paper mills. Using the standard fecal coliform test, up to 90% of non-fecal source thermotolerant K. pneumoniae was falsely identified as fecal source bacteria. Isolating Klebsiella from a variety of mill types and processing stages, indicates the ubiquity of Klebsiella in the pulp and paper mill industry. The use of water recycle systems promotes enhanced thermotolerant bacterial concentrations by providing an excellent growth environment for Klebsiella. Since there is a lack of specificity in the currently used standard for fecal coliform evaluation, a more reliable health risk assessment for fecal coliform bacteria is recommended. A highly specific indicator of fecal waste contamination, thermotolerant fecal coliforms as measured by Escherichia coli, should be used as the standard fecal coliform guideline. (Moore-IVI)
W85-03747

5B. Sources Of Pollution

ENVIRONMENTAL CHEMISTRY OF 1,2-PROPANEDIOL DINITRATE: AZEOTROPE FORMATION, PHOTOLYSIS AND BIODEGRADABILITY,
California Univ., Berkeley. Naval Biosciences Lab.
For primary bibliographic entry see Field 5D.
W85-03220

UPTAKE, ELIMINATION, AND METABOLISM OF 14C-PICRIC ACID AND 14C-PICRAMIC ACID IN THE AMERICAN OYSTER (CRASSOSTREA VIRGINICA),
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
D. T. Burton, K. R. Cooper, W. L. Goodfellow, Jr., and D. H. Rosenblatt.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 6, p 653-663, November, 1984. 4 Fig, 5 Tab, 37 Ref.

Descriptors: *Fate of pollutants, *Picric acid, *Picramic acid, *Oysters, Water pollution, Metabolism, Bacteria.

Picric and picramic acid are used in a variety of industrial, military, and research applications. Both compounds are potential water contaminants. The uptake and elimination of picric and picramic acid in American oysters was studied along with their metabolism, and their distribution to specific tissues. Statistically significant amounts of picric and picramic acid were accumulated above two exposure concentrations in a biphasic uptake pattern. The 42 day C-14 accumulation factors for American oysters continuously exposed to picric acid concentrations of 0.45 mg/L and 0.05 mg/L were 65.5 and 16.5, respectively. Oysters exposed to 0.24 mg/L and 0.02 mg/L picramic acid had 42 day C-14 accumulation factors of 49.3 and 86.8, respectively. Steady state bioconcentration factors could not be calculated. No statistically significant elimination of picric acid was observed during the 14 day elimination study. Depuration of picramic acid was biphasic. Approximately 40% of the accumulated compound was eliminated by the second day of depuration during the initial phase for both the high and low concentrations of picramic acid, while no elimination occurred during its secondary phase. A small percentage of picric and picramic acid was metabolized by the oyster or its bacterial flora. There was no apparent difference between the concentration of the compounds per gram of tissue in the muscle, gill, mantle, or body mass. (Baker-IVI)
W85-03221

FATE OF 2,4,6-TRICHLOROPHENOL, PENTACHLOROPHENOL, P-CHLOROBIPHENYL, AND HEXACHLOROBENZENE IN AN OUTDOOR EXPERIMENTAL POND: COMPARISON BETWEEN OBSERVATIONS AND PREDICTIONS BASED ON LABORATORY DATA,
Gakushuin Univ., Tokyo (Japan). Inst. of Ecotoxicology.
K. Sugiura, M. Aoki, S. Kaneko, I. Daisaku, and Y. Komatsu.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 6, p 745-758, November, 1984. 11 Fig, 1 Tab, 47 Ref.

Descriptors: *Fate of pollutants, *Ponds, *Trichlorophenol, *Pentachlorophenol, *Chlorobiphenyl, *Hexachlorobenzene, Pesticides, Sediments, Fish, Fate of pollutants, Photolysis, Chlorinated hydrocarbons.

In predicting the fate of chemicals in the aquatic environment, both physical and mathematical models have been used. An experiment was carried out to determine whether the time-dependent concentration variations of the compounds in an outdoor experimental pond could be calculated, using various rate constants obtained in laboratory experiments. An outdoor experimental pond was sprayed with 2,4,6-trichlorphenol, pentachlorophenol, p-chlorobiphenyl, and hexachlorobenzene. Time dependent changes in concentration in sediment, fish, and water samples were determined for a period of 60 days. The movement and distribution of the compounds in the system was described in a model. Rate constants for volatilization of these compounds from water, accumulation and excretion by fish, sediment sorption and desorption, and photolysis were also determined. The concentration changes of the compounds in the outdoor experimental pond could be estimated roughly from the model and the rate constants which had been determined in the lab studies. (Baker-IVI)
W85-03227

MOLECULAR WEIGHT FRACTIONATION OF DISSOLVED ORGANIC NITROGEN AND CARBON COMPOUNDS FROM TWO LAKES OF DIFFERING TROPHIC STATUS,

ichigan State Univ., Hickory Corners. W.K. ellogg Biological Station.
K. Ward, and R. G. Wetzel.
rchiv fur Hydrobiologie, Vol. 101, No. 4, p 481-8, October, 1984. 3 Tab, 25 Ref.

escriptors: *Trophic levels, *Nitrogen compunds, *Organic carbon, *Productivity, *Lawnce Lake, *Wintergreen Lake, *Michigan, kes, Oligotrophic lakes, Eutrophic lakes, Macroytes, Phytoplankton, Birds.

ne molecular weight fractions of dissolved organnitrogen and carbon compounds were deterned in lakes of different organic inputs and phic status. The relative concentrations of total OC and DON and molecular weight distribution ere hypothesized to reflect the inputs to the lakes affected by overall lake metabolism. Samples ere collected from Lawrence and Wintergreen kes in southwestern Michigan. Lawrence Lake is small, hard water lake of glacial origin and oderate productivity. Much of the basin is surunded by a marsh composed primarily of emernt macrophytes through which the inlet streams ust pass to reach the lake. Wintergreen Lake is so a small, hard water lake but is extremely oductive. Major organic carbon inputs include aterial from floating leaved macrophytes which velop extensive communities around the periphy of the basin in summer, phytoplankton and puts from migratory and resident bird populaons. Inlet seepage passes through agricultural nd and no extensive marsh areas occur in the atershed. The highest percentage of low moleculr weight DON occurred in the epilimnion in both kes during periods of stratification and was likely lated to phytoplantonic and macrophytic inputs that time. Higher total DON and organic nitroen in all molecular weight fractions occurred in Vintergreen than in Lawrence Lake and reflected e difference in composition of organic inputs and thways of decomposition in each lake. (Baker-VI)
785-03229

OLE OF SULPHIDE IN THE FORMATION F DIMETHYL MERCURY IN RIVER AND STUARY SEDIMENTS,
eicester Polytechnic (England). School of Chemtry.
J. Craig, and P. A. Moreton.
larine Pollution Bulletin, Vol. 15, No. 11, p 406-08, November, 1984. 1 Fig, 5 Ref.

Descriptors: *Sulfides, *Dimethyl mercury, *Mercury compounds, *Sediments, *River Carron estuary, *Scotland, Water pollution, Fate of pollutants, Volatilization.

ncubation experiments were performed on sediment collected from the River Carron estuary Scotland) which contains high levels of mercury s a result of former discharge into the estuary rom a variety of mercury-containing effluents. ediment with and without the addition of sodium lfide to the 4 mg/g level was incubated and the olatile products evolved from the sediment anayzed for dimethyl mercury. Dimethyl mercury vas not detected in the mass spectrometer among he volatile products evolved from the unamended ediment. The mobile species is the volatile hydrohobic dimethyl mercury. Transport to atmosphere in this form may account for a loss of about 2% annually of methyl mercury from sediments. This mobilization pathway may remove significant quantities annually of methyl mercury from sediments exposed to sulfide. (Moore-IVI)
W85-03240

STATUS OF NUTRIENTS IN LAKE MARIUT, A DELTA LAKE IN EGYPT SUFFERING FROM NTENSIVE POLLUTION,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, O. A. El-Rayis, and H. H. Ahdy.
Marine Pollution Bulletin, Vol. 15, No. 11, p 408-411, November, 1984. 2 Fig, 2 Tab, 21 Ref.

Descriptors: *Lake Mariut, *Egypt, *Nutrients, Wastewater pollution, Ammonia, Nitrites, Nitrates, Phosphates, Silicates, Chlorides, Dissolved oxygen, Hydrogen sulfide, Industrial wastes, Water pollution sources, Agricultural drainage water.

Levels of dissolved ammonia, nitrite, nitrate, phosphate and silicate, as well as chlorosity, dissolved oxygen and hydrogen sulfide in the water of Lake Mariut have been investigated over a year. This shallow brackish-water lake, situated south of Alexandria, suffers from intense pollution. Two different water bodies can be distinguished in Lake Mariut. One, occupying the eastern side of the lake, is affected by sewage and industrial waste disposal, as well as discharge of highly polluted water from Qalaa Drain. The water in this region, which had lower regional average chlorosity values, contained abnormal higher concentrations of phosphate and nitrogenous salts in the presence of H2S. The western side was always oxic and showed higher average values of chlorosity. This western region contained lower concentrations of phosphate and nitrogenous salts, due to the influence of the relatively clean water from Umum Drain. The principal source of silicon for Lake Mariut is agricultural drainage. The annual average concentrations of phosphate and nitrogenous salts in this lake were considerably higher than those in the neighboring comparatively less polluted Nozha Hydrodrome. (Author's abstract)
W85-03241

DYNAMICS OF POLLUTANT PHOTOREACTIONS IN THE HYDROSPHERE,
Environmental Protection Agency, Athens, GA.
R. G. Zepp, P. F. Schlotzhauer, M. S. Simmons, G. C. Miller, and G. L. Baughman.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 2, p 119-125, September, 1984. 7 Fig, 4 Tab, 45 Ref.

Descriptors: *Fate of pollutants, *Photoreactions, *Reviews, Solar radiation, Kinetics, Lakes, Rivers, Humic substances, Natural waters, Organic matter, Suspended solids, Algae, Diatoms, Bacteria, Nitrates, Iron, Peroxides.

Light-induced transformations of organic chemicals have been studied to provide kinetic results concerning the influence of sunlight on pollutant behavior in lakes and rivers. A review of these studies shows that the humus component of the dissolved organic matter in natural water affects aquatic photoreactions in two important ways: by attenuating sunlight and by sensitizing photoreactions. Studies of humus-sensitized photoreactions of furans, sulfides, dienes, nitroaromatic compounds, and other chemicals are discussed. Research concerning effects of aquatic particulates on pollutant photoreaction rates are reviewed. Suspended sediment mainly affect photolysis rates through light attenuation and scattering. Algae, diatoms, and bacteria accelerate light-induced transformations of anilines and phosphorothioate insecticides, suggesting that photobiological processes may play a significant role in the breakdown of certain pollutants in aquatic environments. Evidence is presented that nitrate, iron species, and peroxides may be responsible for sunlight-initiated free of radical oxidations of pollutants in some natural waters. (Author's abstract)
W85-03281

PHYSICO-CHEMICAL SPECIATION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN AQUATIC SYSTEMS,
Masspec Analytical Specialty Services Ltd., Stroud (England).
J. W. Readman, R. F. C. Mantoura, and M. M. Rhead.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 2, p 126-131, September, 1984. 4 Fig, 1 Tab, 29 Ref.

Descriptors: *Physico-chemical properties, *Speciation, *Polycyclic aromatic hydrocarbons, Hydrocarbons, Aromatic compounds, Particulates, Tamar estuary, England, Estuarine environment, Fate of pollutants, Path of pollutants.

The particulate chemistry of polycyclic aromatic hydrocarbons (PAH) was investigated using dissolved and particle associated PAH concentrations with partitioning of spiked PAH in subsamples of the same estuarine waters (from the Tamar Estuary, England). Equilibrium partition coefficients calculated from the environmental analysis were one to two orders of magnitude higher than those obtained by sorption experiments. The PAH in the estuary are not in equilibrium between the aqueous and particulate phases, and are considerably enriched in the particulates. Analyses of PAH in suspended particulate size fractions isolated from water sampled at the turbidity maximum of the estuary revealed highest concentrations of PAH in relativly large particles, with surface area controlling PAH distribution to a negligible extent. PAH composition in surface sediments was generally uniform throughout the estuary. In order to predict behavior of PAH in aquatic systems the physico-chemical speciation of the compounds must be modelled. The water/particulate chemistry of PAH in the Tamar is incompatable with current sorption modelling techniques and it would appear that the degree of binding/leachability of the compounds must be quantified as a prerequisite to developing new environmentally realistic models. (Moore-IVI)
W85-03282

BIOACCUMULATION OF ORGANIC MICROPOLLUTANTS FROM SEDIMENTS AND SUSPENDED PARTICULATES BY AQUATIC ANIMALS,
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
J. M. Neff.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 2, p 132-136, September, 1984. 3 Tab, 27 Ref.

Descriptors: *Suspended solids, *Sediments, *Bioaccumulation, *Aquatic animals, Polycyclic aromatic hydrocarbons, Polychlorinated biphenyls, Pesticides, Hydrocarbons, Bioavailability, Grain size, Organic carbon, Solubility, Path of pollutants.

Non-polar organic micropollutants, such as polycyclic aromatic hydrocarbons, polychlorinated biphenyls and some pesticides, which are adsorbed to sediments have a low bioavailability to freshwater and marine animals. Bioaccumulation factors from sediments (concentration in animal/concentration in sediment) of the organic pollutants investigated range from less than 0.1 to about 20, several orders of magnitude lower than bioaccumulation factors from the water for the same compounds. Bioavailability of sediment-adsorbed organic micropollutants is directly related to the solubility of the compound and sediment grain size, and inversely related to sediment organic carbon concentration and animal size. Organic micropollutants adsorbed to sediments are only slightly bioavailable, but sediments in contaminated areas often contain high concentrations of adsorbed pollutants; therefore they represent an important source of contamination of freshwater and marine animals. (Author's abstract)
W85-03283

ORGANIC MICROPOLLUTANTS' BALANCES IN WATERSHEDS OF NORTHESTERN BAVARIA,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
E. Schrimpff.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 2, p 147-151, September, 1984. 1 Fig, 5 Tab, 6 Ref.

Descriptors: *Organic compounds, *Bavaria, *Germany (Federal Republic), Water pollution sources, Fate of pollutants, Polynuclear aromatic hydrocarbons, BHC, Groundwater, River basins, Vegetation, Soil.

Bulk precipitation, near surface groundwater and river water samples were collected over a two year period within 15 river basins of Northeastern Bavaria and analyzed for alpha-BHC, gamma-BHC, fluoranthene, benzo-a-pyrene, indeno-cd-

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pyrene and benzo-ghi-perylene. BHC and polynuclear aromatic hydrocarbons (PAH) annual loads were calculated for river and groundwaters. The average loads of seven river basins each for two well-defined natural regions (the ancient earthblock and the scarplands) were compared. The input of BHCs and PAHs through bulk precipitation is about 30- to 400-fold higher than the river output in fairly natural, unpolluted rivers. Except in urban and industrialized basins, long range transport appears to be the main input source for both BHC and PAH. Vegetation and soils can be considered as fairly good BHC and PAH filters, since only 1 to 2% of the input into the ancient earthblock region and <1% of the input to the Jura-Triassic region reaches the near-surface groundwater. Land use plays no important role in Northeastern Bavaria either for the input of BHC and PAH or for their transfer into the near-surface groundwater table. Land use of watersheds is only relevant for river water pollution by sewage effluents. (Moore-IVI)
W85-03285

BEHAVIOUR OF SOME PAH, PCB AND ORGANOCHLORINE PESTICIDES IN AN ESTUARY, A COMPARISON - EXE, DEVON,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
R. Herrmann, and W. Thomas.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 2, p 152-159, September, 1984. 6 Fig, 3 Tab, 25 Ref.

Descriptors: *Polynuclear aromatic hydrocarbons, *Polychlorinated biphenyls, *Chlorinated hydrocarbons, *Pesticides, *Estuarine environment, *Exe, *England, Suspended solids, Resuspension, Turbidity, Agricultural wastes, Sediments.

The spatial variations in three groups of organic micropollutants: PCB, PAH and organochlorine pesticides in an estuarine environment, were interpreted by principal component and cluster analysis. The regional pattern of PAH and PCB concentration in sediments and in the water column within the Exe estuary is characterized by an increase of concentrations from river water into the mixing zone, and a decrease from there to the sea. Further, the concentrations decrease from the tidal channel towards the tidal flats. This is explained by sedimentation of PAH and PCB adsorbed on suspended sediments entering the estuary from the river. The settling PAH and PCB resuspended ones are carried back by the lower compensation current, thus causing a zone of high PAH and PCB concentrations within the turbidity maximum of the main channel. However, local inputs other than that from the river result in the case of the PCB in a somewhat more irregular pattern, superposed on that of a single source with hydrodynamic distribution as it is the case with the PAH. The pesticides alpha-BHC, gamma-BHC and HCB show a distribution pattern which is dominated by a multiple input of these compounds via brooklets draining intensively used agricultural land. (Author's abstract)
W85-03286

INTERACTIONS OF HALOGENATED HYDROCARBONS WITH SOILS,
Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.).
P. Friesel, G. Milde, and B. Steiner.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 2, p 160-164, September, 1984. 7 Tab, 8 Ref.

Descriptors: *Halogenated hydrocarbons, *Soils, *Path of pollutants, Groundwater pollution, Adsorption, Desorption, Soil organic matter.

Groundwaters and consequently drinking waters have frequently been found to be contaminated by organic chemicals, among which halogenated hydrocarbons (HHCs) are one of the most important groups of pollutants. Since some portion of groundwater results from filtration through soil or similar materials, the behavior or HHCs in soils and sediments has become a major point of interest. The most important interactions of halogenated hydrocarbons with soils are sorption processes. A method was developed to determine sorption equilibria of volatile HHCs with soils. For the HHCs investigated (three aliphatic, five aromatic) confirm that the sorptive capacities of soils are mainly influenced by their contents in soil organic matter. Adsorption depends on the respective content of soil organic matter. Mineral soil components adsorb very little. Sorptive processes are highly reversible. Comparison of the sorption constants of the different compounds show that their solubilities strongly influence the sorptive behavior in soils. There is evidence that besides solubility, there are molecular parameters that are symmetry-related that strongly influence adsorption. (Moore-IVI)
W85-03287

BEHAVIOUR OF SOME ORGANIC MICROPOLLUTANTS IN RIVER SEDIMENTS AND GROUNDWATER,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
H. H. Rump.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 2, p 165-171, September, 1984. 11 Fig, 4 Tab, 11 Ref.

Descriptors: *Fate of pollutants, *Landgraben, *Germany (Federal Republic), *River sediments, *Organic compounds, Polynuclear aromatic hydrocarbons, Hydrocarbons, Aromatic compounds, Path of pollutants, Adsorption, Decomposition, Anilines, Phenols, Halogenated hydrocarbons.

Water occurring as surface water and subsurface water of the unsaturated and saturated zones is a medium for transporting dissolved organic micropollutants, some of which are potentially very toxic. River sediments play a substantial role, not only as a concentrating medium but also in their elimination of these substances. The spatial and time-dependent variations of polycyclic aromatic hydrocarbons (PAH) and halogenated compounds in water and sediment of a polluted river, the Landgraben, were determined in order to elucidate elimination mechanisms such as adsorption and degradation of organic compounds and their relationship to groundwater impairment. The Landgraben near Darmstadt (Federal Republic of Germany) is a small river that is strongly influenced by the effluents of two sewage treatment plants. In addition laboratory degradation experiments were performed using halogenated anilines and phenols and an attempt was made to characterize the organic material of the adsorbents. (Moore-IVI)
W85-03288

SPATIAL AND TEMPORAL CONCENTRATION GRADIENTS OF PAH (FLUORANTHENE, BENZO(A)PYRENE), GAMMA-BHC AND 2,4-D IN SAMPLES OF SOIL, SOIL WATER AND GROUND WATER IN AN AGRICULTURAL RESEARCH AREA,
Central Electricity Generating Board, Ratcliffe-on-Soar (England). Scientific Services Dept.
R. Bierl, W. Kaa, and W. Thomas.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 2, p 172-179, September, 1984. 8 Fig, 3 Tab, 16 Ref.

Descriptors: *Fluoranthene, *Benzo(a)pyrene, *BHC, *2,4-D, *Groundwater pollution, *Soil water, *Soil contamination, Loess soils, Organophosphates, Phenoxyacetic acids, Water analysis, Precipitations, Hydraulic properties.

An analytical method is described to measure simultaneously concentrations of PAH, chlorinated hydrocarbons, phenoxyacetic acids and organophosphates in soil, soil water and ground water in loess soils of an agricultural research area. The method involves extraction of acidified samples with dichloromethane/acetone for soil and dichloromethane for water samples, acid/base-distribution to separate PAH and gamma-BHC from 2,4-D and column clean-up with alumina and Florisil, respectively. Subsequently, residues of 2,4-D are esterified and the concentrations of 2,4,-D and gamma-BHC are determined by GC-ECD, those of PAH by HPTLC. Low concentrations of all pollutants were detected in ground water samples. The highest concentrations in soil and soil water were found for 2,4-D, indicating short-term transport related to precipitation and hydraulic conditions. Concentration levels were 2.6-36.3 micro-g/kg in soil and 20-1633 ng/l in soil water, respectively. (Author's abstract)
W85-03289

ACID GASES AND ACID IN RAIN MONITORED FOR OVER 5 YEARS IN RURAL EAST-CENTRAL ENGLAND,
Institute for Atmospheric Physics, Budapest (Hungary).
A. Martin, and F. R. Barber.
Atmospheric Environment, Vol. 18, No. 9, p 1715-1724, 1984. 8 Fig, 29 Ref.

Descriptors: *Acid rain, *England, *Sulfur dioxide, *Nitrogen oxides, Spatial distribution, *Temporal distribution, Seasonal variation, Water pollution sources, Rain, Ozone.

Sulfur dioxide has been monitored for many years at several rural sites in east-central England, and its temporal and spatial distribution and sources are reasonably well established. The air quality limit values of the Council of the European Communities are not exceeded. NO, NO2 and O3 have also been measured continuously for over 5 years at one rural site and for 2 years at another three sites in this region, and preliminary distribution of these gases are available. The oxides of nitrogen, like SO2, are greatest on average in winter months, but O3 is greatest on average in May, although peak hourly events exceeding the World Health Organization Environmental Health Criteria (WHOEHC) are common during other summer months. The oxides of nitrogen have exceeded the WHOEHC on occasion, and these are thought to have derived mostly from motor vehicles in distant towns, the gases then travelling in shallow inversion layers. Rainwater acidities and other constituents have been measured for over 7 years at several sites in the region, initially on a weekly basis, but in recent years on a daily and then an hourly basis at a few sites, and preliminary distribution patterns are available. Rainwater acidity is greatest on average in Spring, following the O3 pattern more closely than those of the other gases. Daily deposited acidity is episodal. Hourly concentrations of acidity in rainwater during rain events show more than one type of pattern. (Author's abstract)
W85-03290

COMPOSITION AND ACIDITY OF PRECIPITATION IN HUNGARY,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
L. Horvath, and E. Meszaros.
Atmospheric Environment, Vol. 18, No. 9, p 1843-1847, 1984. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Hungary, *Acid rain, *Precipitation chemistry, Acidity, Water pollution sources, Sulfuric acid, Nitric acid, Nitrates, Calcium.

The first precipitation chemistry work in Hungary was carried out in 1902 by bulk sample collection at one station. A program was implemented between 1968 and 1970 by using a network with bulk collectors. In 1973 a new program was initiated by applying wet-only collectors at one station with a sampling period of one month. Since 1977 a network has been organized for monitoring the composition and acidity of precipitation by means of wet-only collectors. The results of the precipitation chemistry measurements carried out are summarized. While data gained by bulk collectors show a west to east gradient in the concentration of different constituents, results obtained with a network consisting of wet-only gauges indicate a rather uniform composition. In the averaged monthly data, a spring maximum can be identified. For the last ten years the concentration of nitrate has increased in precipitation. The acidity of precipitation water collected in Hungary is derived (in acid samples) from sulfuric and nitric acids of anthropogenic origin. Calcium particles of soil

rigin also play a role in the control of the acidity. Moore-IVI)
V85-03291

PISODIC NATURE OF WET DEPOSITED ULPHATE AND ACIDITY,
llinois State Water Survey Div., Champaign.
). Fowler, and J. N. Cape.
tmospheric Environment, Vol. 18, No. 9, p 1859-866, 1984. 6 Fig, 2 Tab, 21 Ref.

Descriptors: *Acid rain, *Sulfates, *Sulfur dioxide, Scotland, Rainfall, Episodicity, Hydrogen ion oncentration, Water pollution sources, Precipita-ion chemistry, Wind.

Daily sampling of acidity and sulfate in rain, air oncentrations of SO2 and aerosol SO4(2-), and limatological variables for the period 1977 to 1981 t a site in southern Scotland are analyzed. The roperties of frequency distribution for wet depos-ted acidity, sulfate and rainfall, and the episodicity f each, are discussed. Up to 40% of annual wet leposited acidity occurred on < 4% of rain days, xceeding the episodicity of dry deposited SO2 by factor of 3. Over the 5 year period, 16% of rain vents were more acid than pH 4.0 and 25% less cid than pH 5.0; meteorological conditions associ-ted with these extremes of the distribution howed marked differences. The most acid events vere associated with large aerosol SO4(2-), con-entrations, small windspeeds and rainfall amounts, nd 48-h surface geostrophic wind back-trajector-es over industrial regions of the U.K. and/or Europe. The least acid events were associated with 48-h back-trajectories over the north Atlantic, arger windspeeds and rainfall amounts. The very cid events are well described by the frequency distribution of rainfall acidity. Artefacts in rainfall chemistry data caused by dry deposition on the collector are discussed with particular reference to the variation of SO4(2-) concentration with rainfall amount. (Author's abstract)
W85-03292

SOURCE APPORTIONMENT OF RAIN WATER IMPURITIES IN CENTRAL ILLINOIS,
Illinois State Water Survey Div., Champaign.
D. F. Gatz.
Atmospheric Environment, Vol. 18, No. 9, p 1895-1904, 1984. 7 Tab, 44 Ref.

Descriptors: *Precipitation chemistry, *Acid rain, *Illinois, *Water pollution sources, Seawater, Salt, Soil, Dust, Road dust, Ammonium, Sulfates, Nitrates, Calcium, Potassium.

The identity and relative contributions of various sources of impurities in precipitation are needed to understand the acidic precipitation phenomenon. This paper reports results of using factor analysis and a chemical element balance (CEB) to apportion sources of impurities in a series of 191 wet-only event precipitation samples collected near Champaign, IL. Factor analysis showed that four major groups of constituents accounted for 86% of the variance in the data: crustal dust, pollutants with gaseous precursors, sea salt, and possibly strong acids. Apportionment of plausible sources by CEB yielded estimates of a 2% contribution of sea salt to the total mass of impurities, a 32% contribution by ammonium and sulfates (including sulfuric acid) and a 16% contribution for nitrates. Calculated results were most sensitive to spatial variations in crustal source composition than to differences in composition between bulk materials and 'source aerosols.' Without taking account of insoluble materials, the probable contributions of soil dust and road dust were 7 and 12%, respectively, with outside limits of 3-8% and 8-24%, respectively. A reasonable assumption regarding Ca and K solubility increased the likely soil contribution from 7 to 15%, but had little effect on the road dust contribution. The use of extracted source material compositions as input to the CEB analyses to compensate for analysis of only the soluble portion of the precipitation samples was not successful. (Author's abstract)
W85-03293

ACID DEPOSITION IN RAIN OVER HILLS,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
D. J. Carruthers, and T. W. Choularton.
Atmospheric Environment, Vol, 18, No, 9, p 1905-1908, 1984. 3 Fig, 11 Ref.

Descriptors: *Acid rain, *Hills, *Orographic rainfall, Washout, Precipitation chemistry, Rainfall, Mathematical models, Feeder-seeder mechanism.

Orographic clouds are formed when low-level moist air is lifted as it flows over hills; the consequent cooling leads to condensation onto aerosol particles, and the formation of small drops. Washout of the orographic cloud drops may occur by raindrops falling from pre-existing precipitation clouds (the feeder-seeder mechanism). A numerical model of the feeder-seeder mechanism of orographic rain is used to describe the development of acid rain due to collection by initially 'clean' raindrops, falling from mid-level clouds, of cloud drops formed in low-level polluted air. A cloud drop pH of 3.5 is assumed. With a hill of 20 km length and 600 m height, strong maxima of precipitation and deposition rates and the lowest pH values occur just upwind of the hill. The maximum deposition rate is an order of magnitude higher than both observed and theoretical values of turbulent diffusion to ground. For a hill 2 km in length and 600 m high, the maximum enhancements and deposition rates are significantly reduced, and in this case occur downwind of the hill summit because of wind drift. There is a low rate of acid deposition well downwind of the hill region. The deposition rates are insensitive to the windspeed. Regardless of the source of the low-level air, the feeder-seeder mechanism can result in higher rates of acid deposition over hills than over level terrain. (Moore-IVI)
W85-03294

CHEMICAL COMPOSITION OF RAINFALL AND WET DEPOSITION OVER NORTHERN BRITAIN,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
J. N. Cape, D. Fowler, J. W. Kinnaird, I. S. Paterson, and I. D. Leith.
Atmospheric Environment, Vol. 18, No, 9, p 1921-1932, 1984. 9 Fig, 3 Tab, 35 Ref.

Descriptors: *Acid rain, *Precipitation chemistry, *Scotland, *England, Hydrogen ion concentration, Nitrates, Sulfates, Ammonium, Rainfall, Spatial distribution, Seasonal variation, Acidity, Sodium, Chloride, Seawater.

Results are presented for the chemical composition of precipitation sampled monthly at 16 sites in northern Britain (Scotland and England) for 1981. Distribution maps of concentration of H(+), NO3(-) and non-marine SO4(2-) show gradients increasing from the north-west to the south and east (H(+) from 10 to 40 micro-eq/l, NO3(-) from 10 to 30 micro-eq/l, non-marine SO4(2-) from 15 to 60 micro-eq/l) but the distribution of NH4(+) was not simple. Deposition of all ions was greatest in the mountainous areas of the south and west, where rainfall amounts were largest. Concentrations of NH4(+) and NO3(-) were approximately the same in 1980 and 1981, but H(+) and non-marine SO4(2-) concentrations were significantly smaller in 1981 than in 1980. Longer term trends (1978-1982) were site-dependent, with larger variability between years. Acidity decreased at all sites over this period, but no conclusions can be drawn on the causes of the observed decrease. Seasonal variations in 1981 were also strongly site-dependent; pronounced annual cycles in concentration were observed at southeastern sites of H(+), NH4(+), NO3(-) and non-marine SO4(2-) with maxima in late spring. Sea-derived materials (Na(+) and Cl(-)) showed pronounced cycles in concentration at all sites, with maxima in autumn/winter, annual cycles in deposition depending upon the annual cycle in precipitation amount. Deposition of H(+), NH4(+), NO3(-)and non-marine SO4(2-) was greatest in the autumn at northwest sites and in the spring at southeast sites. (Author's abstract)
W85-03295

ESTIMATED WASHOUT COEFFICIENTS FOR SULPHUR DIOXIDE, NITRIC OXIDE, NITROGEN DIOXIDE AND OZONE,
Central Electricity Generating Board, Ratcliffe-on-Soar (England). Scientific Services Dept.
For primary bibliographic entry see Field 2K.
W85-03296

SOFT ROT ERWINIA BACTERIA IN SURFACE AND UNDERGROUND WATERS IN SOUTHERN SCOTLAND AND IN COLORADO, UNITED STATES,
Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology.
N. J. McCarter-Zorner, G. D. Franc, M. D. Harrison, J. E. Michaud, and C. E. Quinn.
Journal of Applied Bacteriology, Vol. 57, p 95-105, August, 1984. 2 Fig, 5 Tab, 23 Ref.

Descriptors: *Erwinnia, *Plant pathogens, *Scotland, *Colorado, *Groundwater, *Surface water, Drains, Ditches, Lakes, Reservoirs, Streams, Rivers, Irrigation water, Seawater, Soft rot.

A study was made of the occurrence of Erwinia spp. in Scotland and in Colorado as part of a general investigation into sources of soft rot erwinias in the environment from which the organisms might spread and contaminate erwinia-free potato stocks. An anaerobic liquid enrichment method followed by plating on a selective medium revealed that the soft rot coliform E. carotovora subsp. carotovora was generally present in water from drains, ditches, streams, rivers and lakes (including reservoirs) in southern Scotland and in Colorado in mountainous, upland and arable areas through the year. Many sites were remote from susceptible or diseased crops. E. carotovora subsp, atroseptica was isolated much less frequently and no Erwinia bacteria were isolated from underground waters. Erwinia bacteria were also found in rain-water in Scotland, in winter snow from mountain passes in Colorado, and in sea water from the west and east coasts of Scotland and from the Pacific and Gulf of Mexico coasts of the US. The presence of both subspecies in water supplies used to irrigate farm crops indicates that farmers and growers should consider using underground sources of water or means of purifying surface water; this could be particularly important for both pathogen-free potato stocks and other susceptable crops. (Moore-IVI)
W85-03297

MYCOBACTERIA IN WATER,
Dulwich Hospital, London (England).
C. H. Collins, J. M. Grange, and M. D. Yates.
Journal of Applied Bacteriology, Vol. 57, p 193-211, October, 1984. 1 Fig, 152 Ref.

Descriptors: *Mycobacterium, *Water analysis, *Reviews, Bacteria, Public health, Pathogenic bacteria, Drinking water, Water treatment, Swimming pools, Bioindicators.

The study of the genus Mycobacterium until recently has been dominated by its type (and least typical) species, M. tuberculosis. There is increasing evidence that water may be the vehicle by which other mycobacteria infect or colonize the human body. Mycobacteria, both opportunist pathogens and those that are not known to be associated with human or animal disease, are present in most natural waters and piped water supplies. These organisms are probably not truly aquatic but their normal habitat is mud or decomposing vegetation. Two species, M. kansasii and M. xenopi, are frequently present in tap water, possibly because the temperatures in piped systems, especially in buildings, is more favorable for their growth and there are better opportunities for colonization, but their natural origins are as yet undetermined. M. xenopi, a thermophile, seems to favor hot water faucets. These two species have been found mostly as a result of investigations into their unexpected appearrance in cultures made from material examined for tubercle bacilli. M. ansasii, M. xenopi and MAIS (the M. avium-intracellulare-scrofulaceum group) bacilli occasionally cause pulmonary disease and infection is thought to arise

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from the inhalation of aerosols containing them. Although they are very resistant to chlorine in the amounts used for water treatment, there is no cause for concern since such infections are rare. Under certain conditions, M. marinum may be present in swimming pools and aquaria, and by entering through small cuts and abrasions in the skin of bathers and aquarists may give rise to granulomatous lesions. As methods for the detection of mycobacterium in water are simple and require no special apparatus, the possiblity that they might be useful indicators of pollution needs to be considered. (Baker-IVI)
W85-03298

RELATIONSHIPS BETWEEN THE PARTITIONING OF TRACE METALS IN SEDIMENTS AND THEIR ACCUMULATION IN THE TISSUES OF THE FRESHWATER MOLLUSC ELLIPTIO COMPLANATA IN A MINING AREA,
Quebec Univ., Sainte-Foy.
A. Tessier, P. G. C. Campbell, J. C. Auclair, and M. Bisson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 10, p 1463-1472, October, 1984. 4 Fig, 6 Tab, 38 Ref.

Descriptors: *Mollusks, *Heavy metals, *Mine wastes, *Rouyn-Noranda, *Quebec, Sediment contamination, Copper, Lead, Zinc, Iron, Manganese, Partitioning, Bioindicators, Iron oxyhydroxides, Organic matter.

In order to identify factors influencing trace metal bioavailability to freshwater benthic organisms, relationships were investigated between the partitioning of trace metals in sediments and their accumulation in various tissues of the benthic pelecypod Elliptio complanata. This filter feeder is widely distributed in the streams and lakes of northeastern North America; it is a long-lived sedentary organism that comes into contact with both sediments and water when feeding and respiring, and can accumulate trace metals. Surficial sediment samples and specimens of E. complanata were collected at eight sites located along a metal contamination gradient downstream from the mining and smelting complex in Rouyn-Noranda, Quebec. The mollusks were dissected, digested and analyzed for Cu, Pb, Zn, Fe, and Mn by flame atomic absorption spectrophotometry. Sediment samples were wet sieved and the < 70-micro-m granulometric fraction was subjected to a sequential extraction procedure designed to determine the partitioning of the trace metals among various geochemical phases. Correlations are better for relatively easily extractible metals than for more tightly bound metals for for the total trace metal concentrations. Cu, Pb, and Zn levels in various tissues of E. complanata (or in the whole organism, without the shell) are best related, not to total metal concentrations in the adjacent sediment, but rather to one or more of the relatively easily extracted fractions. Metal accumulation was influenced by the protective or competitive effect of other sediment constituents, such as amorphous iron oxyhydroxides and organic matter. (Moore-IVI)
W85-03308

SOIL LOSSES FROM ROADBEDS AND CUT AND FILL SLOPES IN THE SOUTHERN APPALACHIAN MOUNTAINS,
Southeastern Forest Experiment Station, Asheville, NC. Coweeta Hydrologic Lab.
L. W. Swift, Jr.
Southern Journal of Applied Forestry, Vol. 8, No. 4, p 209-216, November, 1984. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Road construction, *Soil erosion, *Slopes, *Coweeta, *North Carolina, Roads, Gravel, Grass, Soil loss, Storm runoff, Freeze-thaw cycle, Road cuts, Fill.

Roads are often the major source of soil erosion form forested lands. The roadway, or area of exposed soil of a newly constructed road, consists of three distinct surfaces with different characteristics that affect their erodibility: the cut slope, the roadbed, and the fill slope. Measurements were made on an access road to a Forest Service timber sale at at Coweeta Hydrologic Laboratory, North Carolina. Before grass was planted or gravel spread, roadbed surfaces had the least loss per unit area and loss was primarily waterborne fine particles. A large part of the soil loss from fill slopes was due to slippage of wet soils in early spring. Surface erosion of fills was negligible because storm water from the roadbed was not spilled across loose soil. The cut slopes eroded most, principally because soils were loosened by diurnal cycles of freezing and thawing in winter. Inclined surfaces of cut and fill slopes are potential sources of large soil loss but these losses can be mitigated by early establishment of grass cover and by design features to control storm water. Soil loss from roadbeds was generally reduced by gravel surfacing. Without protection, heavy rains remove large amounts of soil from all portions of the roadway. (Moore-IVI)
W85-03318

NITROGEN CYCLE AND ALGAL GROWTH MODELING,
Metcalf and Eddy, Inc., Boston, MA.
D. R. Bingham, C.-H. Lin, and R. S. Hoag.
Journal of the Water Pollution Control Federation, Vol. 56, No. 10, p 1118-1122, October, 1984. 9 Fig, 1 Tab, 21 Ref.

Descriptors: *Algal growth, *Nitrogen cycle, *Great Miami River, *Ohio, *Model studies, Rivers, Cycling nutrients, Pollution load, Eutrophication.

Nutrient and algae modeling are needed as part of river analysis because of the effects of nutrient cycling and algal growth on the river dissolved oxygen resources, the potential aquatic toxicity of ammonia, and the potential eutrophication of lakes and reservoirs resulting from river nutrient inputs. The effects of algal dynamics and nitrogen cycle kinetics on model calibration and wasteload allocations conducted using the QUAL-II model are presented. For a data set dominated by algal effects, it is necessary to consider such effects in model calibration. By ignoring algal effects and nitrogen cycle kinetics in model calibration, it is possible to arrive at an incorrect wasteload allocation. The QUAL-II model was improved by incorporating procedures to account for ammonia uptake by algae and the algal self-shading effect. These procedures seem to be needed for modeling many practical situations where data sets are influenced by algae, despite the need to quantify a large number of coefficients. Wasteload allocations conducted ignoring the impacts of algae were more conservative because of the elimination of photosynthesis and ammonia uptake. Calibration of model coefficients including algal effects and nitrogen cycle kinetics was still required before conducting the wasteload allocations. (Baker-IVI)
W85-03335

LEAD IN UMBILICAL BLOOD, INDOOR AIR, TAP WATER, AND GASOLINE IN BOSTON,
Children's Hospital Medical Center, Boston, MA.
For primary bibliographic entry see Field 5C.
W85-03339

REGRESSION EQUATIONS FOR PREDICTING AVAILABLE PHOSPHORUS AND POTASSIUM IN SOIL RECEIVING BARNYARD DISCHARGES,
Wisconsin Univ.-Madison. Coll. of Agricultural and Life Sciences.
R. M. Motschall, G. D. Bubenzer, and T. C. Daniel.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 747-750, May/June, 1984. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Regression analysis, *Barn wastewater, Phosphorus, Potassium, Fate of pollutants, Farm wastes, Manure, Soil contamination.

On the basis of data from 15 barnyard watersheds (74 observations), empirical equations were developed to predict available P and K concentrations in soil receiving long-term discharges of manure-laden runoff. Regression statistics showed that the available P and K equations explained 74 and 77% of the variation, respectively. The standard deviations of the predicted values from the observed values were low and the overall F-tests were highly significant. A cross-validation procedure (10 barnyards, 36 observations) indicated that the available P equation was a significantly stronger prediction tool than the available K equation. The proposed P equation provides an accurate and reliable method to compare barnyard sites for pollution potential. The accuracy of the P equation is constrained by the data used in the development and evaluation process. The accuracy is further limited by the size of the data base used in this study. The equation can be used as a preliminary planning tool to assess barnyard problems on a watershed basis. With this evaluation tool, results can be used to plan field work and focus attention on problem sites. The equations were developed from soil that received long term barnyard discharges. (Baker-IVI)
W85-03379

WATER AND PESTICIDE VOLATILIZATION FROM A WASTE DISPOSAL PIT,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. L. Baker, and L. A. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 809-816, May/June, 1984. 3 Fig, 7 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Pesticides, *Volatility, *Waste disposal pits, Evaporation, Agricultural chemicals, Alachlor, Propachlor, Trifluralin, Parathion, Organic compounds.

Theory was applied to relate pesticide volatilization to water evaporation from pits used for disposal of dilute waste pesticides. Laboratory experiments were run using the pesticides alachlor, propachlor, trifluralin, and parathion to verify the pediction equation derived. Measurements were made to estimate the water evaporation from a large canopy-covered disposal pit partially filled with soil and the remainder with rock. Where inflow air had from 0 to 100% humidity, pesticide concentrations in air were not significantly affected by whether or not water was simultaneously evaporating. Aeration of pesticide solutions or suspensions, by creation of aerosols, may enhance pesticide losses to the air. Pesticide concentrations in air increased with temperature under equilibrium conditions roughly as predicted by the Clapeyron-Clausius equation. Propachlor concentrations in air under equilibrium conditions were nearly equal to the vapor pressure over a saturated solution times the fraction of saturation, following Henry's Law. An equation is given for predicting the ratios of pesticide to water losses. Using pesticide disposal and water evaporation data for a specific pit, this equation was used to predict that containment problems relative to volatilization could occur for pesticides with vapor pressures greater than .001 mm Hg; whereas, losses for pesticides with vapor pressure less than .001 were predicted to be less than 10%. (Baker-IVI)
W85-03389

PLANT NUTRIENT YIELDS IN RUNOFF FROM A MISSISSIPPI DELTA WATERSHED,
Agricultural Research Service, Oxford, MS.
For primary bibliographic entry see Field 2J.
W85-03397

RECREATIONAL WATER QUALITY ANALYSES OF THE COLORADO RIVER CORRIDOR IN GRAND CANYON,
Arizona Univ., Tucson. School of Renewable Natural Resources.
B. Tunnicliff, and S. K. Brickler.
Applied and Environmental Microbiology, Vol. 48, No. 5, p 909-917, November, 1984. 5 Fig, 1 Tab, 40 Ref.

Descriptors: *Water quality, *Colorado River Corridor, *Grand Canyon, *Fecal coliforms, *Bacterial analyis, Precipitation, Drought, Environmental

ffects, Sediments, Stream discharge, Public ealth.

Ve intensively examined the recreational water uality of the Colorado River and 26 tributaries in Grand Canyon National Park over four consecuve summers. Highly ephemeral precipitation ycles and arid watershed hydrologies were the rincipal factors influencing water quality. Fecal oliforms (FC) in the river and in most tributaries vere < or = 10 FC/100 ml and < or = 20 FC/ 00 ml, respectively, during drought cycles. Juring rainfall cycles, FC densities were highly ariable and often exceeded recreational contact tandards. FC were not found to vary significantly n response to diurnal fluctuations in river stage eight which resulted from hydroelectric stream low regulation. River and tributary bottom sedinents harbored FC in densities averaging 10 to 100 imes those in the overlying waters. Sediment FC lensities were not found to be reliable indicators of verlying water quality when storm flow and nontorm flow periods were compared. (Author's abtract)
W85-03430

SENSITIVITY OF LEGIONELLA PNEUMOPHILA TO SUNLIGHT IN FRESH AND MARINE WATERS,
National Water Research Inst., Burlington (Ontario). Analytical Methods Div.
B. J. Dutka.
Applied and Environmental Microbiology, Vol. 48, No. 5, p 970-974, November, 1984. 5 Fig, 16 Ref.

Descriptors: *Bacterial analysis, *Legionella, *Solar radiation, *Saline Water, Pseudomonas, Escherichia, Streptococcus, Water analysis.

Studies were carried out to assess the sunlight sensitivity of Legionella pneumophila suspended in fresh and marine waters. Comparison studies on sunlight sensitivity of lake water bacteria, Pseudomonas aeruginosa, Escherichia coli and Streptococcus faecalis, were also undertaken. The effects of full sunlight and polyacrylic-screened sunlight were monitored in the study. Results indicate that L. pneumophila cells are slightly more sensitive to sunlight in seawater than in fresh water. Enumeration of sunlight-stressed bacteria in fresh water was found to be dependent on the medium used; the following order of sensitivity to sunlight, from least to most sensitive, was noted: natural lake water bacteria, L. pneumophila, P. aeruginosa, E. coli, and S. faecalis. (Author's abstract)
W85-03431

ROLE OF STAGNATION AND OBSTRUCTION OF WATER FLOW IN ISOLATION OF LEGIONELLA PNEUMOPHILA FROM HOSPITAL PLUMBING,
Veterans Administration Medical Center, Denver, CO.
C. A. Ciesielski, M. J. Blaser, and W. L. Wang.
Applied and Environmental Microbiology, Vol. 48, No. 5, p 984-987, November, 1984. 1 Fig, 4 Tab, 19 Ref.

Descriptors: *Legionella, *Water supply systems, *Plumbing, Bacterial analysis, Stagnation, Public health, Pipes.

The stagnation of water in two of four hospital hot-water storage tanks found to contain Legionella pneumophila was reduced by keeping the two tanks continually on-line for 1 year. L. pneumophila colony counts in these two tanks fell quickly to low levels, whereas the organisms persisted in the two tanks that were not in use. L. pneumophila continued to be isolated from 50 to 100% of the hospital showerheads which were sampled during this period. Aerators and other hospital faucet fixtures which obstruct water flow were also examined. L. pneumophila was isolated from 22 of 30 faucet aerators and 2 of 16 vacuum breakers but not from 26 nonobstructed faucets or 6 backflow preventers. Over a 7-month period, after nine faucet aerators were sterilized, 10 of 60 surveillance cultures revealed L. pneumophila, despite the inability to isolate the organism from the potable-water tanks in use. These data suggest that prevention of stagnation in hot-water tanks may be effective in reducing L. pneumophila concentrations in potable-water systems serving high-risk populations. Faucet aerators, by providing a surface for L. pneumophila to colonize, can become secondary reservoirs for the organism in hospital plumbing. (Author's abstract)
W85-03432

NUMERICAL TAXONOMY OF PHENANTHRENE-DEGRADING BACTERIA ISOLATED FROM THE CHESAPEAKE BAY,
Maryland Univ., College Park. Dept. of Microbiology.
P. A. West, G. C. Okpokwasili, P. R. Brayton, D. J. Grimes, and R. R. Colwell.
Applied and Environmental Microbiology, Vol. 48, No. 5, p 988-993, November, 1984. 1 Fig, 2 Tab, 22 Ref.

Descriptors: *Chesapeake Bay, *Taxonomy, *Bacterial analysis, *Phenanthrene, Bacterial physiology, Jaccard coefficient, Vibrio, Phenograms.

Phenanthrene-degrading bacteria were isolated from Chesapeake Bay samples by the use of a solid medium which had been overlaid with ethanol solution of phenanthrene before inoculation. Eighteen representative strains of phenanthrene-degrading bacteria with 21 type and reference bacteria were examined for 123 characteristics representing physiological, biochemical, and nutritional properties. Relationships between strains were computed with several similarity coefficients. The phenogram constructed by unweighted-pair-group arithmetic average linkage and use of the simple Jaccard coefficient was used to identify seven phena. Phenanthrene-degrading bacteria were identified as Vibrio parahaemolyticus and Vibrio fluvialis by their clustering with type and reference strains. Several phenanthrene-degrading bacteria resembled Enterobacteriaceae family members, although some Vibrio-like phenanthrene degraders could not be identified. (Author's abstract)
W85-03433

EFFECTS OF WATER TEMPERATURE AND SALINITY ON ELIMINATION OF SALMONELLA CHARITY AND ESCHERICHIA COLI FROM SYDNEY ROCK OYSTERS (CRASSOSTREA COMMERCIALIS),
New South Wales Univ., Kensington (Australia). School of Food Technology.
A. J. Rowse, and G. H. Fleet.
Applied and Environmental Microbiology, Vol. 48, No. 5, p 1061-1063, November, 1984. 2 Tab, 14 Ref.

Descriptors: *Salmonella, *Escherichia coli, *Oysters, *Water temperature, *Salinity, Fate of pollutants, Bacterial analysis, Decontamination.

The elimination of Salmonella charity and Escherichia coli from the Sydney rock oyster, Crassostrea commercialis, was examined during commercial purification of oysters under different water temperatures and salinities. Both organisms were rapidly eliminated at 18 to 22 C. Purification was effective but slower at 24 to 27 C and incomplete and inconsistent at temperatures below 17 C. The oysters suffered stress and were not effectively purified at water salinities of 15 to 20% but were rapidly purified at 32 to 47% salinity. Winter-harvested and summer-harvested oysters were purified similarly in water at 18 to 22 C and 32% to 36% salinity. (Author's abstract)
W85-03436

FINITE ELEMENT/FINITE DIFFERENCE WAVE MODEL FOR DEPTH VARYING NEARLY HORIZONTAL FLOW,
Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
For primary bibliographic entry see Field 2H.
W85-03474

ACCUMULATION OF SEDIMENTS, TRACE METALS (PB, CU) AND TOTAL HYDROCARBONS IN NARRAGANSETT BAY, RHODE ISLAND,
Lamont-Doherty Geological Observatory, Palisades, NY.
P. H. Santschi, S. Nixon, M. Pilson, and C. Hunt.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 4, p 427-449, October, 1984. 8 Fig, 6 Tab, 75 Ref. EPA grant 806072020, DOE grant DE AC02-76-EVO2185, NOAA grant NARAD 00016.

Descriptors: *Narragansett Bay, *Rhode Island, *Sediments, *Trace metals, *Lead radioisotopes, *Copper, *Hydrocarbons, Thorium radioisotopes, Plutonium radioisotopes, Copper smelting, Coal mining, Dredging, Bays, Radioisotopes, Isotope studies.

The accumulation of sediments, trace metals and hydrocarbons has been estimated from the analysis of the sediment from six coring sites in Narragansett Bay. Radionuclides (Th-234, Pb-210, Pu-239,240) with known input functions and trace metals (Cu, Pb) were used. Estimates are that 69,000 tons of sediments, 51-90 tons of Pb, 72-100 tons of Cu and 400-1000 tons of total hydrocarbons accumulate annually under present conditions in the bay. This represents 64-117% (Pb), 89-123% (Cu) and 23-58% (hydrocarbons), respectively, of present day inputs to the bay. Furthermore, close to 100% of the particle-reactive radionuclides Pb-210 and Pu-239,240 accumulate in the bay. Present day inputs to the bay were calculated independently as 77-80 tons Pb and 81 tons of Cu. Sewage effluents were the dominant source of Cu, whereas atmospheric deposition and urban runoff were most important for Pb. Dredging activities by the U.S. Army Corps of Engineers between 1946 and 1971 removed more sediments from the bay than would have accumulated during the same time in the undredged areas of the bay. Copper smelting and coal mining on the shores of the upper bay during 1866-1880 left an imprint in the sediments which is still evident. Model derived accumulation rates of Pb, Cu and coal during that time were 3-4 times present-day inputs. (Author's abstract)
W85-03500

BEHAVIOR OF TRITIUM IN THE MARINE ENVIRONMENT: UPTAKE AND DISTRIBUTION OF TRITIATED WATER AND OF TRITIATED ORGANIC COMPOUNDS IN UNICELLULAR AND MULTICELLULAR ALGAE,
Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium).
S. Bonotto, G. Arapis, J. Mellet, D. Hoursiangou-Neubrun, and F. Cinelli.
Hydrobiologia, Vol. 116/117, p 187-200, 1984. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Tritium, *Algal growth, *Fate of pollutants, Seaweed, Acetabularia, Boergesenia, Laurencia, Cystoseira, Salinity, Triiodothyronine.

With the development of nuclear energy and of fusion-reactor technology, it is expected that tritium will become an important radionuclide from the point of view of radioprotection. A number of studies are being done on the fixation of tritium into living organisms. Tritium, applied as tritiated water, is rapidly taken up (or released) by the unicellular algae Acetabularia and Boergesenia as well as by the multicellular algae Cystoseira and Laurencia. Compartmental analysis has shown that, in Acetabularia, three metabolic components can be discerned in the release, having respectively half lives of a few seconds, of about 1 min. and of about 5 hr. Salinity of the external medium affects the uptake of tritiated water as well as of tritiated precursors in Acetabularia, the highest radioactivity values being found in the range of salinity of 37-43%. The effect of a hormone, triiodothyronine, on the uptake of tritiated water in vegetative Acetabularia cells demonstrated a slight stimulation of tritiated-water penetration. This stimulation was too low to provoke a significant increase of tritium incorporation into the organic matter of the cells. (Baker-IVI)
W85-03501

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BIODEGRADATION OF LINEAR ALKYLBENZENE SULFONATES AND SOAP IN RIVER WATER (IN JAPANESE),
Kao Corp., Tochigi (Japan). Research Labs.
K. Yoshimura, K. Ara, K. Hayashi, J. Kawase, and K. Tsuji.
Japanese Journal of Limnology, Vol. 45, No. 3, p 204-212, July, 1984. 8 Fig, 3 Tab, 19 Ref.

Descriptors: *Biodegradation, *Alkylbenzene sulfonates, *Soap, Particulate matter, Organic carbon, Fatty acids, Die-away tests, Degradation.

River Die-Away tests of linear alkylbenzene sulfonates (LAS) and soap were carried out. At 10 mg/l of surfactant in river water, dissolved organic carbon (DOC) due to soap decreased slightly faster than that due to LAS, while no significant difference was observed in the change of particulate organic carbon (POC) of either surfactant. As the result of River Die-Away test of soap at 30 mg/l, POC level increased in the course of biodegradation of soap (till about day 15 of test period). The increase of POC level was inferred to be due to bacterial floc partially containing unsoluble soap (fatty acid salts). Fatty acids in the course of biodegradation of soap were analyzed by a prelabelling HPLC method. The extent of biodegradation of fatty acids decreased in the following order: C12 > C10 approximately = C8 > C14 approximately = C18:2 > C18:1 > C16 > C18. LAS was degraded according to Swisher's 'Distance Principle' that the longer the alkyl carbon chain length, and the longer the distance between the far end of alkyl chain and the phenyl group, the faster the biodegradability becomes. Optimum temperature for LAS biodegradation was about 25 C. Although soap was degraded at both 10 and 40 C, LAS was not degraded at those temperatures. However, after incubation of river water containing LAS at 20 C, LAS was degraded even at 10 C. (Author's abstract)
W85-03508

EVAPORATION FROM FORESTS IN CLOUD ENHANCES THE EFFECTS OF ACID DEPOSITION,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Moscow (USSR).
M. H. Unsworth.
Nature, Vol. 312, No. 5991, p 262-264, 15 November, 1984. 2 Fig, 16 Ref.

Descriptors: *Acid deposition, *Forests, *Clouds, *Evaporation, Leaves, Vegetation, Wind, Europe, North America, Elevation, Altitude, Heavy metals.

Declining growth rates and injury to foliage have been noted in forests at high elevations in areas of Europe and North America. Trees in such areas are regularly enveloped in cloud and mist. Concentrations of dissolved chemicals in cloud drops are often much larger than in rain, so the capture of cloud droplets by leaves may give rise to significant rates of occult deposition of acidic pollutants and heavy metals on forests. The possibility was investigated that evaporation of intercepted cloudwater from forest canopies, proceeding simultaneously with occult deposition, can lead to chemical concentrations on leaf surfaces that are substantially larger than those measured in cloud drops themselves. Calculations suggest that the effects of acid cloud or mist deposition on vegetation depend not only on chemical concentrations in the drops but also on the weather factors and vegetation characteristics that influence deposition and evaporation. It is necessary to measure whether evaporation of drops in the air close to the canopy limits deposition or whether turbulent transfer is sufficiently effective to maintain deposition rates assumed here. (Baker-IVI)
W85-03535

FREE FLUORIDE OF THE PAMLICO RIVER IN NORTH CAROLINA; A NEW METHOD TO LOCALIZE THE DISCHARGE OF POLLUTED WATER INTO AN ESTUARY,
East Carolina Univ., Greenville, NC. Dept. of Chemistry.
J. W. Chamblee, F. K. Arey, and E. Heckel.
Water Research Vol. 18, No. 10, p 1225-1233, 1984. 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Fluorides, *Pamlico River, *North Carolina, *Path of pollutants, *Estuaries, Salinity, Water pollution sources, Calcium, Magnesium, Industrial wastewater, Phosphate mining.

The phosphate mining operation of Texasgulf, Inc., located on the south bank of the Pamlico River raises the possibility of fluoride contamination of the Pamlico estuary. The intermixing of waters from a main tributary and several creeks with ocean water during the tides is affected by the withdrawal of water for use in the manufacturing process and the discharge of wastewater from industrial plants. The commonly employed method of referring ion contents to the salinity of the water may lead to misinterpretation with regard to the degree of pollution when applied to such complex water systems. Experimental Ca(2+) and Mg(2+) data were used to underline the problem. A graphical display showing the fluoride concentration of the water in relation to the square of the distance from a reference sampling site has been recommended for the evaluation of fluoride pollution in the Pamlico Estuary of North Carolina. The comparison of the two relations revealed that the method of referring the ion content to distance is a suitable means to localize the discharge of polluted waste into an estuary. The chelometric titrations methods for calcium and magnesium ions were not affected by the salinity of the water samples. (Baker-IVI)
W85-03539

PRECIPITATION CHEMISTRY AT TURRIALBA, COSTA RICA,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 2K.
W85-03568

CHEMICAL PATTERNS OF BULK ATMOSPHERIC DEPOSITION IN THE STATE OF COLORADO,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis, M. C. Grant, and J. F. Saunders, III.
Water Resources Research, Vol. 20, No. 11, p 1691-1704, November, 1984. 18 Fig, 8 Tab, 22 Ref.

Descriptors: *Atmospheric deposition, *Colorado, *Acid rain, Sulfates, Nitrates, Air pollution, Acidity, Elevation, Hydrogen ion concentration, Carbonates, Water pollution sources, Particulates, Gases.

Bulk deposition samples were taken over a 1 yr interval between May 1982 and May 1983 at 42 sites in Colorado. Collections were complete for the entire year at 36 of these sites. The collections were made biweekly and were analyzed for major cations, major anions, total particulate material and the hydrogen ion. The general patterns of deposition can be understood in terms of three sets of factors: location and potency of sources, transport and deposition mechanisms. Low elevations are the greatest sources of divalent cations and carbonates. They are also the greatest sources of strong acids and their anions. Thus at low elevations both alkaline and acid materials are found together in quantity. Important changes occur, however, in the ratio of divalent cations and carbonates to strong acids and their anions as air moves to higher elevations. These changes can be traced to differences in transport and deposition mechanisms. Transport of divalent cations and carbonates by prevailing winds is less efficient than transport of strong acids. Sedimentation plays an important role in the removal of divalent cations and carbonates, as shown by a statistically significant negative relationship of their deposition rates with elevation. Even in the absence of significant moisture, net loss of divalent cations and carbonates occurs by sedimentation as air moves upslope. Moisture facilitates deposition, but this is a secondary effect. In contrast, transport of strong acids is more efficient because sedimentation is only a minor deposition mechanism, as shown by the lack of significant relationships between elevation and strong acid anion deposition. More efficient transport is explained by the origin of strong acids from gaseous precursors rather than particles. Moisture is the predominant deposition mechanism for strong acids. Thus as air travels from low to high elevations, divalent cations and carbonates sediment steadily, whereas strong acids remain in the air mass until they are scrubbed out by moisture. This phenomenon accounts for high acidity at high elevations, especially where total wet precipitation is highest. (Baker-IVI)
W85-03570

NEUTRALIZATION OF ACID DEPOSITION BY NITRATE RETENTION AT BICKFORD WATERSHED, MASSACHUSETTS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W85-03572

EIGENVALUE SOLUTION CONTINUOUS IN TIME TO THE SPATIALLY DISCRETIZED SOLUTE TRANSPORT EQUATION IN STEADY GROUNDWATER FLOW,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
J. C. Hwang, W. C. Cho, and G. T. Yeh.
Water Resources Research, Vol. 20, No. 11, p 1725-1732, November, 1984. 1 Fig, 24 Ref. EPA contract HQ-8111-03B.

Descriptors: *Eigenvalue technique, *Groundwater movement, *Model studies, *Solute transport equations, Boundary conditions, Transport equations, Path of pollutants.

The spatially discretized two-dimensional solute transport equation in a steady groundwater flow was solved by an eigenvalue technique. The solution is exact in time. An explicit expression was obtained for each nodal point as a function of time. Thus the computer code can be implemented to calculate solute concentration at any nodal point at any given instant with a direct computation. The general solution can be obtained explicitly for transient boundary conditions and variable constant source loads. The solution for steady boundary conditions can readily be derived from the general solution. The method presented herein can provide convenience of data retrieval, particularly in groundwater management modeling. (Author's abstract)
W85-03573

GROUNDWATER CONTAMINATION FROM AN INACTIVE URANIUM MILL TAILINGS PILE: 1. APPLICATION OF A CHEMICAL MIXING MODEL,
California Univ., Berkeley. Lawrence Berkeley Lab.
A. F. White, J. M. Delany, T. N. Narasimhan, and A. Smith.
Water Resources Research, Vol. 20, No. 11, p 1743-1752, November, 1984. 9 Fig, 2 Tab, 12 Ref.

Descriptors: *Groundwater contamination, *Mixing, *Uranium mill tailings, *Mine wastes, *Riverton, *Wyoming, Spoil banks, Hydrogen ion concentration, Trace metals, Radionuclides, Water pollution sources, Path of pollutants.

Low-pH process waters contained in a number of inactive and abandoned uranium mill tailings in the United States represent potential sources of radionuclide and trace metal contamination of groundwater. Detailed investigations at a typical site at Riverton, Wyoming, indicate that chemical transport occurs from initial dewatering of the tailings, downward infiltration due to precipitation, and groundwater intrusion into the base of the tailings pile. Except for elevated uranium and molybdenum concentrations, current radionuclide and trace metal transport is limited by the near-neutral pH conditions of the groundwater. Significant reactions include the dissolution of calcite, production of CO2, and precipitation of gypsum and the hydroxides of iron and aluminum. A geochemical mixing model employing the PHREEQE comput-

r code is used to estimate current rates of the roundwater contamination by tailings water. A naximum mixing of 1.7% of pore water is a factor f 2 less than steady state estimates based on hyraulic parameters. (Author's abstract)
V85-03575

PEROXYACETYL NITRATE SOLUBILITY AND DECOMPOSITION RATE IN ACIDIC VATER,
Battelle Columbus Div., OH.
M. W. Holdren, and C. W. Spicer.
Atmospheric Environment, Vol. 18, No. 6, p 1171-1173, 1984. 1 Fig, 2 Tab, 21 Ref.

Descriptors: Decomposition, *Peroxyacetyl nitrate, *Solubility, *Acidic water, *Acid rain, Path of pollutants, Precipitation chemistry, Nitrates.

H2SO4 and HNO3 are the two species considered o be prime factors in acid deposition. The reacions of NO leading to HNO3 are complex, and everal other oxidizing N compounds can be ormed in the reaction sequence. One of these roducts, peroxyacetyl nitrate (PAN), seems to be biquitous in the continental boundary layer and he unpolluted atmosphere. The solubility of PAN n acidic water and the kinetics of PAN decay in vater were determined. Lab experiments demontrate that PAN is soluble in rainwater and acidic listilled water. A Henry's law coefficient of 5 + or - 1 M/atm was measured at 10 C. PAN exhibited a first order decay in these solutions with a half-ife of 99 min at 5 C. The principal anionic product of PAN decomposition in acid solution was NO3(-) on. Recent modeling studies using the above results indicate that the direct contribution to precipitation nitrate levels is probably not important. The possibility that PAN may serve as an oxidizing agent for SO2 and NO2 in cloud water is currently being studied. (Baker-IVI)
W85-03594

LONG-TERM PRECIPITATION QUALITY AND WET DEPOSITION FIELDS IN THE SUDBURY BASIN,
Ontario Ministry of the Environment, Toronto. Air Resources Branch.
W. H. Chan, R. J. Vet, C.-U. Ro, A. J. S. Tang, and M. A. Lusis.
Atmospheric Environment, Vol. 18, No. 6, p 1175-1188, 1984. 4 Fig, 3 Tab, 5 Ref.

Descriptors: *Chemistry of precipitation, *Acid rain, *Wet deposition, *Sudbury Basin, *Canada, *Ontario, Air pollution effects, Hydrogen ion concentration, Sulfates, Nitrates, Ammonium, Iron, Copper, Nickel, Lead, Zinc, Chromium, Cadmium.

During the period June 1978-May 1980, a network of about 20 wet-only, monthly deposition monitors was operated within a 150 km radius of Sudbury, Ontario, the location of the INCO and Falconbridge Ni smelters, to examine the long term wet deposition pattern in the Sudbury Basin. During most of the first study year (June 1978-May 1979), the INCO smelter (the larger of the two sources) was not operating, and therefore the data were grouped into two periods June 1978-May 1979, and June 1979-May 1980 to look for any smelter impact. Geometric means of the 78/79 and and 79/80 pH and concentration measurements of all network stations were: pH, 4.1 (78/79) and 4.2 (79/80); SO2(-4), 3.4 and 3.4 (all in mg/l); N-NO3(-), 0.6 and 0.6; N-NH4(+), 0.3 and 0.4; Fe, 0.06 and 0.07; Cu, 0.003 and 0.004; Ni, 0.001 and 0.002; Pb, 0.013 and 0.009; Zn, 0.011 and 0.009; Cr, 0.0004 and 0.0004, and Cd, 0.0007 and 0.0005. Results of a Student t-test indicate that there were no statistically significant differences in the two years' concentrations. The precipitation concentration and wet deposition fields for the June 1978 to May 1979, and June 1979 to May 1980 periods were compared. Contrary to expectations, there was no readily observable difference on the local precipitation acidity. The greatest impact of smelting activities near the source was found to be for Cu and Ni. Pb and Cd showed only a small smelter impact. Results for the other substances examined (e.g. SO24(-2), NO3(-), NH4(+), and Fe) apparently were largely governed by non-smelter-related phenomena, such as long-range transport into the study area, and contributions of local wind-blown dust or vehicular traffic. (Author's abstract)
W85-03595

STABLE LEAD ISOTOPES IN POND SEDIMENTS AS TRACER OF PAST AND PRESENT ATMOSPHERIC LEAD POLLUTION IN BELGIUM,
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. of Analytical Chemistry and Mass Spectrometry.
D. Petit, J. P. Mennessier, and L. Lamberts.
Atmospheric Environment, Vol. 18, No. 6, p 1189-1193, 1984. 1 Fig, 1 Tab, 25 Ref.

Descriptors: *Lead isotopes, *Air pollution, *Lake sediments, *Belgium, *Willerzie, Sediments, Water pollution sources, Heavy metals, Path of pollutants.

This study demonstrates the utility of using rural ponds as a large-scale rain gauge to detect the importance of atmospheric lead pollution over the last 100 years in industrialized countries. Stable Pb isotopes are used to identify Pb pollution sources and to evaluate the relative importance of anthropogenic sources to the total Pb fluxes found in a semi-rural region of Western Europe (S. Belgium). The isotopic ratios of lead in surface layers of a sediment core taken in a pond located at Willerzie and dated by Pb-210 geochronology show a pattern that differs clearly from that exhibited in the older sediment layers (pre-1900). These data indicate that the observed increase of lead concentration in the upper sedimentary layers comes from anthropogenic sources which are mainly of atmospheric origin. (Author's abstracts)
W85-03596

RAINWATER PH IN THE VICINITY OF HADERA POWER PLANT, ISRAEL DURING THE WINTER SEASON OF 1981-1982,
Hadera Association of Towns for Environmental Protection (Israel).
For primary bibliographic entry see Field 5A.
W85-03597

RELATIVE IMPORTANCE OF ANTHROPOGENIC VERSUS NATURAL SOURCES OF ACIDITY IN LAKES AND STREAMS OF CENTRAL ONTARIO,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
B. D. LaZerte, and P. J. Dillon.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 11, p 1664-1677, November, 1984. 4 Fig, 2 Tab, 62 Ref.

Descriptors: *Acid deposition, *Acid precipitation, *Acid rain, *Lakes, *Streams, *Ontario, *Sudbury, *Water pollution sources, Air pollution, Hydrogen ion concentration, Sulfur dioxide.

Anthropogenic acid deposition has been implicated in the acidification of surface waters of central Ontario and elsewhere. However, alternative sources of acidity have been proposed, including (i) the release of protons and their accompanying acid anions by soils (e.g. organic acids) and (ii) the exchange of internally generated protons for the cations of atmospherically deposited neutral salts (e.g. sea salts). For a typical acidified catchment in central Ontario the first hypothesis is not important during periods of high discharge or on an annual basis. As most of the neutral salts deposited on inland areas are sulfate and nitrate of anthropogenic origin, any acidity generated via the second mechanism can be reduced by reducing the emission of the salts. A third and alternative hypothesis is that deposition of strong acid alters only the balance between humic anions and sulfate in runoff waters, but not pH; this is shown to be incorrect using catchments from the Sudbury region of Ontario, where rates of acid deposition have recently declined. In central Ontario, acidic deposition derived from anthropogenic SO2 sources is the primary causal factor in recent lake acidification, and that a reduction in the anthropogenic emissions affecting this area will result in a decrease in lake acidity. (Author's abstract)
W85-03602

BEHAVIOUR OF DISSOLVED ARSENIC IN THE ESTUARY OF THE RIVER BEAULIEU,
Southampton Univ. (England). Dept. of Chemistry.
A. G. Howard, M. H. Arbab-Zavar, and S. Apte.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 5, p 493-504, November, 1984. 5 Fig, 3 Tab, 39 Ref.

Descriptors: *Chemical compostion, *Arsenic, *River Beaulieu, *Estuarine environment, Mixing, Oxidation, Speciation, Fate of pollutants.

The chemical forms and distribution of dissolved arsenic species in the estuary of the River Beaulieu (Hampshire, U.K.) are reported. 'Inorganic arsenic (V)' in both the marine and riverine estuary inputs are in true solution passing through ultrafiltration membranes having a nominal molecular weight cut-off of 500 daltons. Extensive removal of dissolved 'inorganic arsenic (V)' is apparent from the distribution of arsenic in the estuary, with laboratory mixing experiments indicating that removal is favored in the low salinity region. 'Inorganic arsenic (III)' and methylated arsenic species account for up to 41% and 70% of the dissolved arsenic, respectively, but are only found during the warmer months when water temperatures exceed ca. 12 C. (Author's abstract)
W85-03631

METAL INCORPORATION BY BENTHIC FAUNA: RELATIONSHIPS TO SEDIMENT INVENTORY,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5C.
W85-03634

MONITORING CARBON IN WORLD RIVERS,
Hamburg Univ. (Germany, F.R.). Inst. of Geology and Paleontology.
E. Degens, S. Kempe, and V. Ittekkot.
Environment, Vol. 26, No. 9, p 29-33, November, 1984. 5 Fig, 4 Ref.

Descriptors: *Monitoring, *Carbon, *Rivers, Nutrients, Cycling nutrients, Dam effects, River flow, Seasonal variation, Organic carbon, Biogeochemical cycling, Suspended solids, Particulates.

Riverine systems play a major role in the transport of nutrients from the planet's land masses and atmosphere to its oceans, and frequently serve as reservoirs for numerous compounds. This project report outlines the activities and initial results of a unique research effort to measure the transport of nutrients, especially organic carbon, in major world rivers. The results of this study may aid scientists in determining some unknown parameters of the global carbon dioxide budget and in understanding how human actions have complicated the biogeochemical cycling of elements. The following trends are discerned. In terms of quantity, maximum particulate organic carbon is being transported by the rivers of Asia, followed by those draining North America, South America, Oceania, Africa, and Europe, in that order. In terms of particulate organic carbon yield, Asia and Oceania top the list. Seasonality introduces high fluctuations in concentrations of suspended matter. In rivers from the temperate regions, concentrations tend to decrease with increasing water discharge. The building of dams fundamentally alters the organic carbon transport of a river by trapping the sediment load in the reservoir behind the dam. The concentrations and transport of nutrients have increased in some rivers that run through industrialized regions by two orders of magnitude, and the rates are still rising. (Baker-IVI)
W85-03654

CHLORINATED ORGANIC CONTAMINANTS ON SETTLING PARTICULATES IN THE NI-

LIBRARY U. OF I. URBANA-CHAMPAIGN

AGARA RIVER VICINITY OF LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
B. G. Oliver, and M. N. Charlton.
Environmental Science and Technology, Vol. 18, No. 12, p 903-908, 1984. 1 Fig, 6 Tab, 30 Ref.

Descriptors: *Niagara River, *Lake Ontario, *Path of pollutants, *Sedimentation, Great lakes, Organic compounds, Pesticides, Polychlorinated biphenyls, Mirex, Insecticides, Octachlorostyrene, Particulates.

Determinations were made of the concentrations of 26 chlorinated organic contaminants in settling particulates from sediment traps in Lake Ontario in the vicinity of the Niagara River and in two offshore stations. The same compounds were analyzed in some Niagara River water and surficial Lake Ontario sediment samples. Compounds studied included chlorinated benzenes and toluenes, some PCB congeners, several pesticides, and miscellaneous compounds such as mirex and octachlorostyrene. Contaminant profiles have been used to distinguish between freshly settling particulates and resuspended bottom sediments found in the traps from various depths. From the sediment trap and river contaminant data a crude estimate of the relative proportion of contaminants sorbed on settling particles in the vicinity of the river was made. Poor agreement was found when field sediment-water partition coefficients were compared to coefficients estimated from octanol-water partition coefficients for most compounds. Contaminant ratios in the material have been used to compute the degree of sediment resuspension in the lake and show that considerable resuspension is occurring particularly during winter months. The general lack of agreement between field partition coefficients and coefficients drived from semi-empirical equations based on physical and chemical properties of the contaminants shows the difficulties that can be encountered in applying laboratory predictions to field situations. (Baker-IVI)
W85-03661

IMPLICIT-ADSORBATE MODEL FOR APPARENT ANOMALIES WITH ORGANIC ADSORPTION ON NATURAL ADSORBENTS,
Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
R. L. Curl, and G. A. Keoelan.
Environmental Science and Technology, Vol. 18, No. 12, p 916-922, 1984. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Adsorption, *Organic compounds, *Model studies, Fate of pollutants, Soil adsorption, Water treatment, Wastewater treatment.

The interaction between organic pollutants and soils and other natural adsorbents is important in determining the fate and distribution of organic pollutants in the environment. Adsorption-desorption hysteresis, the adsorbent-concentration effect, and other apparent anomalies that have been observed in studies of adsorption of organic chemicals on natural adsorbents can be explained by an implicit-adsorbate model. The model is based on the competitive adsorption, between an adsorbate under study, A, and an implicit adsorbate, B, initially on the adsorbent. During batch adsorption-desorption experiments B desorbs and uncovers sites for binding A, increasing the apparent partition coefficient. The model agrees well with several sets of experimental data from the literature, but ranges of model parameters such as the true adsorption partition coefficient for A give equivalently good agreement. The true adsorption parameters are not determinable uniquely from presently available data, in the presence of strong hysteresis or adsorbent-concentration effects. They are determinable if the implicit adsorbate can be identified and characterized. The success of the model suggests that future studies should look carefully at the role of implicit adsorbates. (Baker-IVI)
W85-03663

NEUTRAL ORGANIC COMPOUNDS IN BIOLOGICALLY TREATED BLEACHED KRAFT MILL EFFLUENTS,
Pulp and Paper Research Inst. of Canada, Pointe Claire (Quebec).
For primary bibliographic entry see Field 5D.
W85-03665

OCCURRENCE AND DISTRIBUTION OF ORGANIC CHEMICALS IN TWO LANDFILL LEACHATE PLUMES,
Stanford Univ., CA. Dept. of Civil Engineering.
M. Reinhard, N. L. Goodman, and J. F. Barker.
Environmental Science and Technology, Vol. 18, No. 12, p 953-961, 1984. 4 Fig, 5 Tab, 39 Ref.

Descriptors: *Landfills, *Organic compounds, *Leachates, *Spatial distribution, *Plumes, Chemical analysis, Water analysis, Path of pollutants, Aliphatic acids, Aromatic compounds, Phenols, Terpenes, Chlorinated hydrocarbons, Hydrocarbons, Nitrogen compounds, Groundwater pollution.

Multilevel sampling devices were used to establish the spatial distribution of trace organic compounds in leachate plumes of two sanitary landfills. Decomposing plant material was the source for most of the compounds including aliphatic and aromatic acids, phenols, and terpenes. Industrial and commercial wastes accounted for the minor constituents such as chlorinated and non-chlorinated hydrocarbons, nitrogen containing compounds, alkylphenol polyethoxylates, and alkyl phosphates. The accumulation of chlorinated solvents beneath the leachate plume were indicated by vertical concentration profiles. The sorptive capacity of the sandy aquifer was apparently too low to prevent migration of aromatic hydrocarbons. The distribution of trace organics at the two sites of the study was much more complex than that of inorganics commonly used to map leachate plumes. This indicates that extensive monitoring will be needed to predict future impacts. (Baker-IVI)
W85-03667

FACILE INCORPORATION OF BROMINE INTO AROMATIC SYSTEMS UNDER CONDITIONS OF WATER CHLORINATION,
Minnesota Univ.-Duluth. Dept. of Chemistry.
S. Lin, M. T. Lukasewycz, R. J. Liukkonen, and R. M. Carlson.
Environmental Science and Technology, Vol. 18, No. 12, p 985-986, 1984. 2 Tab, 18 Ref.

Descriptors: *Water pollution sources, *Bromine, *Chlorination, *Water treatment, Drinking water, Disinfectants, Bromination, Chloramine, Chlorine dioxide, Naphthalene, Biphenyl.

The isolation of haloforms containing bromine from the chlorination of drinking water suggests that the efficiency of bromine incorporation is quite high. The question remains as to the possible bromination of substrates that do not result in the formation of trihalomethanes in he presence of bromine when the oxidants chlorine, chlorine dioxide, and chloramine are used. Loss of organic substrate and formation of a series of chlorinated and brominated products resulted from the reaction of aqueous solutions of biphenyl and naphthalene with chlorine in the presence of potassium bromide. In the presence of bromide, the extent of the reaction was typically greater than with chlorine alone. Chloramine (pH $>$ 6.0) and chlorine dioxide (pH 4.5-7.5) in the presence or in the absence of bromide resulted in no substantial loss of biphenyl or naphthalene. (Baker-IVI)
W85-03671

TRANSPORT OF AIRBORNE 90SR AND 137CS DEPOSITED IN THE BASINS OF THE FIVE LARGEST RIVERS IN FINLAND,
Finnish Centre for Radiation and Nuclear Safety, Helsinki.
A. Salo, R. Saxen, and M. Puhakainen.
Aqua Fennica, Vol. 14, No. 1, p 21-31, 1984. 13 Fig, 4 Tab, 20 Ref.

Descriptors: *Radionuclides, *Finland, *Path of pollutants, *Strontium radioisotopes, *Cesium radioisotopes, Fallout, Rivers, Lakes, Catchment area, Deposition.

During the 1960s and 1970s, fallout from nuclear weapons tests were monitored in wet and dry deposition and surface waters in Finland. Different levels of 90Sr and 137Cs concentrations in surface waters were noted in different areas even though the depositions were evenly distributed over the country. To explain the regional differences in the transport of radionuclides by rivers, a comparison was made between the amounts of strontium-90 and cesium-137 deposited in the catchment areas and discharged by the rivers. The comparison was based on the monitoring data and showed average removals of 25 to 52% for Sr-90 and 2.9 to 8.6% of Cs-137 in the different catchment areas. The total amounts of Sr-90 and Cs-137 deposited in and removed from Finland up to 1981 were estimated. Up to 1981 the average removal by water was calculated to be 41% for Sr-90 and 7% for Cs-137. High precipitation seems to increase the Cs-137 to Sr-90 ratio in river water. The Cs-137 to Sr-90 ratio, which is higher in rainwater than in surface and groundwater, leads to an increase in this ratio in river water as the share of rain water increases. The amounts of Sr-90 removed from the catchment areas correlate rather well with the percentage of lakes. Sr-90 is markedly removed by runoff from land to watercourses while Cs-137 is not. Part of the Cs-137 deposited on the water surface is deposited on lake and river bottoms. (Baker-IVI)
W85-03678

OCCURRENCE OF FAECAL COLIFORMS, FAECAL STREPTOCOCCI AND SALMONELLA IN THE WASTE WATER OF THREE ABATTOIRS IN FINLAND 1980-1983,
Valtion Elainlaaketieteellinen Laitos, Helsinki (Finland).
For primary bibliographic entry see Field 5A.
W85-03681

DIETARY ACCUMULATION OF PCBS FROM A CONTAMINATED SEDIMENT SOURCE BY A DEMERSAL FISH (LEIOSTOMUS XANTHURUS),
Environmental Research Lab., Gulf Breeze, FL.
N. I. Rubinstein, W. T. Gilliam, and N. R. Gregory.
Aquatic Toxicology, Vol. 5, No. 4, p 331-342, November, 1984. 2 Fig, 3 Tab, 30 Ref.

Descriptors: *Polychlorinated biphenyls, *Bioaccumulation, *Sediment contamination, *Spot, *Polychaetes, Path of pollutants, Fish food, Food chains, Harbors.

For extremely hydrophobic compounds, such as polychlorinated biphenyls (PCBs), diet is a major source of body residues for at least for some species of fish. Accumulation and dietary transfer of PCBs from contaminated harbor sediments from Newark Bay, New Jersey were studied in a laboratory food chain consisting of sediments, polychaetes (Nereis virens) and a predatory fish, the spot (Leiostomus xanthurus). In phase I fish and polychaetes were separately exposed to field-collected PCB contaminated sediments (5.2 micro-g/g dry weight as Aroclor 1242 and 1254) in flow-through sea-water systems for 40 days to allow organisms to attain steady state concentrations. In Phase II the dietary fraction of PCB accumulation was determined by selectively feeding polychaetes having a known PCB body burden to exposed and control groups of fish. The effect of direct sediment contact on PCB accumulation by L. xanthurus was also investigated. Contaminated sediments can serve as a source of PCBs for uptake and trophic transfer in marine systems. Fish exposed to PCB-contaminated sediments and fed a daily diet of polychaetes from the same sediment accumulated more than twice the PCB whole-body residues than fish exposed to similar conditions but fed uncontaminated polychaetes. The dietary contribution of PCBs accounted for 53% of the total body burden measured in fish fed for 20 days, and this percentage appeared to be increasing. Fish isolated from direct contact with PCB-contaminated sediment do not significantly ($P = \text{or} < 0.05$) accumulate PCB residues when compared with fish allowed contact with sediment. Results demonstrate that contaminated harbor

ediments can serve as a source of PCBs for accu-
ulation and dietary transfer by sandworms and
ot. (Moore-IVI)
/85-03690

ULF OF FOS (FRANCE): MAIN HYDROLO-
ICAL FEATURES (1976-1978),
entre Univ. de Luminy, Marseille (France).
or primary bibliographic entry see Field 2L.
/85-03695

IGNIFICANCE OF INTERNAL LOADING TO
AKE PHOSPHOROUS BUDGETS,
. M. Runke.
reat Lakes Waste and Pollution Review Maga-
ine, Vol. 1, No. 1, p 10-14, April, 1983. 3 Fig, 1
ab, 12 Ref.

Descriptors: *Lake sediments, *Phosphorus, *In-
rnal loading, *Lakes, *Minnesota, Nutrient load-
g, Nutrients, Sediments, Water pollution sources,
utrophication, Lake management.

he importance of internal loading in phosphorus
udget calculations is demonstrated, based on case
udies from Minnesota lakes. Internal loading may
qual or exceed external loads in some lakes. The
rocesses which contribute phosphorus to the
ater column from the sediment, including chemi-
al release and biologically mediated release, all
erve to increase the phosphorus content of the
ke water and contribute to denser algal growth
nd lower water transparency. Elimination of in-
rnal loading will not always be both a feasible
nd efficacious management tool, but should be
ssessed in light of its contribution relative to the
verall phosphorus budget of the lake. Some man-
gement practices may create additional problems.
redging of phosphorus rich sediments may in-
rease the depth of the lake and its propensity to
tratify. Higher amounts of phosphorus may then
ove into the lake water from the sediments since
ypolimnetic oxygen depletion is then more likely.
emoval of bottomfeeding fish creates a fishery
anagement problem since reintroduction of
ottom feeders is a continual problem. It also dis-
upts existing food chain relationships as does re-
oval of aquatic macrophytes. The latter process
lso significantly alters the habitat of aquatic orga-
isms. Lake management specialists should not
verlook internal loading when assessing lake
ater quality problems. Internal loading is often an
mportant process and a significant element in lake
hosphorus budgets. (Baker-IVI)
/85-03710

TOXIC FALLOUT: THE INVISIBLE GREAT
AKES PROBLEM,
. Botts.
reat Lakes Waste and Pollution Review Maga-
ine, Vol. 1, No. 2, p 7-10, June, 1983. 4 Fig, 7 Ref.

Descriptors: *Acid rain, *Great Lakes, *Water
ollution sources, Toxicity, Fish, Public health,
ate of pollutants, Polychlorinated biphenyls, At-
nospheric deposition.

Scientists generally agree today that atmospheric
deposition of invisible toxic chemicals, toxic fall-
out, is the worst pollution problem and the greatest
long term threat to life in the Great Lakes. At
current levels it is believed there is no danger to
human health from direct exposure to Great Lakes
waters. To date, the greatest economic conse-
quence of the presence of toxic chemicals has been
to determine the use of Great Lakes fish for human
and animal food. The link between water quality
and air quality has received much attention be-
cause of the debate over acid rain. In the 1972
Great Lakes Water Quality Agreement between
Canada and the US, phosphorus reduction was the
major objective. Attention then turned to long
range transport of toxics after PCBs were found in
a small lake on Isle Royale in 1975. The atmos-
phere is now considered the chief source of toxic
pollution for the upper Great Lakes and the only
source in many instances. Exact loadings of toxic
substances in the Great Lakes cannot be deter-
mined. The ultimate fate of most toxic chemicals is
also not known, but it is no longer believed that
they necessarily remain trapped in sediments after
settling out of the water column. While the size of
the Great Lakes system is a protection from acidi-
fication, the huge surface area of the lakes makes
them more vulnerable to atmospheric deposition of
toxic substances. The full economic consequences
of the presence of toxic substances in the Great
Lakes cannot be estimated because of a lack of
certainty about the human health consequences of
long term exposure at low levels. (Baker-IVI)
W85-03713

METHYLATION AND DEMETHYLATION OF
MERCURY UNDER CONTROLLED REDOX,
PH, AND SALINITY CONDITIONS,
Rutgers - The State Univ., New Brunswick, NJ.
Dept. of Biochemistry and Microbiology.
G. Compeau, and R. Bartha.
Applied and Environmental Microbiology, Vol.
48, No. 6, p 1203-1207, December, 1984. 4 Fig, 1
Tab, 23 Ref. NOAA Sea Grant NA 81 AA-D-
00065, R1E-5.

Descriptors: *Mercury, *Hydrogen ion concentra-
tion, *Redox potential, *Salinity, *Estuarine sedi-
ments, *Methylation, *Demethylation, Sediments,
Volatilization, Heavy metals, Fate of pollutants,
Microorganisms, Estuarine environment.

In estuarine sediments, the microbially mediated
processes of methylation, demethylation, and vola-
tilization determine the state and overall toxicity of
mercury pollutants. The effects of redox potential
(Eh) and salinity on the above microbial processes
were investigated in reactors constructed to allow
for continuous monitoring and adjustment of the
pH (6.8) and Eh of freshly collected estuarine
sediments. For measurements of methylation and
demethylation activity, sediment slurries adjusted
to appropriate salinity were spiked with $HgCl_2$ or
CH_3HgCl, respectively, and were incubated in the
reactors. Methylmercury was measured by gas
chromatography. Volatilized elemental mercury
($Hg(0)$) was trapped and determined by cold vapor
atomic absorption spectrometry. Volatilization of
$Hg(0)$ and CH_3HgCH_3 were found to be minimal.
Methylation of $Hg(2+)$ was favored at Eh -220
mV as compared to +110 mV. At -220 mV, high
salinity (2.5%) inhibited methylation, and low sa-
linity (0.4%) favored it. At +110 mV, the salinity
effect was less pronounced. Demethylation of
CH_3HgCl was favored at +110 mV regardless of
the salinity level. Low redox potential under low
salinity conditions inhibited demethylation, but
high salinity reversed this inhibition. These find-
ings are helpful for interpreting and predicting the
behavior of mercury pollutants in estuarine sedi-
ments. (Author's abstract)
W85-03737

5C. Effects Of Pollution

EFFECTS OF NACL DEICING SALTS ON
SPHAGNUM RECURVUS P. BEAUV.,
National Park Service, Porter, IN. Science Div.
D. A. Wilcox.
Environmental and Experimental Botany, Vol. 24,
No. 4, p 295-304, May, 1984. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Pinhook Bog, *Indiana, *Sodium
chloride, *Deicers, *Water pollution effects,
*Plant growth, Bogs, Phytotoxicity, Rain.

A study of the effects of sodium chloride on one of
the prominent bryophytes of the Pinhook Bog in
Indiana Dunes National Lakeshore was initiated in
response to documented impacts of deicing salt
runoff from a salt storage area along the Indiana
Toll Road on the vegetation of the bog. Salt con-
centrations between 300 and 1500 mg/l as Cl sig-
nificantly reduced growth in length of Sphagnum
recurvum in lab cultures. Growth in biomass was
also reduced at higher concentrations under cer-
tain treatment conditions. Chloride appeared to be
a stronger growth inhibitor than sodium. When
water content was reduced and evaporational plant
surfaces increased, salt was deposited on plant tips
through the evapotranspiration process, causing
plant mortality at all sodium chloride concentra-
tions tested. Salt encrustations were removed by
washing the plants in simulated rainfall occur-
rences, but the deposits developed quickly again
and produced similar lethal effects within 3 weeks
after the last wash treatment. Since growth reduc-
tion and mortality of S. recurvum were shown at
NaCl concentrations observed in Pinhook Bog, it
is likely that deicing salts were responsible for the
elimination of Sphagnum from the impacted area.
(Baker-IVI)
W85-03218

EFFECTS OF ACRIDINE AND TEMPERA-
TURE ON THE SURVIVAL, DEVELOPMENT,
GROWTH, AND REPRODUCTION OF DIAP-
TOMUS CLAVIPES SCHACHT,
Battelle Columbus Labs., OH. Environmental and
Health Sciences Section.
J. D. Cooney, D. L. Bunting, II, and C. W. Gehrs.
Archives of Environmental Contamination and
Toxicology, Vol. 13, No. 6, p 665-674, November,
1984. 3 Fig, 5 Tab, 33 Ref.

Descriptors: *Acridine, *Temperature effects,
*Copepods, *Toxicity, Water pollution effects,
Fuels, Organic compounds, Reproduction,
Growth, Synthetic fuels, Azaarenes.

The effects of the azaarene acridine, which is a
component of synthetic fuels, on survival, growth,
development and reproduction of the freshwater
calanoid copepod, Diaptomus clavipes, were meas-
ured at 16, 21, and 26 C. Naupliar and copepodid
development and reproduction were the most sen-
sitive criteria used in estimating the effects of acri-
dine on D. clavipes. Growth was not a sensitive
indicator of acridine stress. Acridine had a narcotic
effect in D. clavipes. Although the mode of toxici-
ty of acridine to D. clavipes is not known, this
narcotic effect may explain, in part, the increase in
development times and the decrease in reproduc-
tion of animals exposed to acridine. Temperature is
an important environmental variable and affects
the sensitivity of D. clavipes to acridine. As the
temperature increased from 16 to 21 C, sensitivity
of D. clavipes to acridine increased. At 26 C,
survival of immatures was low at all test concen-
trations, including the controls, indicating that
chronic toxicity testing with D. clavipes should
not be done at this temperature because of the
additional temperature stress. The interaction be-
tween temperature and acridine had its most pro-
nounced effects on life stage duration with more
than a threefold increase in sensitivity to acridine
from 16 to 21 C. Reproductive estimates were also
more affected at 21 C than at 16 C. Although there
was a general decrease in metasomal length of first
stage copepodids and adults with increases in tem-
perature, this difference was less than 10%, indi-
cating that this variable was not strongly affected
by temperature. (Baker-IVI)
W85-03222

HISTOLOGIC AND SKELETAL ABNORMALI-
TIES IN BENZO(A)PYRENE-TREATED RAIN-
BOW TROUT ALEVINS,
University of Southern California, Los Angeles.
School of Medicine.
J. E. Hose, J. B. Hannah, H. W. Puffer, and M. L.
Landolt.
Archives of Environmental Contamination and
Toxicology, Vol. 13, No. 6, p 675-684, November,
1984. 4 Fig, 5 Tab, 43 Ref. National Institute of
Environmental Health Sciences contract 1-ES-7-
2101.

Descriptors: *Water pollution effects, *Trout,
*Toxicity, *Benzo(a)pyrene, Organic compounds,
Polycyclic aromatic hydrocarbons, Larvae.

Histological and skeletal examinations were per-
formed on rainbow trout alevins reared in 0.00,
0.08, 0.21, 0.39, 1.48, 2.40, or 2.99 ng/ml aqueous
benzo(a)pyrene (BaP). Nuclear pycnosis and kar-
yorrhexis were most common in neuroectodermal
and mesodermal derivatives and in liver of BaP-
treated alevins. Microphthalmia was noted in 17%
of the test fish and was frequently associated with
a patent optic fissure. Depressed mitotic rates in
the retina and brain, but not liver, were seen in
alevins reared in 0.21 to 1.48 ng/ml aqueous BaP.

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Test alevins had a significantly higher incidence of skeletal malformations in the skull and vertebral column, and abnormalities of vertebral arcualia often corresponded to areas of kyphoscoliotic flexures. The ecological significance of such morphological abnormalities would be decreased feeding and growth and inability to escape predation, leading to reduced survival. Persistent mixed function oxygenase induction in less affected larvae would lead to continuing production of cytotoxic, mutagenic, and carcinogenic BaP metabolites resulting in anemia, impaired ability to respond to environmental stress and disease, and possibly latent tumorigenesis. (Baker-IVI)
W85-03223

UPTAKE AND ACCUMULATION OF SELECTED HERBICIDES BY THE FRESHWATER ALGA SCENEDESMUS,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
O. A. Aly, S. A. Shehata, and H. Farag.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 6, p 701-705, November, 1984. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Bladex, *Dicryl, *Cyanazine, *Herbicides, *Algal growth, *Scenedesmus, Metabolism, Uptake, Water pollution effects, Organic compounds, Bioassay, Bioaccumulation.

The herbicides dicryl and Bladex (cyanazine) were tested in an algal toxicity bioassay using a continuous culture in order to evaluate the effect of increasing dosages of applied herbicides upon growth, herbicide uptake, and herbicide accumulation in Scenedesmus. The growth pattern exhibited by algal cells under continuous exposure reflects the ability of Scenedesmus to overcome the inhibitory effect of dicryl. The concentration of dicryl in the effluent gradually decreased as the growth of algal cells increased. No clear variations existed between the concentration of dicryl in the filtered and unfiltered effluents, due to the high sedimentation of algal cells. Dicryl accumulation increased with increased exposure time, while percentage uptake decreased with increased dicryl concentration because of a decrease in algal biomass. A relative increase in chlorophyll a content of the continuous growing culture was noted which may be attributed to the adaptation of this alga to the herbicide which leads to the uninhibited surge in Scenedesmus growth, or the continued daily introduction of nutrient rich media leads to the increase in biomass production. Accumulation of Bladex by Scenedesmus depends on the concentration of Bladex and on the time of exposure of the algal cells. (Baker-IVI)
W85-03224

EFFECTS OF ORGANIC AND INORGANIC CHEMICAL CONTAMINANTS ON FERTILIZATION, HATCHING SUCCESS, AND PROLARVAL SURVIVAL OF STRIPED BASS,
Johns Hopkins Univ., Shady Side, MD. Chesapeake Bay Inst.
L. W. Hall, L. O. Horseman, and S. Zeger.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 6, p 723-729, November, 1984. 2 Fig, 5 Tab, 24 Ref. Fish and Wildlife Service contract MON 83213.

Descriptors: *Water pollution effects, *Bass, *Toxicity, Chlordane, DDE, Chlordecone, Toxaphene, Anthracene, Benzo(a)anthrene, Chrysene, Fluoranthrene, Fluorene, Perylene, Pyrene, Phenanthrene, Arsenic, Cadmium, Copper, Lead, Selenium, Pesticides, Polychlorinated biphenyls.

Striped bass have been declining on both the Atlantic and pacific coasts in recent years due to reduced production of dominant year classes. The effects of an organic-inorganic chemical contaminant mixture were evaluated on percent fertilization, percent hatch, and prolarval survival of striped bass. All dilutions of the mixture simulated concentrations of various organic and inorganic contaminants found in striped bass spawning habitats. Organic contaminants included Aroclors 1248, 1254, 1260, chlordane, DDE, chlordecone, toxaphene, anthracene, benzo(a)anthrene, chrysene, fluoranthrene, fluorene, perylene, pyrene, and phenanthrene. Inorganic contaminants present included arsenic, cadmium, copper, lead, and selenium. Percent fertilization and percent hatch were not significantly affected by exposure to various dilutions of the contaminant mixture. The full strength contaminant mixture significantly reduced survival of striped bass prolarvae after 144 h continuous exposure from the time of spawn. A masked effect may have occurred during initial embryo development that was later observed in the prolarvae. The various dilutions of the contaminant mixture used in these experiments simulated concentrations of organic and inorganic contaminants found in striped bass spawning habitats. (Baker-IVI)
W85-03225

EFFECT OF PENTACHLOROPHENOL ON THE GROWTH AND MORTALITY OF EMBRYONIC AND JUVENILE STEELHEAD TROUT,
Corvallis Environmental Research Lab., OR.
S. E. Dominguez, and G. A. Chapman.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 6, p 739-743, November, 1984. 2 Tab, 34 Ref.

Descriptors: *Water pollution effects, *Toxicity, *Trout, *Pentachlorophenol, Organic compounds, Biocides, Growth, Mortality, Immature growth stages.

Pentachlorophenol has been widely used as a broad-spectrum biocide, and its water solubility is unusually high for an organic pesticide. The toxicity of sodium pentachlorophenate to early life stages of steelhead trout was investigated, using a flow through exposure system. A 96 hr LC50 of 66 micro g/L was derived for previously unexposed ten-week-old fry. A 72 day test, beginning 24 hr after fertilization, yielded a chronic toxicity threshold of 14 micro g/L. These results, and the acute/chronic ratio of 4.7, compare reasonably well with values in the literature. Yolk sac edema and cranial malformations, which are commonly observed in chronic tests with technical grade pentachlorphenol, were rare in this test with purified material. In the chronic test, abnormalities first became evident about the time the embryos' eye pigmentation became visible. No adverse effects were seen at PCP concentrations of 11 micro g/L or lower. Fry size was actually elevated at 2.6 micro g/L. The acute test yielded a 96 hr LC50 of 66 micro g/L. (Baker-IVI)
W85-03226

SHORT-TERM AND LONG-TERM EFFECTS OF CADMIUM ON GLYCOGEN RESERVES AND LIVER SIZE IN RAINBOW TROUT (SALMO GAIRDNERI RICHARDSON),
Stuttgart Univ. (Germany, F.R.). Abt. Heizung, Lueftung, Klimatechnik.
L. Lowe-Jinde, and A. J. Niimi.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 6, p 759-764, November, 1984. 3 Tab, 39 Ref.

Descriptors: *Cadmium, *Fish, *Toxicity, Water pollution effects, Metals, Heavy metals, Metabolism.

Trout were exposed to three test concentrations of 36, 12, and 4 micro g Cd/liter for varying exposure periods of 1-84 days. Blood glucose and lactate, liver and muscle glycogen and liver size were examined. Daily observation revealed that the fish exposed to the three test cadmium concentrations were agitated, excitable, and hyperactive compared to the controls. The degree of excitability appeared dose-dependent with the most excitability in the highest cadmium concentration. Appetite was decreased temporarily during the first week of cadmium exposure. In the short term exposure to high cadmium levels of 37 micro g Cd/l, mean blood glucose, lactate levels, and liver somatic index of experimentals were not significantly different from controls. Liver size increased in the lowest cadmium concentration after days 56 and 84. The liver functions in many metabolic processes, including elimination of waste and foreign substances, and the observed increase in liver size may reflect biochemical changes that occur as the fish attempt to maintain homeostasis under the stress of prolonged exposure to cadmium. Apparently, at exposure to cadmium is increased, trout are able to overcome at least some of the initial stress imposed by the cadmium and maintain tissure glycogen at the tested cadmium concentrations. (Baker-IVI)
W85-03228

PROBLEM OF PRAWN FISHERIES IN EGYPT,
K.L.D.A.V. Coll., Roorkee (India). Dept. of Zoology.
N. F. Bishara.
Archiv fur Hydrobiologie, Vol. 101, No. 4, p 577-586, October, 1984. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Water pollution effects, *Prawn, *Egypt, *Mediterranean Sea, *Abu Kir Bay, *Aswan High Dam, *Toxicity, Pesticides, Industrial wastes, Wastewater pollution, Dam effects, Environmental effects.

A continuous and irreversible decrease in prawn landings along the Egyptian Mediterranean coast has been observed during the last 20 years. Based on a survey of the ecological characteristics of the fishing grounds and the different factors that were introduced during the last 20 years a study was made of the entire situation. Three factors were identified as responsible for this decrease in prawn landings: the cessation of Nile water flow into the Mediterranean Sea after the construction of Aswan High Dam in 1976; the sewage pollution at the eastern harbor area which caused pollution not only of the water but also of the bottom sediments on which pennaeids feed; and industrial waste discharged at Abu Kir Bay along with the presence of pesticides in the water. (Baker-IVI)
W85-03235

ACUTE TOXICITY OF ANTIMYCIN A, BAYER 73 AND 3-TRIFLUOROMETHYL-4-NITROPHENOL TO A FRESHWATER TELEOST LEBISTES RETICULATUS (PETERS),
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
P. K. Gupta, P. S. Rao, V. S. Mujumdar, and V. S. Durve.
Archiv fur Hydrobiologie, Vol. 101, No. 4, p 601-607, October, 1984. 4 Tab, 16 Ref.

Descriptors: *Actinimycin A, *Bayer 73, *Trifluoromethyl-4-nitrophenol, *Pesticides, *Fish, *Toxicity, Water pollution effects, Molluscicides, Piscicides, Organic compounds.

Antimycin A, a powerful fish toxicant, Bayer 73, a strong molluscicide, and 3-trifluoromethyl-4-nitrophenol (TFM), a lampricide are widely used to eradicate unwanted fish, and mollusks from bodies of water. These toxicants, being non-selective, affect non-target fish adversely. Experiments on their toxicity to a non-target fish were conducted at 23 C and pH 8.1 using the static bioassay method. The median lethal concentrations, slope functions, median period of survival and the relative potency of the three toxicants were worked out for 12, 24, 48, 72 and 96 hr exposure. The 96 hr LC50's for Antimycin A, Bayer 73 and TFM were 0.00114, 0.39, and 7.0 mg/l. The median periods of survival increased with the decreasing concentrations. The relative potency of Bayer 73 and TFM in relation to Antimycin A were 354.545 and 6363.640, respectively at 96 hr exposure. The presumable harmless concentrations were 0.000049, 0.0294, and 0.4199 mg/l for Antimycin A, Bayer 73 and TFM respectively. The results thus indicate the rank order toxicity among the three chemicals as Antimycin A > Bayer 73 > TFM. Further investigations are warranted to evaluate the toxic efects of these chemicals under various environmental conditions and with different developmental stages and the age groups of fish. (Baker-IVI)
W85-03236

INTERACTIONS OF CARBARYL WITH ESTUARINE BACTERIAL COMMUNITIES,

stitute of Oceanography and Fisheries, Alexan-
ia (Egypt).
H. Weber, and F. A. Rosenberg.
icrobial Ecology, Vol. 10, p 257-269, 1984. 5 Fig,
Tab, 23 Ref.

escriptors: *Carbaryl, *Water pollution effects,
Estuaries, Estuarine environment, Cellulose, De-
mposition, Bacteria, Insecticides.

he effects of carbaryl on filter paper decomposi-
n were investigated since cellulose decomposi-
n is an essential process in estuaries. The fate of
rbaryl in a model ecosystem under sterile and
nsterile conditions was also examined. Adding
rbaryl (100 micro g/ml) to a model estuarine
osystem did not affect the number of bacteria in
e sediment, but reduced the diversity of the
icrobial community as compared with a control
odel ecosystem. Two carbaryl-tolerant strains of
cteria were isolated from the carbaryl-treated
stem, but none were isolated from the control
stem. Bacterial growth and filter paper decom-
sition in mixed cultures was prevented by 100
icro g/ml carbaryl, but this amount had no effect
the extracellular cellulase of an estuarine isolate.
he toxicity of carbaryl to pure cultures of an
tuarine isolated was attenuated by increasing the
nount of organic matter in the medium. No effect
bacteria numbers, diversity, or filter paper de-
mposition was noted by the addition of 1, 10, or
0 micro g/ml carbaryl to field plots. The amount
carbaryl in sediments exposed to 100 micro g/ml
ll below the limit of detection by thin-layer chro-
atography within 12 hr. In sterile and nonsterile
odel systems, carbaryl was rapidly adsorbed to
diment, and hydrolyzed to 1-naphthol in both
diment and water. Although carbaryl may be
xic to bacteria under some conditions, the
nounts that might enter and persist in an estuary
e insufficient to have a significant impact on the
diment microbial community. (Baker-IVI)
/85-03238

IGH MORTALITY OF THE LARVAE OF THE OMMON MUSSEL AT LOW CONCENTRA-IONS OF TRIBUTYLTIN,
.. R. Beaumont, and M. D. Budd.
Iarine Pollution Bulletin, Vol. 15, No. 11, p 402-
05, November, 1984. 2 Tab, 20 Ref.

Descriptors: *Toxicity, *Tributyltin, *Mussels, Larvae, Water pollution effects, Harbors, Estuaries, England, Organotin compounds, Paints.

The increased use of anti-fouling paints containing ributyltin compounds is resulting in increased evels of organotins in harbors, estuaries and areas f high pleasure craft activity. Long term sensitivi-y of the larval stage of Mytilus edulis, the ommon mussel, to tributyl tin oxide (TBTO) is xamined. Larvae were exposed to filtered sea-ater containing 10, 1, or 0.1 micro g/l TBTO, the iocide in recent antifouling paint formulations. No arvae survived longer than 5 days in 10 micro g/l TBTO or 10 days in 1 micro g/l TBTO. About alf the larvae subjected to 0.1 micro g/l TBTO vere dead by day 15 and most of the surviving arvae were moribund and had grown significantly nore slowly than controls. It is noted that current ecorded levels of TBT at several estuaries in England are higher than 0.1 micro g/l. The value f carrying out longer studies in order to deter-nine the toxic effects of organotins is noted. Baker-IVI)
W85-03239

LIMNOLOGY OF LAKE ALEXANDRINA, RIVER MURRAY, SOUTH AUSTRALIA, AND THE EFFECTS OF NUTRIENTS AND LIGHT ON THE PHYTOPLANKTON,
Adelaide Univ. (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W85-03242

SEASONAL CHANGES IN DISSOLVED-GAS SUPERSATURATION IN THE SACRAMENTO RIVER AND POSSIBLE EFFECTS ON STRIPED BASS,
Teufel and Associates, Davis, CA.
J. Colt.
Transactions of the American Fisheries Society, Vol. 113, No. 5, p 655-665, September, 1984. 4 Fig, 3 Tab, 48 Ref.

Descriptors: *Sacramento River, *California, *Supersaturation, *Dissolved gases, *Bass, Immature growth stages, Environmental effects, Dam effects, Runoff, Air entrainment, Heated water, American River, Feather River, Fish hatcheries.

Since the 1960's, there has been a major decrease in the adult population of striped bass in the Sacramento-San Joaquin Delta, California. The major mortality of larvae apparently occurs during the transition from the yolk-sac to the postyolk-sac stage. During the transition period, striped bass are extremely sensitive to dissolved-gas supersaturation. Dissolved-gas supersaturation levels were monitored in the Sacramento River system in central California during 1981-1982. Gas supersaturation was highest in the spring when temperature and flow were increasing rapidly, and was caused primarily by inflows of highly supersaturated water from the American and Feather rivers. During high runoff, air entrained by falls and rapids can produce supersaturation. Rapid heating can produce gas supersaturation because the solubility of gases is reduced at higher temperatures. Entrainment of air at dams does not appear to be responsible for gas supersaturation in these two rivers, although the dams may have an influence on dissolved gas levels in the Sacramento River. Gas supersaturation in the Sacramento-San Joaquin River system may adversely affect the eggs and larvae of wild striped bass Morone saxatilis and salmonids in hatcheries. The siting of salmonid hatcheries below large dams insures that hatchery fish will be exposed to high levels of gas supersaturation. Because larval striped bass are positively phototactic, they are at greater risk than fish that are found lower in the water column. (Moore-IVI)
W85-03247

TRI- AND TETRA-CHLOROVERATROLE, METABOLITES PRODUCED BY BACTERIAL O-METHYLATION OF TRI- AND TETRA-CHLOROGUAIACOL: AN ASSESSMENT OF THEIR BIOCONCENTRATION POTENTIAL AND THEIR EFFECTS ON FISH REPRODUCTION,
Swedish Environmental Research Inst., Stockholm.
A. H. Neilson, A. S. Allard, S. Reiland, M. Remberger, and A. Tarnholm.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 10, p 1502-1512, October, 1984. 8 Fig, 6 Tab, 34 Ref.

Descriptors: *Bleaching wastes, *Chloroguaiacols, *Trichloroveratrole, *Tetrachloroveratrole, *Toxicity, *Biological magnification, Fish, Bacteria, Methylation, Embryonic growth stage, Larval growth stage, Water pollution effects, Industrial wastes.

Conventional bleaching of chemical softwood pulp yields a wide range of chlorinated organic compounds that are formed by a series of complex reactions between chlorine and the lignin in the pulp. Strains of bacteria belonging to the genera Pseudomonas and Acinetobacter possess the ability to transform, by O-methylation, components of spent bleachery effluent such as 4,5,6-trichloroguaiacol and high molecular weight chlorinated lignin. Zebra fish (Brachydanio rerio) were used to examine bioconcentration potential, toxicity to embryos and larvae, and the sensitivity of the offspring of exposed adults. Bioconcentration factors (total wet weight) on a logarithmic scale were 3.5 and 4.4 for 3,4,5-trichloroveratrole and tetrachloroveratrole, respectively. 3,4,5-Trichloroveratrole, tetrachloroveratrole, pentachloroanisole, and 1,2,3-trichloro-4,5,6-trimethoxybenzene had threshold toxic concentrations to zebra fish embryos and larvae of 450, 100, 2.8, and 450 micro-g/L, respectively, and all of them inducing (at lower concentrations) deformations including curvature of the larvae and distortion of the notochord. Preexposure of adults to tetrachloroveratrole at a concentration of 16 micro-g/L adversely affected the offspring, resulting in a decreased viability of the embryos, lowered median survival time for larvae, and greater sensitivity to tetrachloroveratrole. 3,4,5-Trichloroveratrole (5-150 micro-g/kg liver fat) and tetrachloroveratrole (40-400 micro-g/kg liver fat) were detected in fish from localities subjected to discharge of bleachery effluent, and were absent in fish from uncontaminated localities. Not only compounds present in bleachery effluent, but also those produced in the environments by bacterial O-methylation, have potentially hazardous biological activities. (Moore-IVI)
W85-03310

OCCURRENCE AND TOXICITY OF HERBICIDES IN REEF BUILDING CORALS,
Smithsonian Tropical Research Inst., Balboa (Panama).
P. W. Glynn, L. S. Howard, E. Corcoran, and A. D. Freay.
Marine Pollution Bulletin, Vol. 15, No. 10, p 370-374, October, 1984. 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Herbicides, *Toxicity, *Corals, *Panama, *Pacific Ocean, Water pollution effects, Pesticide toxicity, Dichlorophenoxyacetic acid, Trichlorophenoxyacetic acid, Insecticides, Phthalates, Plasticizers.

The effects of herbicides on reef-building corals were investigated as a result of the detection of herbicide residues, most notably 2,4-D and 2,4,5-T, in the tissues of stressed and dying corals on the Pacific coast of Panama. The reef areas initially affected in Panama border continental shores which are subject to intense agricultural activities and high herbicide input. Phenoxy acid concentrations < 10.0 ppb were detected in four of the eight coral species examined. All bleached corals contained relatively high concentrations of 2,4-D and somewhat lesser amounts of 2,4,5-T. Insecticides found in Panamanian coral tissues included lindane, endrin ketone 153, endrin, dieldrin, ethion, endosulfan 1, chlordecone, dimethoate, p,p'-DDT, o,p'-DDT, and p,p'-DDE. Two plasticizers were also identified, butyl benzyl phthalate, and di-(2-ethylhexyl)phthalate. Tolerance tests conducted using Pocillopora damicornis demonstrated a toxic effect of 2,4-D amine salt on this coral. (Baker-IVI)
W85-03313

THERMAL EFFLUENT AS A SPORADIC CORNUCOPIA: EFFECTS ON FISH AND ZOOPLANKTON,
Loyola Univ. of Chicago, IL.
J. Janssen, and J. P. Giesy.
Environmental Biology of Fishes, Vol. 11, No. 3, p 191-203, October, 1984. 4 Fig, 2 Tab, 35 Ref. DOE contract EY-76-A-09-0943.

Descriptors: *Thermal pollution, *Fish, *Zooplankton, *South Carolina, *Par Pond, Savannah River Plant, Heated water, Cooling ponds, Herring, Bass, Bluegills, Fish food organisms, Nuclear powerplants, Effluents, Mortality, Seasonal variation.

Par Pond is located at the Savannah River Plant and is a 1120 ha impoundment retained at the 'cold dam.' Nuclear reactor cooling water flows from the pond's south arm to the reactor, through cooling canals and small ponds to Pond C. The 'hot dam' separates Pond C and Par Pond. As effluent from Pond C enters the larger Par Pond it sporadically carries with it zooplankton and/or dead fish. Pond C produces high zooplankton densities in two situations: high and hot effluent flow during cold winter weather; and low (cool) effluent flow during warmer seasons. High zooplankton densities attract blueback herring, which attract largemouth bass. Dying and dead bluegills from Pond C (heat killed) are eaten by Par Pond bass which swim into effluent temperatures as high as 46 C to take these easy prey. Blueblack herring and largemouth bass distribution are affected by the presence of food rather than by temperature. Par Pond blueblack herring appear to be available to bass mainly when herring are near the effluent from Pond C and when they spawn in spring in the littoral zone. Because blueblack herring in Par Pond live only one year and because their presence in bass habitat is seasonal there is strong seasonal component to

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bass food abundance. The strong seasonality of food abundance for bass at the effluent correlates with the winter peak in bass condition. The effects of the thermal effluent are not directly due to heated effluent but are indirect effects on the trophic dynamics of the system and depend on the physical structure of the system, season, and geography. (Moore-IVI)
W85-03315

LEAD IN UMBILICAL BLOOD, INDOOR AIR, TAP WATER, AND GASOLINE IN BOSTON,
Children's Hospital Medical Center, Boston, MA.
M. Rabinowitz, H. Needleman, M. Burley, H. Finch, and J. Rees.
Archives of Environmental Health, Vol. 39, No. 4, p 299-301, July/August, 1984. 3 Fig, 12 Ref.

Descriptors: *Lead, *Boston, *Massachusetts, *Potable water, Heavy metals, Water quality, Water pollution sources, Air pollution.

A strong statistical correlation was found among the monthly averages of lead concentrations in umbilical cord blood (about 500 births/month), indoor air (12 sites/month), and gasoline lead sales between March 1980 and April 1981 in Boston. Tap water was sampled from the kitchen cold tap after a 4-L flush. Tap water lead variations did not correlate with blood lead in this population. Lead may have adverse effects, even at low doses. It is undoubtedly true that an individual's body burden of lead is a composite of the multiple, available sources, including air, water, food, and dust. Lead in gasoline makes an appreciable contribution to the lead burden of humans, and the addition of lead to gasoline is uniquely amenable to adjustment, regulation and control. (Baker-IVI)
W85-03339

WEEDAGE OF THE HOCHRHEIN BY CROWFOOT (RANUNCULUS FLUITANS) (VERKRAUTUNG DES HOCHRHEINS DURCH 'FLUTENDEN HAHNENFUSS'),
H. Hofmann.
Wasserwirtschaft, Vol. 74, No. 7/8, p 380-382, 1984. 3 Fig.

Descriptors: *Hochrein, *Crowfoot, *Aquatic weeds, Phosphates, Nutrients, Wastewater disposal, Ecological effects, Water pollution effects.

In the dammed sections of the river Hochrhein and even in the fast flowing parts of the river, water plants occur in such an abundance, that navigation, fishery and bathing is impaired and the efficiency of water power stations is reduced. The main cause of that abundant increase of crowfoot (Ranunculus fluitans) is the high nutrient concentration (especially phosphate) due to waste water discharges into the river. (Author's abstract)
W85-03440

ACID PRECIPITATION AND FOREST GROWTH IN NORWAY,
Norsk Inst. for Skogforskning, Aas.
L. Strand.
Aquilo, Vol. 19, No. 1, p 32-39, 1983. 7 Fig, 9 Ref.

Descriptors: *Acid rain, *Norway, *Tree growth, Water pollution effects, Acidity, Forests, Tree rings.

The effect of acid precipitation on the growth of forest trees in Norway was assessed based on 6000 tree ring series. Tree ring analyses were based on the period 1911-1972. Background for the analysis is the hypothesis that acid precipitation had increased gradually since 1950, and this effect should be detected as a break in the tree ring series. The ring widths are measured by their logarithms, and usually show ring width decreasing linearly with age (age effect). The age effect may be computed on the basis of the period 1911 to 1950 and compared with the age effect computed on the ring widths for the period 1950-1972. The difference can be measured as a reaction coefficient. The major problem encountered in connection with the analysis of such data is statistical in nature. This particular study was unable to demonstrate any effect of acid precipitation on tree growth. How experiments should be designed under field conditions to determine any damage to forests is still a major question to be considered. (Baker-IVI)
W85-03489

POSSIBLE INDIRECT LONG-TERM EFFECTS OF ACID PRECIPITATION ON FOREST GROWTH,
Norsk Inst. for Skogforskning, Aas.
A. O. Stuanes.
Aquilo, Vol. 19, No. 1, p 50-63, 1983. 8 Fig, 33 Ref.

Descriptors: *Acid rain, *Forests, *Tree growth, Water pollution efects, Acidity, Plant growth, Nitrates, Sulfates, Aluminum, Hydrogen ion concentration, Leaching.

Possible indirect long-term effects of acid precipitation on forest growth in Scandinavia are discussed. As long as the forest in question is deficient in nitrogen there will most probably be an accumulation of nitrogen in the ecosystem. An increased leaching of nitrate when nitrogen is not the limiting element is to be expected. Increased input of sulfate will in most soils give an increased leaching of nutrient cations together with hydrogen ion. Potassium seems not to be very sensitive to leaching in the soils studied. Therefore a possible long term indirect effect of acid precipitation on forest growth might be that the increased deposition of nitrogen and a decreased content of nutrient cations induce a deficiency of magnesium and possibly potassium. The aluminium concentrations found in Norwegian experiments are as high as those reported from Germany, but generally the calcium concentrations are higher. This gives usually a Ca/Al ratio in the effluent higher than 1. So far there is no indication that the trees suffer from Al-toxicity in Norwegian field experiments. The effects suggested in this study are based on relatively short term experiments supplied very acid artificial rain. (Baker-IVI)
W85-03490

TRACE METALS AND THE PRODUCTIVITY OF SHELF WATERS OFF NORTH WEST AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Marine Labs.
D. Mackey.
Australian Journal of Marine and Freshwater Research, Vol. 35, No. 5, p 505-516, October, 1984. 8 Fig, 2 Tab, 34 Ref.

Descriptors: *Trace metals, *Australia, *Productivity, Biomass, Nutrient enrichment, Runoff, Phytoplankton, Copper, Nickel, Cadmium, Liquid chromatography.

Oceanographic measurements on the North West Shelf of Australia indicated that nutrient enrichment was derived from a combination of terrestrial run-off and interaction with sediments. There was no evidence for upwelling. In situ fluorescence measurements suggested that the phytoplankton biomass was low and did not increase in regions of nutrient enrichment. On the continental shelf, the concentrations of copper, nickel and cadmium were typical of unpolluted waters and by using a reverse-phase high performance liquid chromatography absorbent (SEP-PAK), about 20% of the copper was found to be organically bound with smaller amounts of organically bound nickel, zinc, and iron and even less organically bound cadmium, chromium and manganese. The copper-complexing capacity of the surface waters (5-10 nM) was comparable to the total concentration of trace metals liable to form organic complexes so that the trace metal speciation may change markedly with small changes in trace metal concentration or complexing capacity. Calculations show that the concentration of free copper ions is too low to have any adverse affects on the biota and it is suggested that the productivity of the water may be affected by the limited bioavailability of essential trace metals. (Author's abstract)
W85-03494

EFFECTS OF DIESEL OIL ON RECOLONIZATION OF BENTHIC ALGAE,
Norsk Inst. for Vannforskning, Oslo.
T. Bokn.
Hydrobiologia, Vol. 116/117, p 383-388, 1984. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Water pollution effects, *Oil pollution, *Industrial wastes, *Algae, Recolonization, Plant growth, Intertidal waters, Diatoms, Chlorophyta.

The effect of continuous low dosages of diesel oil on the colonization of intertidal organisms was investigated. The experiment includes organisms established by transplanting stones from the outside shore together with their natural cover of algae and animals. The growth in an oil-exposed basin (B1) was compared with that in a control basin (B2). During the first month of oil exposure, the chips on the rack in B1 were overgrown mainly by diatoms, while the chips on the corresponding rack in B2 were dominated by Enteromorpha spp. Some reduction in covering degree was noted in February on both racks. On B1 a mixture of M. nummuloides and Navicula spp. was found. Pennate diatoms and the green algae Ulothrix spp./Urospora spp. dominated the cover of B2. All of the dominant species on B1 have been diatoms, and none has played any important role in the flora on B2 with very few exceptions. While there was little evidence whether the predominant diatoms on B1 were favored by diesel oil or not, the winter diatom Melosira nummuloides was the overall dominant organism in the supralittoral and littoral zone in southeast Norway after an oil spill during late December 1982. Except during the month of October, red algae have been absent. (Baker-IVI)
W85-03503

EFFECTS OF TREATED MUNICIPAL WASTEWATER ON THE EARLY DEVELOPMENT OF SARGASSACEOUS PLANTS,
Tohoku Univ., Sendai (Japan). Dept. of Fishery Science.
H. Ogawa.
Hydrobiologia, Vol. 116/117, p 389-392, 1984. 1 Fig, 3 Ref.

Descriptors: *Municipal wastewater, *Algal growth, *Sargassum, *Water pollution effects, Waste disposal, Orthophosphates, Ammonium, Nitrogen compounds, Nitrates, Marine environment, Hydrogen ion concentration.

The responses of algae to pollution by municipal wastewater depend on the chemical or physical nature and the concentration of dissolved substances in the wastewater, and on the physiological characteristics of the algae themselves. The germination rates of zygotes of Sargassum horneri on exposure to secondary effluent, ammonia, and other nitrogenous compounds are presented. Inhibition of germination with secondary effluent and ammonia occurred in an increasing ammonia-N concentration above 10 mg/l. Inhibition of germination with ammonium chloride however, occurred only in the concentration between 50 and 110 mg/l. Germination on exposure to urea, nitrite and nitrate was not significantly inhibited at any prepared concentration. Similarly high germination rates were observed in zygotes exposed to orthophosphates. In seawater alone, pH 4 completely prevented germination, but pH 5-10 had virtually no inhibitory effect. On the basis of these findings, it seems possible that the early development of marine algae would be significantly affected by the ammonium compounds in the secondary effluent. (Baker-IV)
W85-03504

EFFECT OF CRUDE OIL ON THE COLONIZATION OF MEIOFAUNA INTO SALT MARSH SEDIMENTS,
Louisiana State Univ., Baton Rouge. Dept. of Zoology and Physiology.
C. J. Decker, and J. W. Fleeger.
Hydrobiologia, Vol. 118, No. 1, p 49-58, 1984. 5 Fig, 2 Tab, 24 Ref.

escriptors: *Salt marshes, *Sediments, *Oil spills, Vater pollution effects, *Invertebrates, Cope-ds, Population dynamics, Fuel, Industrial astes, Polychaetes, Nematodes, Species diversity.

controlled colonization experiment was de-gned to study the effect of an oil spill on estua-ie meiofauna. Forty-five replicate azoic sediment ambers were treated with 0, 133, or 381 mg drocarbons: 100 g dry sediment of South Louisi-a crude oil were each quantitatively sampled ith three replicate cores for colonizing meio-una. Chambers were sampled on days 2, 5, 10, 30 d 60 postplacement in a Louisiana Spartina alter-flora salt marsh. Polychaetes showed a delayed olonization and reduced densities in oiled relative non-oiled sediments. Significant depression was ted of nematode numbers in the high oil treat-ent but no delay in colonization was identified. nhydrosoma woodini was the only species which splayed a reaction to the presence of the oil but ly in the top centimeter of sediment. This species monstrated significantly decreased densities due the heavily oiled treatment throughout the udy until day 60 when numbers in the heavily led chambers were significantly higher than ose in the non-oiled chambers. Species diversity as calculated on the meiobenthic copepod assem-age. Diversity in the high oil treatment was nerally lower than that in other treatments rough day 30. Fewer species colonized the heav-oiled chambers before day 30. No oil effect hich was separate from a chamber effect for pepod community structure was detected. aker-IVI)
85-03505

NTERRELATIONSHIP BETWEEN SOME EN-IRONMENTAL FACTORS OF RIVERBED RAVELS AND POLLUTION INDEX OF OTTOM FAUNA IN THE RIVER,
umamoto Univ. (Japan). Faculty of Engineering.
Nakajima, T. Oda, and Y. Matsunami.
panese Journal of Limnology, Vol. 45, No. 3, p 0-230, July, 1984. 4 Fig, 5 Tab, 12 Ref.

escriptors: *Kuma River, *Kumamoto Prefec-re, *Japan, *Gravels, *River beds, *Pollution dex, *Benthos, Suspended solids, Flash floods, iotic index, Diversity index, Water pollution, Bio-gical oxygen demand, Nitrogen, Phosphate, lidges.

he interrelationship between some environmental ctors and indicator species of bottom fauna phase the river was investigated and measured in the uma River in Kumamoto Pref. during September d November of 1982 and 1983. Among environ-ental factors, suspended solids in river water are riously affected by flash floods, and these sus-ended solids affect matters attached to riverbed ravels. Pollution index, biotic index and diversity dex have been used to clarify the degree of water llution in the river in addition to chemical water uality such as BOD, nitrogen and phosphates. he numbers of individual Chironomidae larvae ave a good positive correlation (r = 0.824-0.847) ith the weight of attached matters. Bottom fauna rew to the critical level of standing crop at 700 y mg/100 sq cm of attached matters on the verbed gravels. It was also very clear that num-ers of species, numbers of individual and standing rops of bottom fauna have a close correlation ith their living space, e.g, ratio of gravel to ampling area (occupation ratio), and flatness of ravels. It was found that biotic indicators should e studied and reported more precisely regarding ne riverbed environmental factors such as gravel ze, living space, and standing crop on the gravel. Author's abstract)
V85-03509

EFFECT OF NUTRIENT ENRICHMENT ON THE NATURAL PHYTOPLANKTON COMMU-NITY OF LAKE BIWA MAINTAINED IN GLASS BOTTLES,
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
M. S. R. Ibanez, M. Nakanishi, and Y. Tezuka.
Japanese Journal of Limnology, Vol. 45, No. 3, p 31-239, July, 1984. 3 Fig, 5 Tab, 14 Ref.

Descriptors: *Lake Biwa, *Japan, *Nutrient enrichment, *Phytoplankton, Nitrogen, Phosphorus, Water pollution effects, Chlorophyll a, Productivity, Lakes.

Near- and offshore waters of the south basin of Lake Biwa were bottled, enriched with nitrogen and phosphorus, alone and in combination, and incubated for a long period in the surface layer of the lake. Experiments were carried out during four seasons in the nearshore water and for one season in the offshore water. The phytoplankton response to wastewater was also investigated. Results of the experiments showed that nitrogen and phosphorus in combination have the most stimulatory effect on phytoplankton growth, whereas there was some evidence that nitrogen rather than phosphorus stimulated phytoplankton growth more in terms of chlorophyll a and total cell number. Nitrogen plus phosphorus and nitrogen treatments remarkably changed the phytoplankton composition leading to an increase in green algae. Polluted river water without nutrient addition also promoted algal growth. (Author's abstract)
W85-03510

COMPARATIVE STUDY ON THE FATE OF THE POLYCHLORINATED BIPHENYL 2,4,5,2',4',5'-HEXACHLOROBIPHENYL AND THE POLYCYCLIC AROMATIC HYDROCARBON PHENANTHRENE IN FLOUNDER (PLATICHTHYS FLESUS), DETERMINED BY LIQUID SCINTILLATION COUNTING AND AUTORADIOGRAPHY,
Bergen Univ. (Norway). Inst. of Marine Biology.
J. E. Solbakken, K. Ingebrigtsen, and K. H. Palmork.
Marine Biology, Vol. 83, No. 3, p 239-246, November, 1984. 2 Fig, 3 Tab, 28 Ref.

Descriptors: *Polychlorinated biphenyls, *Phenanthrene, *Hexachlorobiphenyl, *Flounder, *Autoradiography, *Liquid scintillation, Biodegradation, Fish, Chlorinated hydrocarbons, Animal tissues, Water pollution effects.

The uptake, distribution and excretion of the xenobiotics (C-14)2,4,5,2',4',5'-hexachlorobiphenyl (6-CB) and (9-(C-14))-phenanthrene in the flounder Platichthys flesus after a single intragastric administration was studied by liquid scintillation counting and whole-body autoradiography. The flounders were collected in October 1981 from a coastal area near Bergen, Norway. The initial distribution patterns of the two lipophilic components were similar, whereas a large differences in the rate of elimination was demonstrated. The 6-CB-derived radioactivity remained much longer in the tissues than that of phenanthrene. An accumulation of the two components in lipid-rich tissues was clearly illustrated in the autoradiograms. High concentrations were also found in melanin-rich tissues such as skin and the uveal tract of the eye. A relatively high concentration of phenanthrene was found in the lens of the eye. Much more 6-CB-derived radioactivity was observed in the female gonads than in those of the male, suggesting the former to be an important means of excretion of this compound in female flounders during spawning. The residual levels of 6-CB-derived radioactivity one yr after administration were about 10% of those measured after 10 wk. Flounders showed low biodegradability of 6-CB. (Author's abstract)
W85-03511

TOXICITY OF COPPER SULPHATE AND ZINC SULPHATE TO MACROBRACHIUM LAMARREI (H. MILNE EDWARDS) (DECAPODA, PALAEMONIDAE),
Gorakhpur Univ. (India). Dept. of Zoology.
R. Murti, and G. S. Shukla.
Crustaceana, Vo. 47, No. 2, p 168-173, September, 1984. 2 Tab, 27 Ref.

Descriptors: *Copper sulfate, *Zinc sulfate, *Water pollution effects, *Prawn, Industrial wastes, Sulfates, Aquatic fauna, Toxicity, Pesticides.

Macrobrachium lamarrei were exposed to six different concentrations of copper sulfate and zinc sulfate solutions. The specimens showed increased activity immediately after their transfer to the test solutions. They subside their activity very soon in copper sulfate, whereas in zinc sulfate they remain active for about 2 hr frequently coming to the surface of the toxic solution. In both cases, profuse secretion of mucus has been noted on the whole body surface, but most pronounced in the gill region. The 96 h LC50 values of copper sulfate (0.247 mg/l) and zinc sulfate (3.188 mg/l) show that copper is thirteen times more toxic to this species than zinc. The minimum concentration of zinc sulfate to initiate slight mortality was 1 mg/l while for copper the corresponding value was as low as 0.01 mg/l. The first mortality in copper sulfate solution of 0.5 mg/l was noted after 4 hr exposure in contrast to zinc sulfate where it required 6 hr in 15 mg/l solutions. (Baker-IVI)
W85-03513

METHODS FOR EVALUATION MAXIMUM ACCEPTABLE TOXICANT CONCENTRATION OF SOME PESTICIDES UPON THE FRESHWATER FISH. I. EVALUATION MATC VALUES OF FUNGICIDE THIRAM (METODE DE DETERMINARE A VALORILOR MAXIME ADMISIBILE (MATC) IN APA A UNOR PESTICIDE ASUPRA UNOR SPECII DE PESTI DULCICOLI. I. DETERMINAREA VALORII MATC A FUNGICIDULUI TIURAM),
Institute of Terrestrial Ecology, Edinburgh (Scotland).
E. Leonte, L. Ene, I. Serban, F. Harald, and P. Petre.
Buletinul de Cercetari Piscicole, Vol. 35, No. 1-2, p 67-87, 1982. 6 Fig, 5 Tab, 19 Ref.

Descriptors: *Bioassays, *Thiram, *Fungicides, *Goldfish, *Carp, *Pesticide toxicity, Toxicity, Fish, Growth stages, Embryonic growth stage, Larval growth stage, Water pollution effects, Pesticides.

The lethal and sublethal chronic toxicity of chemical substances (pesticides) upon freshwater fish was evaluated. A long term bioassay using goldfish (Carassius auratus gibelio) was conducted for evaluation of maximum acceptable toxicant concentration (MATC) of the fungicide thiram; methodology elaborated on includes the experimental requirements, the morphologic and physicologic characteristics measured, methods of evaluation and estimation utilized. The substitution of a long term chronic bioassay by rapid tests was attempted on the embryonate eggs, larval stages, and fingerlings of grass carp (Ctenopharyngodon idella) in the first month of development. The MATC values of fungicides thiram for grass carp was determined to be 0.018 mg/L and application factor to be a = 0.45. (Author's abstract)
W85-03531

INFLUENCE OF THE GEOTHERMAL WATERS ON FISHES AND AQUATIC INVERTEBRATES, IN THE PLAIN OF BANAT (INFLUENTA APELOR GEOTERMALE, DIN CIMPIA BANATULUI, ASUPRA PESTILOR SI NEVERTEBRATELOR ACVATICE),
V. Popescu-Marinescu, L. Elian-Talau, M. Papadopol, D. Nicolescu, and L. Teodorescu.
Buletinul de Cercetari Piscicole, Vol. 35, No. 1-2, p 85-100, 1982. 12 Fig, 7 Ref.

Descriptors: *Thermal water, *Geothermal water, *Fish, *Invertebrates, *Plain of Banat, *Romania, Water pollution effects, Daphnia, Carp, Tubificids, Oligochaetes, Crustaceans, Bioassays.

Research on the effects of geothermal waters (both used and unused) on vertebrates and invertebrates made the water's toxico-lethal character obvious in waters with a normal concentration or diluted up to over 17%. Among the organisms used in the experiment, Daphnia magna (a cladoceran) and young carps (Lyprinus carpio) have proved to be more sensitive. Tubifex tubifex (an oligochaete) have proved to be more resistant. Taking in account the toxicity of geothermal waters with addition of a specific smell and taste contracted by the

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meat fish, their overflow into natural receivers is not recommended. (Author's abstract)
W85-03532

STUDIES ON THE EFFECTS OF SEWAGE EFFLUENT ON GASTROPOD POPULATIONS IN EXPERIMENTAL STREAMS,
Aston Univ., Birmingham (England). Dept. of Biological Sciences.
A. J. Watton, and H. A. Hawkes.
Water Research, Vol. 18, No. 10, p 1235-1247, 1984. 6 Fig, 9 Tab, 21 Ref.

Descriptors: *Gastropods, *Indicator organisms, *Wastewater pollution, Water pollution effects, Effluents, Abundance, Biomass, Population dynamics, Reproduction, Mortality.

The validity of using selected gastropod species as biological indicators of pollution in rivers was investigated. Lymnaea peregra and Potamopyrgus jenkinsi were studied over a 21 month period of exposure to clean river water, and to river water containing 25 or 50% treated sewage effluent. Each water channel contained riffle and pool stretches. In each case the abundance and biomass of both species were higher in the riffles. The concentration of the sewage effluent did not have a significant effect on abundance or biomass of L. peregra. The abundance and biomass of P. jenkinsi were significantly greater in riffle and pool in the absence of effluent. Abundance and biomass of P. jenkinsi were significantly greater in the 25% effluent channel than in 50% effuent. No significant differences in the growth of L. peregra between channels was noted. L. peregra laid significantly greater amounts of eggs and egg masses in riffle and pool in the presence of effluent. No differences were noted in the reproduction rate per adult of P. jenkinsi between the 0 and 25% effluent channels. Population differences between channels are probably largely the result of differing mortality rates. (Baker-IVI)
W85-03540

PREDICTION OF BIOCONCENTRATION IN FISH,
Building Research Establishment, Princes Risborough (England). Princes Risborough Lab.
For primary bibliographic entry see Field 5A.
W85-03542

UPTAKE AND RELEASE OF ENVIRONMENTALLY OCCURRING ODOROUS COMPOUNDS BY FISH, A REVIEW,
Helsinki Univ. (Finland). Dept. of Limnology.
P.-E. Persson.
Water Research, Vol. 18, No. 10, p 1263-1271, 1984. 2 Fig, 5 Tab, 72 Ref.

Descriptors: *Fish, *Flavor, *Organic compounds, *Water pollution effects, Toxicity, Odor, Taste, Reviews, Wastewater.

The occurrence of chemical compounds in the environment which may impair the flavor of fish is reviewed. Fifty-seven compounds, various mixtures and waste waters are listed with effective concentrations and exposure data. Factors affecting the uptake and release of environmentally occurring odorous substances by fish are discussed. At least 57 chemical compounds, several mixtures of compounds and waste waters have been shown to cause off-flavor of fish under laboratory conditions. Uptake of flavor-impairing substances by fish from their environment may proceed very rapidly while the release of these compounds proceeds more slowly. Uptake rates are influenced by the concentration of the active substance, the exposure time, the water quality and the physiological state of the fish. Release rates are influenced by purging conditions, quality of water, water temperature and amount of substance originally absorbed. For 61.4% of the compounds tested, concentrations impairing the flavor of fish were higher than the corresponding threshold odor concentrations in water. Toxic concentrations are generally higher than concentrations influencing the flavor of fish. (Baker-IVI)
W85-03543

NEUTRALIZATION OF ACID DEPOSITION BY NITRATE RETENTION AT BICKFORD WATERSHED, MASSACHUSETTS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
H. F. Hemond, and K. N. Eshleman.
Water Resources Research, Vol. 20, No. 11, p 1718-1724, November, 1984. 5 Fig, 3 Tab, 31 Ref.

Descriptors: *Acid deposition, *Acid rain, *Nitrates, *Bickford Reservoir, *Massachusetts, Chemical composition, Nitrogen, Nutrients, Water pollution effects.

Current data from Bickford Reservoir and its watershed in central Massachusetts document highly effective nitrate retention throughout the year. The process of nitrate retention significantly mitigates the effects of present levels of nitric acid deposition on surface water chemistry and may have the capacity to neutralize possible increased levels of nitrate deposition in the future. Concentrations of all major inorganic ions were measured in the reservoir and tributaries at biweekly intervals from July 1981 through June 1983. In contrast to several other northeastern U.S. watersheds, stream and water column nitrate levels are very low (approximately 1 micro eq/L), and no 'nitric acid pulse' has accompanied spring runoff in 2 years of study. Major differences in nitrogen processing among northeastern U.S. watersheds appear to significantly alter watershed susceptibility to acidic deposition and may be of comparable importance to soil depth and mineralogy in the identification of acid-sensitive ecosystems. (Collier-IVI)
W85-03572

INFLUENCE OF PHOSPHONATES UPON PHOSPHATE ELIMINATION. 1. COMMUNICATION: 1-HYDROXYETHANE-1,1-DIPHOSPHONIC ACID (HEDP) (DER EINFLUSS VON PHOSPHONATEN AUF DIE PHOSPHATELIMINATION 1. TEIL: 1-HYDROXYETHAN-1,1-DIPHOSPHONSAURE (HEDP)),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5D.
W85-03590

UPTAKE AND ACCUMULATION OF INORGANIC TIN BY A FRESHWATER ALGA, ANKISTRODESMUS FALCATUS,
Canada Centre for Inland Waters, Burlington (Ontario).
P. T. S. Wong, R. J. Maguire, Y. K. Chau, and O. Kramar.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 11, p 1570-1574, November, 1984. 4 Fig, 2 Tab, 27 Ref.

Descriptors: *Tin, *Algae, *Ankistrodesmus, *Bioaccumulation, *Trace metals, Lead, Arsenic, Zinc, Cadmium, Mercury, Antimony, Copper, Plant physiology.

Uptake of Sn by Ankistrodesmus falcatus occurred very rapidly. The alga accumulated 2.3 and 4.1 mg Sn/g dry weight of cells after 2 and 60 min of incubation, respectively, in the presence of 46 micro g Sn/L of medium. Increasing Sn concentrations in the medium resulted in a steady increase in the Sn concentrations in the cells. At 6 mg of Sn and 3 mg of dry weight of cells in one L of medium, the cells had accumulated 100 mg Sn/g dry weight of cells, representing 10% of the dry cell mass. The uptake of Sn from the medium and the release of Sn from the cells were not affected by other metals (Pb, As, Zn, Cd, Hg, Sb, and Cu). Addition of EDTA, however, caused an immediate and rapid release of 60% of Sn from the cells. Heat-killed cells took up Sn faster and to a higher level than living nonheated cells. About 85% of Sn taken up by the cells was recovered in the cellular polysaccharide fraction and 15% in the protein fraction, while the lipid and the small molecular weight metabolites accounted for 0.2% of the total Sn. (Author's abstract)
W85-03598

ELECTROLYTE AND WATER BALANCE IN PLASMA AND URINE OF RAINBOW TROUT (SALMO GAIRDNERI) DURING CHRONIC EXPOSURE TO CADMIUM,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
M. A. Giles.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 11, p 1678-1685, November 1984. 1 Fig, 3 Tab, 40 Ref.

Descriptors: *Trout, *Water pollution effects, *Cadmium, *Blood, *Urine, *Electrolytes, Calcium, Magnesium, Trace metals, Fish physiology, Animal physiology, Chlorides, Potassium, Sodium

Rainbow trout (Salmo gairdneri) were exposed to 3.6 and 6.4 micro g Cd/L for periods up to 178 d. Transitory changes in plasma calcium and magnesium were observed in fish exposed to 3.6 micro g Cd/L although the differences were not significant. Exposure to 6.4 micro g Cd/L, however, resulted in significantly lowered plasma sodium, potassium, calcium, and chloride and elevated magnesium concentrations. Analyses of urine indicated that the rate of urine production, osmolality and sodium, potassium, chloride, magnesium, calcium, and protein concentrations were unaffected by exposure to 3.6 micro g Cd/L although slight changes were observed in the first week of exposure. Urine production rate and urinary concentrations of potassium and chloride were unaffected in trout exposed to 6.4 micro g Cd/L but sodium, protein, and osmolality were elevated and calcium and magnesium concentrations reduced in these fish. The results demonstrate that the majority of the cadmium-induced electrolyte imbalances do not result from impairment of renal function. (Author's abstract)
W85-03603

OSMOREGULATORY AND HEMATOLOGICAL RESPONSES OF RAINBOW TROUT (SALMO GAIRDNERI) TO EXTENDED ENVIRONMENTAL ACIDIFICATION,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
M. A. Giles, H. S. Majewski, and B. Hobden.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 11, p 1686-1694, November 1984. 5 Fig, 4 Tab, 44 Ref.

Descriptors: *Trout, *Hydrogen ion concentration, *Water pollution effects, *Fish physiology, Blood, Calcium, Magnesium, Chlorides, Sodium, Osmolality, Animal physiology.

The dose-dependent relationships of several physiological responses to acid were examined in rainbow trout (Salmo gairdneri) exposed for 22 d to water at pH 4.2-6.0. Significant increases in ventilatory and cardiac rates occurred at pH sub w < 4.9. Hematocrit and hemoglobin concentration increased progressively with acid stress at pH sub w < 5.5. Plasma calcium, magnesium, sodium, and chloride concentrations were reduced and plasma phosphate elevated in acid-exposed fish. Seasonal differences were observed in the quantitative responses to acid exposure in the relationship between hematocrit and hemoglobin concentration and in the plasma concentrations of calcium and magnesium. The fractional contribution of sodium and chloride to plasma osmolality decreased linearly with increasing hydrogen ion concentration, and the change in plasma sodium, chloride, and osmolality per unit change in pH sub w was 35.2 mmol/L, 39.7 mmol/L, and 47.4 mosmol/kg, respectively, in the pH range of 4.5-5.2. We concluded that the discrepancy between the reduction in plasma osmotic pressure and the combined reduction in the major plasma electrolytes is a result of the elevation in concentration of an unidentified plasma solute which offsets 40-45% of the expected reduction in osmotic pressure. (Author's abstract)
W85-03604

CHANGES IN POPULATIONS AND DRIFT OF STREAM INVERTEBRATES FOLLOWING LAMPRICIDE TREATMENT,

anada Centre for Inland Waters, Burlington (On-
rio).
. M. Dermott, and H. J. Spence.
anadian Journal of Fisheries and Aquatic Sci-
nces, Vol. 41, No. 11, p 1695-1701, November,
984. 1 Fig, 4 Tab, 25 Ref.

escriptors: *Lampricides, *Invertebrates, *Ontar-
, *Goulais River, *Achigan Creek, *Soper
reek, Trifluoromethyl nitrophenol, Water pollu-
on effects, Population dynamics, Hardness, Pesti-
de toxicity, Aquatic drift, Aquatic insects, Anne-
ds, Turbellaria, Crustaceans.

he most successful method of controlling num-
ers of sea lamprey (Petromyzon marinus) in the
reat Lakes has been through the use of the selec-
ve chemical 3-trifluoromethyl-4-nitrophenol
TFM). The effects of TFM treatment on inverte-
rate abundance, recolonization, and drift rates
ere examined in three Great Lakes tributaries,
aving a wide range of water hardness. The Gou-
is River (a Lake Superior tributary) and its tribu-
ry, Achigan Creek, are softwater streams with
kalinities of 12-20 meq. Soper Creek, a Lake
ntario tributary, is hard with an alkalinity of 230
eq. In the softwater streams only philopotamid
ddisflies and lumbriculid worms were signifi-
ntly reduced after the TFM treatment, whereas
eir abundance in the untreated stream sections
as unchanged. Treatment of the hardwater
ream resulted in a dramatic mortality of leeches.
bundance of soft-bodied oligochaetes and Tur-
llaria were significantly reduced, while numbers
Simuliidae, Hydropsyche, and Baetis increased 4
after treatment. Daytime drift rates of Annelida,
urbellaria, Amphipoda, Glossosomatidae, and Ti-
lidae increased significantly during the lampri-
de treatment. Increased drift rates rather than
ortality appears to be the major impact of the
mpricide on invertebrate communities. The po-
ntial production of the stream is thus reduced.
Author's abstract)
/85-03605

PTAKE EFFICIENCY OF THE GILLS OF NGLISH SOLE (PAROPHRYS VETULUS) OR FOUR PHTHALATE ESTERS,
orvallis Environmental Research Lab., Newport,
R. Marine Science Center.
. L. Boese.
anadian Journal of Fisheries and Aquatic Sci-
nces, Vol. 41, No. 11, p 1713-1718, November,
984. 2 Fig, 2 Tab, 23 Ref.

escriptors: *Sole, *Phthalic acid esters, *Gills,
Fish, Water pollution effects, Fish physiology,
ioavailabilty, Fish tissues, Phthalate esters, Plasti-
zers.

ptake efficiences of the gills of English sole (Par-
phrys vetulus) for four homologous phthalic acid
sters were directly measured and compared with
ctanol-water partition coefficients (K sub ow).
est compounds were diethyl phthalate (DEP),
utyl benzyl phthalate (BBP), bis(2-ethylhexy)
hthalate (DEHP), and di-n-octyl phthalate
OC). Mean uptake efficiences in a single pass
rough the gills were 11% for DEP (log K sub
w = 3.2), 42% for BBP (log K sub ow = 5.8),
% for DEHP (log K sub ow = 8.7), and 12% for
OC (log K sub ow = 9.2). Uptake efficiences for
EP and BBP were inversely correlated with
eight-specific ventilation volume and did not cor-
elate with aqueous concentration. Uptake efficien-
ies for DOC and DEHP were uncorrelated with
ny measured parameter. Solubilities of phthalic
id esters were measured by generator column.
EP and BBP had aqueous solubilities similar to
ublished values, but DEHP was 1/700 and DOC
as 1/3000 below published solubility values.
OC and DEHP used to determine uptake effi-
iencies were most likely in colloidal or micellar
rm, which may be less bioavailable than soluble
rms of the compound; this would reduce the
pparent uptake efficiency, regardless of K sub ow
alue. (Author's abstract)
/85-03607

IETAL INCORPORATION BY BENTHIC AUNA: RELATIONSHIPS TO SEDIMENT IN-ENTORY,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
J. B. Frithsen.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 5, p 523-539, November, 1984. 1 Fig, 6 Tab, 61 Ref. EPA grant 806072020.

Descriptors: *Benthos, *Trace metals, *Coastal waters, *Radioisotopes, *Model studies, Metals, Heavy metals, Beryllium radioisotopes, Cadmium radioisotopes, Cobalt radioisotopes, Chromium radioisotopes, Cesium radioisotopes, Iron radioisotopes, Manganese radioisotopes, Mercury radioisotopes, Protactinium radioisotopes, Tin radioisotopes, Zinc radioisotopes.

Concentrations of radionuclides in benthos in a model coastal marine environment were related to the concentrations of those isotopes in sediment and estimations were made of the quantity of radionuclides annually incorporated by benthic organisms as a percentage of the amount present in the sediments. Twelve radionuclides (Be-7, Cd-109, Cs-134, Co-58, Co-60, Cr-51, Fe-59, Mn-54, Hg-203, Pa-233, Sn-113, and Zn-65) were added to the uniformly mixed water column of a mesocosm run in batch mode (non-flow through) as an acid stabilized mixture. Concentrations were measured during the following nine months. Surface living fauna incorporated more radionuclides than deeper fauna. Calculations of total annual radionuclide incorporation by benthic fauna indicated that meiofauna (metazoans passing through a 500 micro m sieve but retained on a 100 micro m sieve) incorporated a similar amount of the labelled metals as the macrofauna (metazoans retained on a 500 micro m sieve), even though the latter have a larger standing stock biomass. Benthic metazoan fauna can annually cycle from 1% (Sn) to nearly 50% (Cd) of the amount of added radionuclides measured in sediments. (Collier-IVI)
W85-03634

EPIDEMIOLOGIC MONITORING OF POSSIBLE HEALTH REACTIONS OF WASTEWATER REUSE,
California Univ., Los Angeles. School of Public Health.
R. R. Frerichs.
Science of the Total Environment, Vol. 32, No. 3, p 353-363, 1984. 3 Tab, 11 Ref. EPA grant R806399.

Descriptors: *Epidemiology, *Public health, *Water reuse, *Recharge, *Los Angeles, *California, Groundwater recharge, Wastewater renovation, Human diseases, Water pollution effects.

The possible health effects of consuming groundwater partially recharged with recycled wastewater were monitored in a long-term study of residents of several communities in eastern Los Angeles County, California. In three phases of ecologic studies, health measures were compared among residents of two recycled water area (high and low concentration) and two control areas. Included were measures of mortality, reportable illnesses, adverse birth outcomes, and incident cases of cancer. While significant differences were noted among the four study areas when comparing several health outcomes, none of the differences were in a direction to suggest a dose-response relationship between reclaimed water consumption and disease. To supplement findings of the ecologic studies, a household survey was conducted of approximately 2,500 women, half residing in the high recycled water area and half in the control area. The survey provided increased information on reproductive outcomes and on excess effects after controlling for important potential confounding factors such as cigarette use and alcohol consumption. The results of both the ecologic studies and the household survey provide no indication that recycled water has a noticable harmful effect on the health of a population exposed for nearly two decades. (Author's abstract)
W85-03639

COMPARISON OF THE MUTAGENICITY OF SEWAGE SLUDGES,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5E.
W85-03662

METHOD FOR ESTIMATION OF SLIMING OF NETS IN LAKE WATERS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5A.
W85-03679

MODIFIED LOGISTIC GROWTH EQUATION: EFFECTS OF CADMIUM CHLORIDE ON THE DIATOM, THALASSIOSIRA WEISSFLOGII AND THE DINOFLAGELLATE, AMPHIDINIUM CARTERI IN UNIALGAL AND BIALGAL BATCH CULTURES,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
W. K. W. Li.
Aquatic Toxicology, Vol. 5, No. 4, p 307-313, November, 1984. 1 Fig, 1 Tab, 28 Ref.

Descriptors: *Diatoms, *Dinoflagellates, *Cadmium compounds, *Logistic Growth Equation, Algal growth, Population density, Phytotoxicity, Mathematical equations, Interactions.

Growth of bacteria and microalgae in batch cultures follows a well-known pattern characterized by successive phases: lag, exponential, stationary, and decline. The logistic equation of Verhulst is widely used to describe the growth of populations; however, it pertains only to the exponential and stationary phases. A simple modification to the logistic equation is proposed: it extends the description of microbial population growth in batch cultures from the exponential, through the stationary, into the decline phase. The modified equation was first applied to the growth of a diatom (T. weissflogii) and a dinoflagellate (A. carteri), each in monospecific culture. The conditions in each culture were changed by introducing: a chemical inhibitor (cadmium chloride), the other species, and finally both the inhibitor and the other species together. The modified equation described the effects of cadmium chloride on the diatom and dinoflagellate in unialgal and bialgal cultures by specifying changes in four parameters: the specific rate of growth, an asymptotic maximum population density, the specific rate of decline, and a parameter related to the time at which the population density is reduced to one half of its value at stationary phase. When the diatom was initially dominant, the outcome of competition in the absence of Cd(2+) was co-existance with the dinoflagellate; Cd(2+) caused the diatom to decline. When the two species were initially approximately equal, the Cd(2+) provided a refuge for the diatom. When the diatom was initially subdominant, no refuge against the dinoflagellate was provided for the diatom by Cd(2+). (Moore-IVI)
W85-03687

JOINT EFFECTS OF A MIXTURE OF 14 CHEMICALS ON MORTALITY AND INHIBITION OF REPRODUCTION OF DAPHNIA MAGNA,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicology.
J. Hermens, H. Canton, N. Steyger, and R. Wegman.
Aquatic Toxicology, Vol. 5, No. 4, p 315-322, November, 1984. 6 Tab, 17 Ref.

Descriptors: *Daphnia, *Toxicity, *Mortality, *Reproduction, Water pollution effects, Industrial wastes, Mixtures.

The aquatic environment in industrial areas often is polluted with a large number of chemicals. The prediction of the joint toxicity of mixtures, composed of many dissimilarly acting chemicals, is very complex. The joint effect on mortality and on inhibition of reproduction (as a more specific toxicity parameter) to Daphnia magna was determined for a mixture of 14 aquatic pollutants with several chemical structures and probable modes of action. Mixtures were prepared in about equitoxic concentrations (identical fractions of their LC50 or

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EC50). The joint toxicity in the reproduction test was lower in comparison with the mortality test. The potential for addition may be reduced when more specific sublethal toxicity criteria are studied. The joint toxicity at sublethal level is lower than at lethal level, but the toxicity of the mixtures remains much higher than that of the individual chemicals and is still near concentration addition. (Moore-IVI)
W85-03688

EFFECTS OF ZINC ON THE ULTRASTRUCTURE OF THE BRAIN CELLS OF THE LARVAE OF CLUPEA HARENGUS L.,
University Coll. of Swansea (Wales). Dept. of Zoology.
B. Somasundaram, P. E. King, and S. E. Shackley.
Aquatic Toxicology, Vol. 5, No. 4, p 323-330, November, 1984. 7 Fig, 1 Tab, 26 Ref.

Descriptors: *Herring, *Larvae, *Zinc, *Toxicity, Water pollution effects, Heavy metals, Estuarine environment, Nervous system, Fish eggs.

The Atlantic herring (Clupea harengus) has stocks which spawn in estuarine water where heavy metal pollution may occur. Aquatic organisms may be most susceptible to environmental stress during their development. C. harengus adults, which were about to spawn, were gill netted from Castle Reach, Wales, during March 1983. Eggs were stripped from these fish and artificially fertilized. The ultrastructural changes in the brain cells of C. harengus larvae, hatched from eggs incubated in four zinc concentrations (0.5, 2.0, 6.0 and 12.0 ppm), were examined by morphometric analysis. The fine structure of the brain cell was affected by zinc at all concentrations examined. Significant swelling of the nuclear membranes, rough endoplasmic reticulum, an increase in intracellular spaces and a decrease in the relative volume of mitochondria were observed. At 12.0 ppm zinc significant reduction in the relative volume of the nucleus, degeneration of the mitochondrial cristae and a reduction in the ribosomes were observed. In the zinc-treated larvae the reduced oxygen utilization by the mitrochondria, accompanied by a possible loss of energy, would affect the normal function of the mid and hind brain, which would result in an impairment of visual and swimming responses. The effects of zinc, at concentrations which are not immediately lethal, are of importance to movement and hence to viability of the larvae. (Moore-IVI)
W85-03689

EFFECTS OF FENVALERATE ON LARVAL DEVELOPMENT OF PALAEMONETES PUGIO (HOLTHUIS) AND ON LARVAL METABOLISM DURING OSMOTIC STRESS,
Environmental Research Lab., Gulf Breeze, FL.
C. L. McKenney, and D. B. Hamaker.
Aquatic Toxicology, Vol. 5, No. 4, p 343-355, November, 1984. 5 Fig, 1 Tab, 54 Ref.

Descriptors: *Fenvalerate, *Larvae, *Grass shrimp, *Osmotic stress, *Pesticide toxicity, Metabolism, Development, Pyrethroid insecticides, Water pollution effects, Estuarine environment, Salinity, Toxicity.

Larvae of the estuarine grass shrimp, Palaemonetes pugio, were reared in the laboratory from hatch through metamorphosis under optimal salinity conditions (20%) in a range of lethal and sublethal concentrations of the pyrethroid insecticide, fenvalerate. A nominal concentration of 3.2 ng fenvalerate/l significantly reduced the percentage of larvae that completed metamorphosis. Oxygen consumption rates were significantly higher for larvae exposed to this lethal concentration for only 24 h. Exposure to a sublethal concentration of 1.6 ng fenvalerate/l prolonged the duration of complete larval development. Acute osmotic stress modified the metabolism of larval P. pugio reared in sublethal fenvalerate concentrations of 0.1 and 0.2 ng/l and these metabolic responses varied with stage of development. After 8 days of exposure to fenvalerate, oxygen consumption rates were elevated when larvae were exposed acutely to hypoosmotic stress (10% S). Metabolic responses of premetamorphic larvae to hyperosmotic stress (30% S) were also modified by sublethal fenvalerate exposure. Alterations in metabolic-salinity patterns of larval grass shrimp developing under sublethal concentrations of fenvalerate suggest reduction in the ecological fitness of this sensitive life stage by limiting their capacity to adapt to the fluctuating salinity conditions of estuarine waters. (Author's abstract)
W85-03691

TOXIC EFFECTS OF VANADIUM ON THE METABOLISM OF SOME FRESHWATER ALGAE CULTURED IN VITRO (EFFECTS TOXIQUES DU VANADIUM SUR LE METABOLISME DE QUELQUES ALGUES D'EAU DOUCE CULTIVEES IN VITRO),
Rennes-1. (France). Lab. d'Hydrobiologie.
B. Savoure.
Hydrobiologia, Vol. 118, No. 2, p 147-151, November, 1984. 3 Tab, 9 Ref.

Descriptors: *Vanadium, *Phytotoxicity, *Algae, Plant metabolism, Nitrates, Enzymes, Molybdenum.

Laboratory studies on unialgal cultures have shown that vanadium at a concentration of 1000 micro-g/l may have stimulatory and inhibitory effects on the metabolism of cells. A significant decrease in the synthesis of soluble carbohydrates caused by vanadium at this concentration is demonstrated. In contrast, a stimulating effect on protein metabolism and nitrate-reductase activity in cells is shown. It is suggested that enhancement of this enzyme activity may be due to the cationic form of vanadium, donating electrons and stimulating the reduction of nitrates, primarily activated by molybdenum. (Author's abstract)
W85-03692

EFFECTS OF PHOSPHORUS AND NITROGEN ENRICHMENT ON THE PHYTOPLANKTON IN A TROPICAL RESERVOIR (LOBO RESERVOIR, BRAZIL),
Universidade Estadual Paulista, Botucatu (Brazil). Inst. Basico de Biologia Medica e Agricola.
For primary bibliographic entry see Field 2H.
W85-03694

INSURANCE AGAINST LIABILITY FOR ENVIRONMENTAL POLLUTION - COVERAGES AND LIMITATIONS,
E. I. Selig.
Great Lakes Waste and Pollution Review Magazine, Vol. 1, No. 1, p 17-19, April, 1983. 1 Fig, 1 Ref.

Descriptors: *Legal aspects, *Water pollution effects, *Insurance, Plumes, Path of pollutants, Groundwater pollution, Cleanup operations, Spills.

As a result of using large quantities of water to extinguish a fire at a chemical plant, the groundwater underneath the plant became contaminated. While the company was insured against cleanup costs, the insurance company and the chemical firm viewed the problem differently. The chemical firm filed suit against the insurance company, seeking declaratory relief. The defendant argued that plaintiff owned the groundwater underlying the site of plaintiff's own facility, and that damage to such groundwaters was therefore excluded from coverage. The Court disagreed, holding that groundwater in its natural state is not capable of ownership by the above ground legal owner of the property, but becomes his property only when he brings it within his possession or control by withdrawing it from the ground. The defendant was found liable to reimburse the plaintiff for costs and expenses of correcting the chemical contamination of groundwater underneath the plaintiff's premises, as well as of groundwater that had migrated beyond those premises from the site of the original contamination. The primary practical lesson to be learned from the Aviex case is that insurance contracts against liability for complex occurrences need to be carefully crafted, reviewed and negotiated by the parties. This is especially true in the relatively new field of environmental impairment liability insurance, which is now required for hazardous waste management facilities and is als available to industrial and commercial facilitie that handle potentially hazardous chemicals i their operations. (Baker-IVI)
W85-03711

EFFECT OF ORGANIC CONTAMINATIO UPON MICROBIAL DISTRIBUTIONS AN HETEROTROPHIC UPTAKE IN A CAPE COI MASS., AQUIFER,
Geological Survey, Menlo Park, CA. Water Re sources Div.
R. W. Harvey, R. L. Smith, and L. George.
Applied and Environmental Microbiology, Vo 48, No. 6, p 1197-1202, December, 1984. 5 Fig, Tab, 18 Ref.

Descriptors: *Groundwater pollution, *Bacteri *Wastewater pollution, *Cape Cod, *Massachu setts, Water pollution effects, Path of pollutant Land disposal, Effluents, Infiltration, Specific co ductivity, Particulates, Organic compound Plumes.

The effect of land-disposed, secondarily treate sewage upon bacterial concentration, distributio solid-solution partitioning, and glucose uptal rates were studied within a 4-km-long plume contaminated groundwater at Otis Air Base, C Cape Cod, Massachusetts. The treated sewage discharged to infiltration sand beds, percolates the water table, and moves southward with th flowing groundwater toward Nantucket Soun Water samples for microbial assays were obtaine for a network of screened observation wells. S core samples of aquifer sediments were taken depths ranging from 12 to 32 m at 0.21 and 2.93 k from the source of contamination. The number free-living (unattached) bacteria in contaminate groundwater declined steadily with increasing di tance from the source of sewage infiltration. Bact rial abundance in groundwater sampled at 0.31 k correlated strongly with specific conductance a increased sharply at depths from 6 m to 14 m, the declined at 20 and 31 m. Most bacteria in contam nated and uncontaminated zones of the aquif were bound to the surfaces of particulates, < micro-m in diameter. Portions of the total samp population associated with solid surfaces range from 98% at 0.21 km and 19 m depth to abo 100% at 2.93 km and 24 m depth. The gluco uptake rate, assayed at in situ and 5 micro-M concentrations, declined steadily in contaminate groundwater sampled along a transect. The stro correlation between the abundance of free-livi groundwater bacteria and the proximity to th source of contamination within the first kilomet of the plume suggests an influence from contam nant organics. (Moore-IVI)
W85-03736

STUDY ON ORGANIC POLLUTION PARAM ETERS FOR DYES AND DYEING AUXILL RIES,
Government Industrial Research Inst., Osak Ikeda (Japan).
T. Saito, Widayat, W. winiati, K. Hagiwara, and Y. Murakami.
Analytische Chemie, Vol. 319, No. 4, p 433-43 October, 1984. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Dyes, *Oxygen deman *Wastewater treatment, *Dye industry waste Chemical oxygen demand, Biochemical oxyg demand, Textile industry, Biodegradation, Aerob conditions, Surfactants, Acetic acid.

Organic pollution parameters of the refracto chemicals have been investigated for the dyes a dyeing auxiliaries widely used in the textile indu try. The resistance and susceptibility of the chem cals to aerobic biodegradation are predicted f nine kinds of dyes. In general, an organic substan with more than approximately 0.7 of BOD5/TO seems to be susceptible to aerobic biodegradati like self-purifying action of natural water. Mo dyes, DBS, polyoxyethylenenonylphenyl esth and some dyeing auxiliaries showed a relative high resistance to aerobic biodegradation sin their BOD5/TOC ratios were 0.08-0.89, wh

me surfactants and acetic acid appeared to show sceptibility to aerobic biodegradation since their OD5/TOC ratios were large. The accumulation biorefractory chemicals with small BOD5/TOC io has a great potential impact on the deteriora- n of the natural water quality. (Baker-IVI)
85-03746

D. Waste Treatment Processes

NVIRONMENTAL CHEMISTRY OF 1,2-PRO- ANEDIOL DINITRATE: AZEOTROPE FOR- ATION, PHOTOLYSIS AND BIODEGRADA- LITY,
lifornia Univ., Berkeley. Naval Biosciences Lab.
F. Wyman, H. E. Guard, and W. M. Coleman,

rchives of Environmental Contamination and xicology, Vol. 13, No. 6, p 647-652, November, 84. 2 Fig, 2 Tab, 17 Ref. ONR contract N00014- -0200-1001.

escriptors: *Propanediol dinitrate, *Azeotropes, hotolysis, *Biodegradation, Fuel, Water pollu- n effects, Wastewater treatment, Biological stewater treatment.

e feasibility of detoxification by microbial biode- adation including the use of a commercially ailable culture, and photolysis with ultraviolet ht were considered in dealing with 1,2-propane- ol dinitrate, commonly known as propylene ycol dinitrate (PGDN), the major component of Naval torpedo fuel, Otto fuel II. Because of the ssible pollutant and health effects of PGDN, stewaters containing Otto fuel II must be de- ified prior to disposal. The compound proved istant to biodegradation by microorganisms nd in sewage sludge, a pure culture of Pseudo- nas aeruginosa, and a commercially available oculum, Phenobac, employed for degradation of rogen containing organic wastes. PGDN is pho- abile in ultraviolet, decomposing to pyruvic and tic acids. In biodegradation experiments, PGDN idly evaporated from aqueous solutions. This expected volatility of PGDN, which poses a tential health hazard, was attributed to the for- tion of a PGDN-water azeotrope, whose pres- ce was demonstrated by partition experiments. aker-IVI)
85-03220

ENITRIFICATION IN SEWAGE TREAT- ENT PLANTS - DEMAND IN REGIONS ITH SMALL CARBONATE HARDNESS OF IE DRINKING-WATER (DENITRIFIKATION KLARANLAGEN - FORDERUNG IN RE- ONEN MIT GERINGER CARBONATHARTE ES TRINKWASSERS),
ttgart Univ. (Germany, F.R.). Inst. fuer Sied- gswasserbau, Wasserguete- und Abfallwirts- aft.
Kapp.
asserwirtschaft, Vol. 74, No. 6, p 319-326, June, 84. 10 Fig, 11 Ref.

escriptors: *Biological wastewater treatment, enitrification, *Hardness, Wastewater treat- nt, Alkalinity, Hydrogen ion concentration, occulation, Microbial denitrification.

low-loaded biological sewage treatment plants e microbial oxidation of ammonium nitrogen is ccessful. The nitrification leads to a reduction of e alkalinity of the sewage by the production of drogen ions. In the case of a low carbonate rdness, a decrease in the pH-value with the gative consequences for the flocculent structure the biological sludge is to be expect. The micro- l denitrification is an appropriated counter- easure. (Author's abstract)
85-03271

ASTEWATER DISINFECTION WITH BRO- INE CHLORIDE,
G. Zeh, Jr.
blic Works, Vol. 115, No. 10, p 56-57, October, 84. 2 Fig, 2 Tab.

Descriptors: *Drinking water, *Disinfection, *Bromine chloride, Chlorine, Bromine, Economic aspects, Fish, Toxicity, Water treatment.

Bromine chloride provides an important ecological advantage when used in place of chlorine to disinfect wastewater plant effluent in that it is not toxic to fish. In addition, it is more effective than either of its two individual elements for cooling water treatment and is also cost competitive with other wastewater disinfection methods that do not produce an effluent residual. Reactions of bromine chloride with water or ammonia are analogous to those of chlorine. However, the half life of the bromine compounds is approximately 10 minutes compared to about 20 hrs for similar chlorine compounds. Until recently, a lack of safe technology discouraged wide spread use of bromine chloride in water treatment. Although the compound is not any less hazardous today, equipment and methods for storing and dispensing it are far more reliable. In wastewater treatment applications, bromine chloride is best utilized in its liquid form. (Baker-IVI)
W85-03273

LANDSCAPE DESIGN HELPS SELL INNOVATIVE WASTEWATER EFFLUENT DISPOSAL SYSTEM,
J. Z. Olcott, and T. A. Pedersen.
Public Works, Vol. 115, No. 10, p 74-75, October, 1984. 2 Fig.

Descriptors: *Wastewater disposal, *Rapid infiltration basins, *Landscaping, *Orange County, *Florida, Guidelines, Design criteria, Infiltration, Wastewater irrigation, Groundwater recharge.

Landscape design can lessen the impact of major disposal projects and help create an esthetically pleasing environment. It can also help move a project down the road to approval, especially if the concerns of residents have been addressed. An example of a successful project in Orange County, Florida, is described where a wastewater effluent management plan included landscape design to make a more acceptable and effective project. The proposed wastewater management plant was to reuse the effluent for irrigation of citrus crops and for recharge of groundwater resources via rapid infiltration basins (RIB). Landscape design considerations for the infiltration basins were identified during the evaluation of the engineering and technical conceptual design. Guidelines and design standards include configuration of the basins, maximum slope gradient for landscaped basins, quantity and type of plants used for visual effects, fencing, and distance relationships between basins and viewers. (Baker-IVI)
W85-03275

SMALL TOWN CONQUERS WASTEWATER TRIBULATIONS,
Culp/Wesner/Culp, Denver, CO.
H. H. Benjes, and C. G. Johnson.
Public Works, Vol. 115, No. 10, p 78-80, October, 1984. 5 Fig, 1 Tab.

Descriptors: *Wastewater treatment facilities, *Spearfish, *South Dakota, Aeration, Sludge, Clarifiers, Activated sludge process, Debris, Computers.

Spearfish, South Dakota, suffered a catastrophic loss of its wastewater treatment lagoon in the spring of 1978. The replacement facility designed to handle the problems includes a plant designed to meet a 10 mg/L day discharge requirement for BOD5 and TSS. During the facility planning, there was concern for several of the design concepts. Extended aeration sludge experiences a 20 day or more sludge age in the process and should therefore be stable. It was decided that liquid sludge storage without aeration would be satifactory. Exposed final clarifiers in South Dakota will freeze. However, the designer elected not to cover the clarifiers in order to avoid creating a highly corrosive atmosphere and concomitant metal deterioration. Activated sludge plants that are not preceded by primary clarifiers accumulate a great deal of debris that constantly recycles from the clarifier to the aeration basin. Special effort is needed to accommodate this debris. The designer provided a performance-reporting program, a preventive maintenance program, and an inventory control program for an Apple II computer system. (Baker-IVI)
W85-03276

KINETICS OF THE DESORPTION OF AMMONIA FROM WATER BY DIFFUSED AERATION,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
J. Patoczka, and D. J. Wilson.
Separation Science and Technology, Vol. 19, No. 1, p 77-93, January, 1984. 6 Fig, 2 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Ammonia, *Diffused aeration, *Desorption, Kinetics, Nitrogen removal, Mass transfer, Mathematical equations.

Effluents from conventional wastewater treatment plants contain large concentration of nitrogen, with ammonia nitrogen being the main form. Desorption of ammonia from wastewater occurs when liquid of high pH is brought into contact with large amounts of air. Ammonia desorption by diffused aeration was investigated in a lab-scale, batch aeration column, and the theoretical basis for the operation was developed. A formula was derived for the calculation of the fraction of ammonia present in the solution in undissociated form (susceptible for desorption) for any given temperature and pH. Desorption was found to be equilibrium controlled. Lower limits of the ammonia mass transfer coefficient for bubbles rising through the water column were estimated. The impact of the surface effect on the rate of desorption was taken into account in the calculations. The depth of submersion of the diffuser and the bubble size have no impact on the efficiency of the process. Due to mass-balance and mass-transfer considerations, diffused aeration is not an economical process for ammonia removal. The large amounts of air required and rapid mass transfer rate indicate that apparatus with very low resistance to air flow will be more economical. (Moore-IVI)
W85-03299

NICKEL REMOVAL FROM A SYNTHETIC NICKEL-PLATING WASTEWATER USING SULFIDE AND CARBONATE FOR PRECIPITATION AND COPRECIPITATION,
Auburn Univ., AL. Dept. of Civil Engineering.
S. McAnally, L. Benefield, and R. B. Reed.
Separation Science and Technology, Vol. 19, No. 2/3, p 191-217, February/March, 1984. 12 Fig, 4 Tab, 20 Ref.

Descriptors: *Wastewater treatment, *Nickel, *Metal-finishing wastes, *Sulfides, *Carbonates, Chemical precipitation, Coprecipitation, Industrial wastes, Mathematical models, Hydrogen ion concentration.

A significant problem for municipal wastewater treatment plants is the inefficient removal of toxic metal constituents. The primary source of toxic metals in municipal wastewater is industrial discharge, such as metal electroplating wastewater. The uses of soluble sulfide and carbonate were evaluated to determine their effectiveness in reducing nickel in a synthetic nickel plating wastewater. An optimum pH range for nickel removal from a synthetic wastewater was found to be 10.0-11.0. The optimum removal occurred at pH 11 where a residual total nickel concentration of 0.1 mg/L was obtained with a sulfide:nickel weight ratio of 2.0 and a carbonate:nickel weight ratio of 20.0. A similar degree of removal was achieved at pH 10 where a residual total nickel concentration of 0.2 mg/L was obtained with a carbonate:nickel ratio of 10.0 and a sulfide:nickel ratio of 0.5. A mathematical model of the synthetic system produced by multiple regression analysis predicted the sample data trends quite effectively. (Moore-IVI)
W85-03300

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SEASONAL CHANGES IN CONCENTRATION OF MAJOR NUTRIENT ELEMENTS IN THE RHIZOMES AND LEAVES OF TYPHA ELEPHANTINA ROXB,
Rajasthan Univ., Jaipur (India). Dept. of Botany.
B. Gopal, and K. P. Sharma.
Aquatic Botany, Vol. 20, No. 1/2, p 65-73, October, 1984. 3 Fig, 23 Ref.

Descriptors: *Cattails, *Nutrients, *Wastewater treatment, *Seasonal variation, *India, Calcium, Magnesium, Nitrogen, Phosphorus, Macrophytes, Aquatic plants, Wetlands.

Macrophytes may be used in wetlands for stripping wastewaters of their excessive nutrient loads; nutrients can be removed by harvesting the plant biomass. In the case of rooted emergents, only the aboveground parts are harvested. T. elephantina, a common macrophyte of Indian wetlands, has an extensive system of rhizomes; the leaves are broad, thick and up to 4 m long. The tissue concentrations of calcium, magnesium, nitrogen and phosphorus in the leaves (aboveground shoots) and vertical branches of rhizomes of T. elephantina were studied near Jaipur (India) during 1975-76. Calcium and magnesium concentrations did not show trends of seasonal change. Nitrogen exhibited two peak levels in the leaves during May and November, and a peak in the rhizomes during March. Phosphorus concentration exhibited two peak levels in the rhizomes during July and January, and at least one clear peak in the leaves during April. Total nutrient contents were calculated using biomass data for leaves published earlier. About 35% N and 50% P of the total maximum content in the leaves translocated to the rhizomes during winter and later some of it was used again for new shoot growth. While the translocation of nutrients such as nitrogen to the belowground parts conserves nutrients, it also favors microbial immobilization, which plays an important role in wastewater treatment by macrophytes. (Moore-IVI)
W85-03316

SHORT-TERM RESPONSES OF YOUNG TYPHA DOMINGENSIS AND TYPHA ORIENTALIS PLANTS TO HIGH LEVELS OF POTASSIUM CHLORIDE,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
C. M. Finlayson.
Aquatic Botany, Vol. 20, No. 1/2, p 75-85, October, 1984. 4 Fig, 5 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Cattails, *Potassium chloride, *Feedlot wastes, *Australia, Animal wastes, Aquatic plants, Biological wastewater treatment, Plant growth.

The determination of the responses of the native emergent plants Typha domingensis and T. orientalis to KCl is part of an investigation into the ability of aquatic plants to treat wastewater effluents in southeast Australia. The responses of young shoots of T. domingensis and T. orientalis to KCl were tested under glasshouse conditions. Preliminary trials had shown that piggery effluent containing 75 mM K and 48 mM Cl was toxic to these species. In the glasshouse both were able to grow at 25-50 mM KCl but only the fresh-weight growth of T. orientalis at 25 mM KCl exceeded that of the control plants. Plants at 75 and 100 mM KCl had chlorotic and wilted leaves. Growth was also measured as dry-weight and leaf-number changes. At the four KCl levels used (25, 50, 75 and 100 mM) the plants accumulated K, 6-8% dry weight, at the expense of Ca and Na accumulation. Both Typha species are capable of growing in the K and Cl levels found in abattoir and piggery effluents. Field experiments are being conducted to determine whether plants can develop to maturity, with a rhizomatous systenm in these effluents. If water loss by evapotranspiration is large, the actual concentration of salt in the effluent may increase despite the fact that some has been removed by the plants. (Moore-IVI)
W85-03317

AUTOMATION FOR INDUSTRIAL WATER TREATMENT,
For primary bibliographic entry see Field 5F.
W85-03321

SURVEY OF COMBINED TRICKLING FILTER AND ACTIVATED SLUDGE PROCESSES,
CH2M Hill, Inc., Corvallis, OR.
J. R. Harrison, G. T. Daigger, and J. W. Filbert.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1073-1079, October, 1984. 2 Fig, 6 Tab, 14 Ref.

Descriptors: *Water treatment, *Trickling filters, *Activated sludge process, Filters, Sludge, Evaluation, Wastewater treatment facilities, Cost analysis.

Forty-three wastewater treatment plants using combined trickling filter (TF) and activated sludge (AS) processes were surveyed to determine their process performance and operational characteristics. Well-designed and properly operated combined TF and AS plants of all modes are capable of producing secondary quality effluents and at times may produce even better quality effluents. The settleability of sludges produced in plants using combined TF and AS processes was generally very good, as indicated by sludge volume index values less than 135mL/g. The measured yield value from the combined TF and AS processes can be quite variable. Such variations may be the result of the build-up and subsequent sloughing of biosolids in the FT. Power savings are possible through the use of combined TS and AS systems. Staffing requirements do not seem to be affected by the type of combined TF ans AS process used. Major equipment problems at plants using the combined approach are most likely to occur with the TF and/or TF pumping system. Plant operators indicate a high level of satisfaction for combined processes. The cost-effectiveness of the combined approach systems must be judged on a case by case basis. (Baker-IVI)
W85-03329

OPTIMIZATION OF A WASTEWATER TREATMENT PLANT BY THE EMPLOYEE INVOLVEMENT OPTIMIZATION SYSTEM (EIOS),
Miami Univ., Oxford, OH.
A. M. Springer, R. Schaefer, and M. Profitt.
Journal of the Water Pollution Control Federation, Vol. 56, No. 10, p 1080-1092, October, 1984. 11 Fig, 3 Tab, 4 Ref.

Descriptors: *Wastewater treatment facilities, *Optimization, *Employee involvement, Evaluation, Systems analysis, Operation, Management, Wastewater treatment, Effluents.

In many cases, wastewater treatment plant operations can be optimized to achieve effluent quality that conforms ro EPA guidelines. Any procedure that is adopted must be easy to use by current plant personnel, and assimilate into the existing plant routine. The Employee Involvement Optimization System (EIOS) procedure for wastewater treatment plant optimization can be used in any process which is subject to long response times. The procedure retains many of the desirable characterisics of Evolutionary Operation Procedure (EVOP) procedure while incorporating a procedure to check for outliers. The procedure was successfully used to optimize a wastewater treatment plant. The only negative factor encountered was the potentially long term required to complete a project. This problem can be overcome by incorporating or making this procedure part of the standard plant operation. (Baker-IVI)
W85-03330

CASE HISTORY OF INDUSTRIAL PRETREATMENT IN COLUMBUS, OHIO,
Erm-Midwest, Inc., Columbus, OH.
H. Stonerook, J. Kerr, G. Newell, and L. Ferell.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1093-1098, October, 1984. 8 Tab, 2 Ref. EPA Grant No. C390892-01.

Descriptors: *Wastewater treatment, *Industrial wastes, *Wastewater pretreatment, *Heavy metals, Columbus, Ohio, Zinc, Nickel, Cadmium, Sludge disposal, Effluent limits.

The city of Columbus has developed an industri pretreatment program to monitor and control th discharge of industrial wastes to its wastewate treatment facilities. A comprehensive study o heavy metals revealed that monthly average con centrations of zinc and nickel at the Jackson Pik plant and of nickel at the Southerly plant wi exceed final NPDES limitations. Cadmium con centrations in sludge are a problem at both treat ment plants. Cadmium in Jackson Pike sludge ma require reduced land application rates after 1986 t meet federal regulations. Cadmium in Southerl sludge could interfere with the distribution of con posted sludge as a soil conditioning product prepreposed federal regulations regarding cadm um content become law. Clearly, pretreatment o industrial wastewater is needed to prevent thes problems in the future. The city currently monitor 84 industries for extra strength discharges an sewer use problem pollutants. It is proposed thi the wastes from an additional 70 industries b characterized to determine loadings of metals an other pollutants. This data should then be used in revised mass balance for metals to account for th large quantities of cadmium, nickel, chromium, an other metals currently unaccounted for. Curre mass balance data for metals are inadequate t determine the effectiveness of current effluen limits for industry. (Baker-IVI)
W85-03331

DEMONSTRATION OF RAPID INFILTRA TION TECHNOLOGY, ISMAILIA, EGYPT,
Canal Cities Consultants, Cairo (Egypt).
P. E. Levine.
Journal of the Water Pollution Control Federatio Vol. 56, No. 10, p 1104-1109, October, 1984. 2 Fi 5 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Rapid infi tration, *Ismailia, *Egypt, Infiltration, Leachin Nitrates, Ammonia, Fecal coliforms, Bacteria, Su pended solids, Volatile organics, Phosphorus, N trogen, Chemical oxygen demand.

A pilot scale rapid infiltration (RI) facility w operated to establish the treatment effectiveness RI technology at Ismailia, Egypt. Raw to primar quality wastewater was diverted to two 4- by 5- test basins. Each basin was instrumented to allo monitoring of basin inflow and infiltration rates. addition, samples were taken to monitor influe and percolate quality. The basins were operate under a variety of flooding to drying cycles. Infi tration rates were maintainable throughout the te period. Short drying cycles of 3 to 4 days had negative effect on infiltration rates, and a minimu of 7 days drying between flooding was required maintain infiltration rates. Infiltration rates of 3 5 cm/hr were determined to be appropriate f design purposes. A total annual hydraulic loadi rate of 26.3 to 43.8 m/yr was estimated for desig purposes. After 2.5 m of vertical travel, suspend solids, volatile suspended solids, fecal colifor ammonia, organic nitrogen, phosphorus, and CO were significantly reduced. Percolate salinity p rameters exceeded influent concentrations as result of soil profile leaching. Maximum reductio in percolate nitrate could be achieved by maintai ing a 12 day drying cycle between basin floodin With the exception of salinity and nitrate, perc late quality met generally accepted guidelines f reuse as an irrigation water source. (Baker-IV W85-03333

INNOVATIVE PROCESS FOR TREATING R CYCLED COOLING WATER,
Texas A and M Univ., College Station. Dept. Civil Engineering.
B. Batchelor, and M. McDevitt.
Journal of the Water Pollution Control Federatio Vol. 56, No. 10, p 1110-1117, October, 1984. 8 F 9 Tab, 30 Ref.

Descriptors: *Water softening, *Lime, *Wat reuse, *Cooling water, Scaling, Sulfates, Sili Calcium, Costs, Water treatment.

The ultra-high lime process is a modification conventional lime softening that has been practic

or many years. In many instances the ultra-high me process can offer significant advantages over lternative processes for removing scale-forming hemicals from cooling waters. The chemistry of alcium silicate precipitation is reviewed; this pre-ipitation makes the process feasible and may ender it economical as well. Possible uses for the ethod include the ability to remove all scale-orming chemicals, at potentially lower cost be-ause it relies on an inexpensive treatment chemi-al which may be recoverable, and the ability to se conventional lime softening equipment. Re-ioval of silica during ultra-high lime treatment an be described as the formation of monocalcium licate. Temperature does not have a great effect n the solubility product between 23 and 50 C. ligh sulfate concentration (50 mM) affected the on activity products obtained. This effect may be nitigated by using different formation constants or soluble calcium sulfate. Stoichiometry between alcium and silica was not regular. The kinetics of lica removal by the ultra-high lime process seem o be rapid enough to be substantially complete in ie retention times typically used for lime soften-ng. Preliminary cost estimates show the ultra-high me process applied in a combined sidestream/ nake-up configuration was less costly than the igh lime process for the system studied. (Baker-VI)
V85-03334

METHOD FOR ESTABLISHING SITE-SPECIF-IC STREAM DESIGN FLOWS FOR WASTE-LOAD ALLOCATIONS,
Environmental Protection Agency, Washington, DC. Wasteload Allocation Section.
I. Biswas, and B. A. Bell.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1123-1130, October, 1984. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Water quality standards, *Model tudies, *Streamflow, *Waste load, Water pollu-ion control, Design flows, Pollutant load.

A majority of States use the chronic level water uality criteria and the 7-day, 10-year low flow as he stream design flow. To implement the recently ublished two-number water quality criteria (the inal chronic value and the final acute value of any ollutant) states will need to establish the stream esign flow for use in steady-state water quality nodeling. The result predicts an optimum design low for the final chronic value of any pollutant. A cientifically established stream chronic design low method makes it possible to set one optimum vasteload allocation to meet the two-number vater quality criteria. The method is based on the nique toxicity characteristics of the pollutant in-olved, the unique variability of receiving stream low, and the unique dilution available for the ndividual discharge. The procedure needed to use he method is simple, and the data needed to ollow the recommended procedure are usually vailable. (Baker-IVI)
W85-03336

STATUS OF WATER QUALITY MODELING IN THE PULP AND PAPER INDUSTRY,
B. K. Firth.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1131-1135, October, 1984. 2 Fig, 4 Tab, 15 Ref.

Descriptors: *Pulp and paper industry, *Industrial waste, *Water quality, *Model studies, Water pol-ution control, Dissolved oxygen, Biochemical oxygen demand, Industrial wastes.

The Clean Water Act of 1972 prompted the use and development of water quality models by engi-neers and scientists from both the private sector and governmental regulatory agencies. Receiving water models have been used to represent the assimilative capacity of receiving waters, assign wasteload allocations, and to quantify additional waste treatment needs for water quality limited streams. Modeling activities to date have focused on one objective, the maintenance of dissolved oxygen standards. Review of modeling efforts by both sectors focused on the National Council for Air and Stream Improvement (NCASI) program. This group has made a major contribution to water quality modeling in the areas on input parameter estimation techniques, model documentation, and protocol for the proper selection, calibration, and verification of water quality models. State of the art water quality models are most sensitive to sediment oxygen demand reaeration, and primary production. Biochemical oxygen demand oxidation rates are also sensitive to the kinetic model although, under the assumption of first order, they are not as sensitive as the parameters noted above. Receiving water models should be selected based on the ability of the model to represent the physical, chemical, and biological phenomena associated with a given receiving water. Water quality models are presently being used to assess the potential use of innovative waste treatment strategies to comply with restrictive wasteload allocations. (Baker-IVI)
W85-03337

LIVESTOCK LAGOON SYSTEMS FOR DISPOSAL OF PESTICIDE WASTES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
E. R. Collins, J. A. Petruska, D. E. Mullins, R. W. Young, and R. W. Nicholson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 755-761, May/June, 1984. 6 Fig, 6 Tab, 7 Ref.

Descriptors: *Pesticides, *Waste disposal, *Wastewater treatment, Farm wastes, Manure, Chlordane, Diazinon, Baygon, Carbamates, Organic compounds, Agricultural chemicals, Facultative digesters, Aerobic digesters.

Facultative and aerobic digesters for livestock wastes were used to degrade pesticide materials (chlordane, Diazinon, Baygon) in the laboratory. Three different animal wastes were used as digester media for the process: swine, chicken and dairy cattle manure. The rates of chlordane, Diazinon, and Baygon disappearance were substantial when incorporated with liquid suspensions of animal wastes under both aerobic and facultative conditions similar to those found in lagooning of animal wastes. Differences in response were observed depending on the pesticide involved, the digester type and whether or not a single pesticide or a mixture of the three were added to the digesters. Field use of livestock waste lagoons for disposal of small amounts of dilute solutions of chlordane and Diazinon indicated that long term intervals were required to breakdown low concentrations of chlordane under field conditions using waste lagoons. Diazinon disappears rapidly from the supernatant of waste lagoons, although there is some accumulation in the sludge phase. Baygon, a representative of the carbamate pesticides, was not tested for disposal under field conditions. (Baker-IVI)
W85-03381

REMOVAL OF CR(VI) FROM AQUEOUS SOLUTIONS BY ADSORPTION ON FLY ASH-WOLLASTONITE,
Banaras Hindu Univ., Varanasi (India).
K. K. Panday, G. Prasad, and V. N. Singh.
Journal of Chemical Technology and Biotechnology, Vol. 34A, No. 7, p 367-374, October, 1984. 6 Fig, 1 Tab, 27 Ref.

Descriptors: *Wastewater treatment, *Chromium, *Adsorption, *Fly ash, *Wollastonite, Industrial wastes, Thermodynamic properties, Infrared, Desorption, Wastewater treatment.

Hexavalent chromium is a major pollutant from various industrial effluents, and the release of chromium-rich effluents into municipal sewage systems may make sludge disposal difficult. Adsorption may be a way of controlling the soluble metal concentrations in treatment systems. A mixture of fly ash and wollastonite (1:1) was used in place of a single adsorbent for the removal of Cr(VI) from aqueous solutions. The studies were carried out at various concentrations, retention times, pH and temperatures. Untreated fly ash and wollastonite have been used so that industries should not face any extra expenditure in treating effluents containing Cr(VI). The removal of Cr(VI) increased with time, up to 80 min, after which it became constant. The applicability of the Langmuir isotherm for the present system has been tested and the surface mass transfer coefficient at 30 C and pH 2.0 determined. Maximum removal was accomplished at pH 2.0 and 30 C. Adsorption was first governed by diffusion followed by surface compound formation. The thermodynamic parameters, desorption results, and infrared studies indicated that the surface compounds, formed by interaction of adsorbate ions and different constituents of mixed adsorbent, were stable in nature. (Baker-IVI)
W85-03407

ABOUT THE REMAIN OF CATIONIC SURFACTANTS IN WASTE WATER. REACTION OF CATIONIC SURFACTANTS WITH BENTONITE (UBER DEN VERBLEIB VON KATIONENAKTIVEN TENSIDEN IM ABWASSER. REAKTION VON KATIONENAKTIVEN TENSIDEN MIT BENTONIT),
Hoechst A.G., Frankfurt-am-Main (Germany, F.R.).
G. Wirzing.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 319, No. 3, p 255-266, October, 1984. 12 Fig, 6 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Bentonite, *Surfactants, *Chemical reactions, Adsorption, Cations, Anions.

Anionic and cationic surfactants in waste water are retained by different materials. When anionic and cationic surfactants were simultaneously dissolved, a synergistic effect was observed; considerably larger quantities of both surfactants are adsorbed. The adsorption behavior was studied on bentonite, used as model substance. Bentonite sol is flocculated by a definite concentration of cationic surfactant solution. The suspension volume of the flocculated bentonite sol reaches a maximum in the range of the critical micelle concentration. Pure cationic or anionic surfactants are adsorbed on a corresponding polar surface in a monolayer. Cationic and anionic surfactants simultaneously in solution form association complexes, which are adsorbed in multi-layers. Desorption of the adsorbed cationic surfactant on bentonite is practically impossible. (Author's abstract)
W85-03413

EFFECT OF TEMPERATURE ON THE SORPTION OF LEAD AND CADMIUM BY ION EXCHANGE,
Zagreb Univ. (Yugoslavia). Dept. of Analytical Chemistry.
S. Cerjan-Stefanovic, M. Blanusa, and M. Kastelan-Macan.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 319, No. 3, p 304-305, October, 1984. 1 Fig, 9 Ref.

Descriptors: *Wastewater treatment, *Water treatment, *Lead, *Cadmium, *Ion exchange, Heavy metals, Temperature effects, Sorption.

Simple exchange effects were studied in the temperature range of 293 to 333 K to establish the effect of temperature on the binding of lead(II) and cadmium(II) from waters contaminated with these heavy metals. The parameters of metal-ion exchange were studied in order to anticipate the possibility of technological cleaning of natural or wastewaters. Binding efficiency was dependent on temperature, which may explain some problems encountered in the separation of toxic metals from natural waters. The temperature of the medium during binding must always be taken into consideration. (Baker-IVI)
W85-03415

MICROBIAL REMOVAL OF WASTEWATER ORGANIC COMPOUNDS AS A FUNCTION OF INPUT CONCENTRATION IN SOIL COLUMNS,

LIBRARY U. OF I. URBANA-CHAMPAIGN

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
S. R. Hutchins, M. B. Tomson, J. T. Wilson, and C. H. Ward.
Applied and Environmental Microbiology, Vol. 48, No. 5, p 1039-1045, November, 1984. 7 Fig, 1 Tab, 26 Ref.

Descriptors: *Microbial degradation, *Organic compounds, *Soil columns, Extraction, Gas chromatography, Mass spectrometry, Phenylphenol, Methylthiobenzothiazole, Dichlorobenzene, Benzophenone, Methylnaphthalene, Tetramethylbutylphenol, Wastewater treatment.

The fate of six organic compounds during rapid infiltration of primary wastewater through soil columns was studied. Feed solutions were prepared which contained all six compounds in individual concentrations ranging from 1 to 1,000 micro g/liter and were applied to separate soil columns on a flooding-drying schedule. Feed solutions and column effluents were analyzed for the compounds by XAD resin (Rohm and Haas Co.) extraction and gas chromatography-mass spectrometry during each of three successive inundation cycles. Breakthrough profiles of o-phenylphenol were relatively consistent during the test, with fractional breakthrough (mass output/mass input) being independent of input concentration. Consistent profiles were also observed for 2-(methylthio)benzothiazole, although fractional breakthroughs were higher at lower input concentrations, indicating that removal processes were operating less efficiently at these levels. The behavior of p-dichlorobenzene was similar to that of 2-(methylthio)benzothiazole after the first inundation cycle, with the exception that increased fractional breakthroughs were observed at the highest input concentration as well. Microbial adaptation was evident for benzophenone, 2-methylnaphthalene, and p-(1,1,3,3-tetramethylbutyl)phenol, as indicated by increased removal efficiencies during successive inundation cycles, especially at the higher input concentrations. Column effluent concentrations of the latter two compounds were independent of input concentrations during the final stage of the test. Microbial activity and adaptation were confirmed for several of the compounds by using isotopes and measuring the extent of mineralization in batch tests with soil from one of the columns. The data demonstrate that microbial activity is important in the removal of several trace organic compounds during rapid infiltration of wastewater and that this removal is generally enhanced by the presence of adapted microflora. (Author's abstract)
W85-03434

ANAEROBIC INHIBITION OF TRACE ORGANIC COMPOUND REMOVAL DURING RAPID INFILTRATION OF WASTEWATER,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
S. R. Hutchins, M. B. Tomson, J. T. Wilson, and C. H. Ward.
Applied and Environmental Microbiology, Vol. 48, No. 5, p 1046-1048, November, 1984. 5 Fig, 13 Ref.

Descriptors: *Organic compounds, *Anaerobic conditions, *Wastewater treatment, Aerobic conditions, Soil columns, Microbial degradation.

When soil columns were operated aerobically on a flooding-drying schedule in a previous study, good removals were observed for several organic compounds at concentrations ranging from 1 to 1,000 micro g per liter in primary wastewater. In this study, fractional breakthroughs of most compounds increased substantially once operating parameters were modified and the soil became anaerobic. These results imply that microbial removal of trace organic compounds can be inhibited if anaerobic conditions develop during rapid infiltration of wastewater. (Author's abstract)
W85-03435

FURTHER TASKS FOR THE INTENSIFICATION OF WASTEWATER AND SLUDGE TREATMENT (DIE WEITEREN AUFGABEN ZUR INTENSIVIERUNG DER ABWASSWER- UND SCHLAMMBEHANDLUNG),
Ministerium fuer Umweltschutz and Wasserwirtschaft, Berlin (German D.R.).
P. J. Weigl.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 5, p 99-102, July, 1984. 1 Fig.

Descriptors: *Wastewater treatment, *Sludge treatment, *Germany (Democratic Republic), *Berlin, Biological wastewater treatment, Phosphorus removal, Water conservation, Automation, Wastewater treatment facilities.

The goals of the government of the German Democratic Republic to reduce the amount of wastewater in natural waters has been partially realized with a decrease of 1.2 million population equivalents by 1982. Currently, 950 wastewater-treatment facilities handle 4.3 million cu m wastewater/day, of which 2.04 million cu m is treated mechanically and 2.26 million cu m biologically. Further intensification of treatment at existing facilities is needed due to rising water demand and increases in wastewater requiring treatment. Concrete goals for the present and coming five-year-plan time period include the following: for facilities in Berlin, completion of the technology for chemical phosphorus elimination in mechanical sludge dewatering, a procedure for biological phosphorus elimination, concluding research and development for absorption heat pumps, and increasing the agricultural application of wastewater and the use of gas produced in biological treatment; for other specified facilities, enzymatic sludge stabilization, 100% performance increase of mechanical plants through the introduction of high-load biological treatment using the adsorption activated sludge procedure, and energy-use reduction through automatic regulation of oxygen application. Other requirements for reducing wastewater load include increased use of water-conserving industrial and agricultural methods with few waste products, regional planning, and automation of treatment facilities. (Gish-IVI)
W85-03458

PROBLEMS IN WASTEWATER SLUDGE TREATMENT - PRACTICAL EXPERIENCE IN SEWAGE-SLUDGE THICKENING (PROBLEME DER ABWASSERSCHLAMMBEHANDLUNG BETRIEBSERFAHRUNGEN MIT DER EINDICKUNG VON FRISCHSCHLAMM),
VEB Wasserversorgung und Abwasserbehandlung, Berlin (German D.R.).
G. Ostermann.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 5, p 102-104, July, 1984. 2 Fig.

Descriptors *Sludge treatment, *Sludge thickening, *Germany (Democratic Republic), Dewatering, Sludge drying, Wastewater treatment facilities, Costs, Sludge digestion, Energy costs.

Increasing volumes of sludge in wastewater treatment in the German Democratic Republic have resulted in procedural and financial problems: although sludge comprises only about 1% of wastewater, investment and operating costs for its treatment are 30-50% of total costs for most facilities, while inadequate capacity and performance for digestion and dewatering have destabilized the treatment process. A 10-million-Mark experimental facility has been set up to study new methods of sludge treatment for large facilities. Four 1,200-cu-m circular sludge thickeners with rotating bar agitators have been in use since winter 1981-1982, the first application in municipal sewage treatment in the country. The thickeners have a diameter of 16 m; the agitating component consists of 3.5-m-long tubular bars spaced 30 cm apart and centrally driven at low speed. Design capacity is about 1,800 cu m sludge/day. Sludge thickening reduced sludge volume by 30-50% (organic solids content is about 74%); the separated sludge water contained 0.1-0.8% solids and < or = 1,200 mg/l 5-day BOD: digestion water was no longer extracted from the digestion tank, resulting in a reduction of 6 tons/day 5-day BOD for the wastewater-purification stage in 1983; less energy is required to heat sludge before digestion due to the reduced sludge volume; energy expenditure is low at 4 kWh/day for each agitator and 70 kWh/day for sludge-water conveyance; and reduced sludge volume allows a longer stay in the digestion tanks. This last result has allowed cost savings, since without the thickeners (which cost 5 million Marks), three 8,000-cu-m digestion tanks costing 9 million Marks would have had to be installed for a 24-day digestion period. (Gish-IVI)
W85-03459

LATEST RESULTS AT THE DEEP-CURRENT AERATION FACILITY IN ROVNO (USSR) (NEUESTE ERGEBNISSE UBER DIE TIEFSTROMBELUFTUNGSANLAGE IN ROVNO (UDSSR)),
Ukraine Inst. of Water Conservation, Rovno (USSR).
O.-P. Sinjew, and V. Hettler.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 5, p 104-105, July, 1984. 2 Fig.

Descriptors: *Wastewater treatment, *Deep-current aeration, *Rovno, *USSR, Aeration, Activated sludge process, Sludge, Biomass.

Tests were conducted at the experimental deep current aeration facility for wastewater treatment at the Ukrainian Institute of Hydraulic Engineers in Rovno, USSR. The shaft at the facility is 56 m deep and has a diameter of 250 m. A mixing basin replaces preliminary treatment. Because of inadequate separation in the secondary treatment basin, an enclosed flotation chamber was installed. Air was introduced via a compressor. After 4 days, total purification capacity was achieved: activated sludge concentration in the shaft was 6 kg dry matter/cu m; 95 and 85% removal of 5-day BOD and COD, respectively, was achieved; but the oxygen concentration of 6-8 g/l in the deaerator was uneconomical. Volume load was 3.5-3.8 kg 5-day BOD/cu m/day, and the sludge index was 50-90 l/kg. The facility was rearranged with circulation in the reactor aided by a pump, aeration via Venturi tube, and separation in a vertical-current flotation/settling basin. These changes led to an improvement in performance such that results corresponded to those of the air-lift procedure: activated-sludge concentration was 4-6 kg dry matter/cu m, volume load was 3.5-3.8 kg 5-day BOD/cu m/day, and sludge index was 70-120 l/kg. Excess sludge production was 150-160 g/cu m < 50% that of the usual rate. Circulation volume and air introduction are adjustable when minimum intake pressure and minimum descent velocity remain constant. Separation occurred such that the high biomass concentration in the shaft aeration basin/secondary treatment unit could be maintained; this separation system would also allow activated sludge concentration in the unit in the unit to be increased to > 10 kg/cu m. (Gish-IVI)
W85-03460

PROCEDURES FOR INTENSIVE BIOLOGICAL TREATMENT OF MUNICIPAL WASTEWATER IN THE USSR (VERFAHREN ZUR INTENSIVEN BIOLOGISCHEN REINIGUNG STADTISCHER ABWASSER IN DER UDSSR),
Nauchno-Issledovatel'skii Inst. Kommunalnogo Vodosnabzheniya i Ochiski Vodi, Moscow (USSR).
N. A. Terentjewa.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 5, p 106-107, July, 1984.

Descriptors: *Biological wastewater treatment, *Municipal wastewater, *USSR, Dissolved oxygen, Activated sludge process, Organic matter, Biomass, Flocculation, Flotation, Wastewater treatment.

Methods of intensifying the biological stage at wastewater-treatment facilities in the USSR include those that raise specific degradation speed of organic matter per biomass unit and those that increase biomass. Raising oxygen levels throughout the biological stage can increase degradation speed by about 50% without reducing purification levels. Biomass is increased by raising the concentration of activated sludge; this decreases degrada-

n speed (by 48% with a rise in biomass from 2 to
/l in wastewater with a 5-day BOD of 150 mg/
The use of flocculation in the tertiary-treatment
in improves dry-matter content to more than
3 g/l achieved by the conventional procecure.
ygen level can be increased by a continuous
pply of air at the separation stage to produce
tation; replacement of the supplementary-treat-
nt basin by a flotation facility improves the
rification level. Flotation increases degradation
ed 1.5-fold and lessens the degree of decrease in
gradation speed produced by increasing sludge
ncentration (the decrease would be 25% instead
48% under the above conditions). Full biologi-
purification (BOD < or = 15 mg/l) is
ieved after about 2 hr for municipal wastewater
h a 5-day BOD of 100-400 mg/l at an activated-
dge concentration of 3-8 g/l. Aerobic conditions
also be improved by raising dissolved oxygen
ncentration in the activation basin to 8 mg/l.
ish-IVI)
85-03461

ENDS IN THE INTENSIFICATION OF UDGE MANAGEMENT IN WASTEWATER-EATMENT FACILITIES OF THE CSSR RENDS BEI DER INTENSIVIERUNG DER HLAMMWIRTSCHAFT IN KLARANLAGEN ER CSSR),
zkumny Ustav Vodohspodarsky, Prague
zechoslovakia).
Sedlacek.
asserwirtschaft - Wassertechnik, Vol. 34, No. 5,
08-110, July 1984. 1 Tab, 25 Ref.

escriptors: *Sludge treatment, *Sludge thicken-
, *Czechoslovakia, Dewatering, Sludge drying,
astewater treatment facilities, Composting,
dge conditioning.

rrent trends in the intensification of sludge treat-
nt in Czechoslovakia are described on the basis
a review of domestic and foreign literature and
perience in wastewater-treatment facilities
WTF). Sludge thickening has advantages over
watering and drying in that considerable energy
ings are realized during separation of sludge
ter and further treatment stages are favorably
luenced; in municipal WWTF, thickening could
duce the total volume of raw sludge of 5.83
llion cu m/yr by 1.5 million cu m. Sludge ho-
genization can result in a 20% increase in dewa-
ing capacity and a 30% cost reduction for con-
ioning; intensification of the process is achieved
the use of sludge storage tanks, which most
WTF with enclosed digestion possess. The
xing operation of these tanks has been optimized
seven WWTF by using air-lift pumps (6 200-
n-diameter pumps for a 20-m-diameter tank).
ie foreign and domestic trend in sludge condi-
ning has been toward the use of polymer floccu-
nts. For dewatering, there are 7-8 centrifuges in
eration in municipal WWTF with capacities of
5 cu m/hr for the smaller type and 6-8 cu m/hr
r the larger type. By 1985, 25 imported screen-
lt presses should be installed for dewatering;
veral domestic machines are already operating;
od results with regard to operation and cost
ve been achieved in tests in Prague and Brno. A
cuum filter with separate filtercloth regeneration
being tested in Brno. A further important field is
dge application; here the trend is toward its use
composts rather than direct application. (Gish-
I)
85-03462

LUDGE TREATMENT AT THE ASTEWATER-TREATMENT FACILITY IN HE CITY OF PECS (SCHLAMMBEHAND-UNG IN DER ABWASSERREINIGUNGSAN-AGE DER STADT PECS),
izgazdalkodasi Tudomanyos Kutato Intezet, Bu-
pest (Hungary).
. Buerg.
Vasserwirtschaft - Wassertechnik, Vol. 34, No. 5,
111-112, July, 1984. 1 Fig.

escriptors: *Pecs, *Hungary, *Sludge digestion,
Wastewater treatment facilities, Methane,
Vastewater treatment, Mixing.

The new sludge-digestion facility (start-up end of 1984) at the Pecs, Hungary wastewater-treatment facility conforms to conventional technology except for some details. Digestion time in the heated tank is 15 days at an interior temperature of 33-35 C, and volume load is 3 kg/cu m/day. Digested sludge is then conveyed to an unheated secondary-digestion tank, from which it is removed with an expected 7-8% dry-matter content. The projected pipe connections allow variations in procedure: e.g., if the heated digestion tank is out of order, the secondary tank can take over its function, while the water section of the gas container becomes a secondary-digestion tank. A long hiatus in methane production is thereby avoided, which is important because the methane is used to drive the drying facility, upon which efficient plant operation depends. Other possibilities are control of sludge age and consistency and alteration of solids concentration in the heated tank. During an intensive 12-15-day digestion period, the tank contents are to be circulated 5-6 times/day consisting of 3 different movements of sludge; the mixing system is patented. The digestion tank is heated by two 1.5-million kJ/hr heat exchangers. Dry-matter control is achieved by means of a specially designed shaft connected to the digestion tank; thicker sludge can be moved from the tank bottom to the shaft or thinner sludge from the shaft surface to the tank; sludge can also be returned from the secondary-treatment tank. (Gish-IVI)
W85-03463

ENERGY-SAVING CONTROL OF THE AEROBIC STAGE BY MEANS OF A MICROPROCESSOR (ENERGIESPARENDE STEUERUNG DER AEROBSTUFE DURCH MIKROPROZESSOR),
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
J. Kerese.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 5, p 112-113, July, 1984. 2 Fig.

Descriptors: *Computers, *Automation, *Wastewater treatment facilities, Aerobic conditions, Energy conservation, Data acquisition, Data processing, Pumps, Aerators.

Installation of a VM 990 microprocessor at a small wastewater-treatment facility (capacity 4,000 cu m/day) to control the aerobic stage is described. The goals of automation were to save energy by adapting the pumps and aeration rotors to load; use of the least possible number of processing instruments; and timed data collection, presentation, and processing. Besides the central processing unit, the system includes CRTs (cathode ray tubes) and a console. Data is output hourly in tabular form and includes rate of revolution of the pumps (in rpm), volume of wastewater flowing through the system (cu m/hr), volume of return sludge (cu m/-hr), concentration of dissolved oxygen in the activation basin (mg/l), and electrical energy consumption (kWh). The user is able to call up two displays on the CRT: the first is a technological circuit diagram of the facility showing whether each machine is 'at rest' or 'working,' and indicating automatic operation of the pumps, aeration turbines, and circulating pumps; the second displays current and the previous day's wastewater load as a function of time, oxygen concentrations, and mean hourly pump revolution rate. The automatic system has been in use since the beginning of 1982 and resulted in a 22% energy saving that year. There have been few operational problems. (Gish-IVI)
W85-03464

BIOGAS FROM SMALL FACILITIES (BIOGAS AUS KLEINEN ANLAGEN),
Hochschule fuer Architektur und Bauwesen Weimar (German D.R.).
G. Voigtlander, and C. Fischer.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 5, p 117-119, July, 1984. 21 Fig, 1 Tab, 19 Ref.

Descriptors: *Biogas, *Wastewater treatment facilities, *Germany (Democratic Republic), Energy, Sludge digestion, Costs.

Municipal wastewater-treatment facilities in the German Democratic Republic are capable of generating only 0.03% of the country's energy needs (based on 1981 figures) in the form of biogas; nevertheless this is an important energy source, especially when used to cover the energy requirements of the facility itself or those of a nearby industrial plant. Recent research has concentrated not only on large but also on small facilities. Small, simply-designed facilities for biogas production are common in Asia, with approximately 70,000 operational in India and 7 million in China. Diagrams are presented to illustrate the design of 13 gas-producing sludge-digestion facilities, including plants in the Philippines, USA, East Asia, Czechoslovakia, China, and India. Comparison between open and closed digestion tanks with regard to gas produced and investment costs indicate that research should be directed toward open tanks. The results would be scientifically and economically interesting if gas could be produced with relatively few additional expenses, if suitable uses for small quantities of gas could be found within the wastewater-treatment facility (e.g., conversion into thermal energy to intensify the treatment process), and if relatively inexpensive storage facilities for the gas could be developed. (Gish-IVI)
W85-03466

UTILIZATION OF PIT WATER AT THE JANSCHWALDE SUPER POWER STATION AS A MEANS OF RATIONAL WATER USE (GRUBENWASSEREINSATZ IM GROSSKRAFTWERK JANSCHWALDE ALS MASSNAHME DER RATIONELLEN WASSERVERWENDUNG),
S. Jacksteit, K. Noack, and H. Marx.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 6, p 134-135, August, 1984.

Descriptors: *Mine drainage, *Water reuse, *Janschwalde Power Station, *Germany (Democratic Republic), Coal mines, Cooling water, Thermal powerplants, Cooling water, Desalination, Wastewater treatment, Aquaculture.

The Janschwalde power station (JPS), with a design output of 3,000 MW, is the first brown-coal power station in the German Democratic Republic to have its entire water demand covered by pit water from the neighboring brown-coal mines. Design water demand for JPS is 11,875 cu m/hr, but since water for technological processes is provided by desalting water from the cooling process, actual total water demand for a 3,000-MW output is 10,800 cu m/hr. Since the pit water has a high iron content and low pH, a water-treatment facility was constructed on the perimeter of JPS. This facility fulfills the double function of treating pit water before use at JPS (application of lime, iron sulfate, and chlorine; flocculation and sedimentation; and gravel filtration) and for discharge into the receiving stream. The quality and temperature of the treated pit water provided ideal conditions for trout breeding; a net cage facility was built to produce 30 tons/yr of trout for human consumption. JPS treats all its mechanical wastewater, including storm water, in a sludge-storage basin at the treatment facility. Intraplant recycling and multiple use of facilities have resulted in a reduction in water demand at JPS from 3.0 cu m/sec to 1.8 cu m/sec; no wastewater charges are paid. The desalination water presently discharged into the receiving stream, which is thermally polluted, will in future be used for a carp-breeding facility. (Gish-IVI)
W85-03470

FURTHER DEVELOPMENT OF OIL-SEPARATION TECHNOLOGY (WEITERENTWICKLUNG VON TECHNOLOGIEN BEI DER OLABTRENNUNG),
Institut fuer Energetik, Leipzig (German D.R.).
R. Kinder.
Wasserwirtschaft - Wasertechnik, Vol. 34, No. 6, p 141-144, August, 1984. 7 Fig, 5 Ref.

Descriptors: *Wastewater treatment, *Oily water, Gravity separation, Flocculation, Coalescence, Adsorption, Membrane filtration, Emulsions.

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A system for treating wastewater polluted by oil is presented. A rigid technological procedure will not solve the problem, since treatment depends on the type of oil, its distribution in the watery phase, the quality of the wastewater apart from the oil it contains, and the aims of treatment. A system valid in most cases would comprise a first stage, consisting of gravity separation of coarsely dispersed oil (well-established equipment is available for this); a second stage for the elimination of finely dispersed oil by means of chemical flocculation or coalescence; and a third stage to remove the most finely dispersed oil, for which adsorption, coalescence for non-load-stabilized emulsified oil, or membrane filtration could be used. Emulsions require extensive pretreatment before they can be introduced into this system. According to available information, membrane processes are only occasionally practicable due to high requirements for the dry-matter content of water to be treated and to low current density. The coalescence procedure is particularly important, since it fulfills current requirements in the German Democratic Republic for rational water use. (Gish-IVI)
W85-03473

STUDIES OF THE HYDROBIOLOGY OF A TROPICAL LAKE IN NORTH-WESTERN QUEENSLAND. III. GROWTH, CHEMICAL COMPOSITION AND POTENTIAL FOR HARVESTING OF THE AQUATIC VEGETATION,
For primary bibliographic entry see Field 2H.
W85-03496

OBSERVATIONS ON AND RESULTS OF RATIONAL ENERGY USE AT THE NEUBRANDENBURG WATER AND WASTEWATER TREATMENT FACILITIES (ERFAHRUNGEN UND ERGEBNISSE BEI DER RATIONELLEN ENERGIEANWENDUNG IM VEB WASSERVERSORGUNG UND ABWASSERBEHANDLUNG NEUBRANDENBURG),
VEB Wasserversorgung und Abwasserbehandlung, Neubrandenburg (German D.R.).
M. Schweinberger, and D. Scholer.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 6, p 183-186, June, 1983. 1 Fig, 2 Tab.

Descriptors: *Water treatment facilties, *Neubrandenburg, *Germany (Democratic Republic), Energy conservation, Operating costs.

The Neubrandenburg District in the German Democratic Republic contains 522 waterworks with 1,471 wells, 34 pressure stations, 69 wastewater treatment plants, and 96 pumping stations. Increased water demand and its associated pressure reduction and high-rise construction with its need for increased pumping pressure have led to an increase in electrical energy required in the water supply sector of 101.4% between 1975 and 1982 (0.586-0.594 kWh/cu m); it is hoped to reduce this figure to 0.585 by 1985. Specific energy consumption at the Neubrandenburg wastewater treatment facility rose from 0.147 to 0.291 kWh/cu m (198%) from 1975 to 1982 and is expected to rise to 0.425 kWh/cu m by 1985 due to the start-up of new facilities. Rational energy use policies can only be effective if they are a fixed component of the management process; at Neubrandenburg, responsibility lies with the director and filters down through the chief engineer, territorial managers, and heads of technical departments. The basic document for implementation of a unified policy at the facility is the energy and action plan for rational energy use for the five-year-plan time period and for the current planning year. Within this, the chief energy specialists work out annual instructions for planning energy carrier requirements and for analyzing energy carrier use and ongoing regulation and control. Results of rational energy use at Neubrandenburg at the end of 1982 included a 43 kW saving in electrical energy at the Gnoien waterworks by installing two heat pumps to replace a hot-air blower, two heaters, and a night storage oven, resulting in a total saving in heating the plant of 62.4 MWh and 3,160 Marks/yr; and a profit of 21,000 Marks realized by coordinating transportation between plants to save fuel. (Gish-IVI)
W85-03514

INCREASING THE RATE OF DEGRADATION IN WASTEWATER POND FACILITIES WITH ANAEROBIC PRELIMINARY TREATMENT BASINS (ZUR STEIGERUNG DER ABBAURATE IN ABWASSERTEICHANLAGEN MIT ANAEROBEM VORBECKEN),
Bezirks-Hygieneinstitut, Greifswald (German D.R.).
S. Schwarz.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 6, p 212-213, June, 1983. 4 Fig, 3 Ref.

Descriptors: *Wastewater treatment, *Settling basins, *Greifswald-Ladebow, *Germany (Democratic Republic), Degradation, Biodegradation, Sludge digestion, Anaerobic digestion.

Using the example of the anaerobic preliminary-treatment basin at the Greifswald-Ladebow (G-L) wastewater-treatment pond facility in the German Democratic Republic, a means of increasing biological degradation in the colder months and of raising the degradation rate in overloaded pond systems is described. The basin has an elongated shape and a depth of 2.70 m in the third nearest the inlet and of 2.00 m in the remaining two-thirds. The large basin volume with its retention time of several days allows, (a) the formation of a floating layer of matter so that heat is retained underneath, and (b) settling of most of the fine sludge. Temperatures vary only slighlty under the floating layer, promoting the development of microflora adapted to these conditions; these release nutrients allowing the development of an autotropic population of algae. At G-L, the lowest temperature at which reproduction occurs on sunny days in fall is 15 C; retention time is 2-3 days. Heat retention together with the large basin capacity and relatively dilute wastewater are significant factors in sludge mineralization and also allowed continuous operation of the basin for four years without cleaning it out. Partial biological purification was achieved, thereby raising the degree of degradation in the pond sequence following the preliminary treatment basin. (Gish-IVI)
W85-03522

PHOSPHATE REMOVAL IN ACIDIFIED AND LIMED LAKE WATER,
O. Broberg.
Water Research, Vol. 18, No. 10, p 1273-1278, 1984. 2 Fig, 5 Tab, 20 Ref.

Descriptors: *Phosphorus removal, *Aluminum, *Liming, *Lake Gardsjon, *Sweden, Acid lakes, Fish populations, Seston, Iron, Precipitates, Phosphates.

Competition between biotic uptake of phosphorus and different abiotic precipitation reactions for the removal of phosphorus from solution were studied. Biotic and abiotic removal of phosphate from lake water from the acidified Lake Gardsjon (Sweden) as well as immediate changes in these processes upon liming were examined. In the original lake water (pH 4.7) biotic uptake largely dominated phosphate removal and abiotic precipitation was of minor importance. The results changed in the limed series (pH 7.2). Abiotic precipitation dominated the phosphate removal and biotic uptake was strongly reduced. Ca, Mn, Fe, and Al were present, but only Fe and Al occurred in the particulate material. The coprecipitation of phosphate and iron was probably due to adsorption on iron hydroxide at both pH values. The nature of phosphorus-aluminum precipitates is largely unknown but different possible complxes are discussed as well as the relative importance of iron and aluminum precipitates. The seston community has a high capacity for phosphate assimilation, which implies that it is possible to restore or improve planktonic primary production in acidified lakes by phosphate fertilization. For applied purposes this study indicates that phosphorus fertilization in order to raise phytoplankton production to support increased fish production could not be recommended in this type of water since abiotic precipitation and a reduced phosphate assimilation capability immediately after a liming will heavily reduce the fertilization effect. Precipitation of aluminum and iron during suitable conditions will not prevail longer than a few months and by then a new phytoplankton community will have become established. (Baker-IVI)
W85-03544

KINETICS OF CARBON UTILIZATION IN TREATMENT OF LEACHATE,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
D. S. Mavinic.
Water Research, Vol. 18, No. 10, p 1279-1284, 1984. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Leachate, *Carbon, Landfills, Aerobic conditions, Kinetics, Waste disposal.

Kinetic parameters describing carbon utilization from landfill leachates, under aerobic biotreatment, and similar operating conditions, are quantified. The quantification is based primarily on a number of leachate treatment studies. Kinetic parameters associated with domestic sewage are compared. The effects of different operating temperatures on individual coefficients are also presented. An example is given of the graphical procedure used to derive the four basin kinetic parameters from aerobic treatment of a high strength, municipal leachate at 9 C. Using the kinetic values obtained, minimum cell residence times were computed and incorporated into a brief discussion on process design and possible implications for full-scale treatment of such leachates. (Baker-IVI)
W85-03545

INFLUENCE OF PHOSPHONATES UPON PHOSPHATE ELIMINATION. 1. COMMUNICATION: 1-HYDROXYETHANE-1,1-DIPHOSPHONIC ACID (HEDP) (DER EINFLUSS VON PHOSPHONATEN AUF DIE PHOSPHATELIMINATION 1. TEIL: 1-HYDROXYETHAN-1,1-DIPHOSPHONSAURE (HEDP)),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
B. Horstmann, and A. Grohmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, No. 5, p 177-181, October, 1984. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Phosphonates, *Phosphates, *Wastewater treatment, Flocculation, Filtration, Chemical precipitation, Gravel filtration, Dispersants.

Phosphonates are increasingly used for water treatment and as ingredients of detergents and cleansing agents. For this reason, phosphonates have been studied in laboratory scale flocculation and filtration plants as to their influence upon, and potential for elimination by, advanced effluent treatment. The phosphonate, HEDP, may principally be removed from water by flocculation and filtration. However, a considerable adverse influence upon flocculation and filtration became evident which could be compensated for only by an additional dosage of precipitants. The resulting particulate precipitation products were stabilized by the dispersant action of HEDP and could not be retained in a gravel filter. The interference with flocculation was exactly within the beta range to be attained for phosphate elimination (beta = molar Me(3+)/total P ratio). The present state of effluent treatment does not warrant a complete elimination of HEDP. (Author's abstract)
W85-03590

STRIPPING TEST FOR ESTIMATION OF THE REMOVAL OF ORGANIC SUBSTANCES BY AERATION (STRIPBARKEITSTEST ZUR ABSCHATZUNG DER ENTFERNBARKEIT ORGANISCHER SUBSTANZEN AUS DEM WASSER DURCH BELUFTEN),
ESWE-Inst. fuer Wasserforschung und Wassertechnologie G.m.b.H., Weisbaden (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W85-03593

FFECTIVE MANGANESE REMOVAL USING IME AS AN ADDITIVE,
uburn Univ., AL. Dept. of Civil Engineering.
R. Jenkins, L. Benefield, M. J. Keal, and R. S. eacock.
ournal of the American Water Works Associa-on, Vol. 76, No. 9, p 82-86, September, 1984. 11 g, 9 Ref.

escriptors: *Water treatment, *Manganese, ime, Calcium, Alum, Costs, Flocculation, Co-ulation, Sand filtration.

he possibility that supplemental Ca(2+) would hance the removal of manganese from natural aters was examined and the economic benefits of eating water in this manner was determined. The plication of an oxidant and alum is effective in moving manganese by sand filtration. The alum sage can be substantially reduced, however, by e application of lime, with no effect on manga-se removal. Turbidity removals for alum-calci-n treatment and for alum treatment alone were nilar. On the basis of current chemical costs, um-calcium supplementation can result in a sav-gs of roughly $16/mil gal treated, or approxi-ately 47%. Both chemicals are commonly used in ater treatment and are readily available. If proper ed equipment is currently in use, such supple-entation would incur no capital cost. Because of e flocculation properties of the particles formed the manganese-calcium reactions, the use of lcium as a substitute coagulant in manganese-earing waters should be further studied. (Baker-VI)
W85-03619

OUR-TANK RECIRCULATION SYSTEM ITH A HYDROCYCLONE PREFILTER AND SINGLE WATER RECONDITIONING UNIT,
epartment of Fisheries and Oceans, Winnipeg Manitoba). Freshwater Inst.
. R. Scott, and L. Allard.
rogressive Fish Culturist, Vol. 46, No. 4, p 254-61, October, 1984. 7 Fig, 1 Tab, 19 Ref.

escriptors: *Fish farming, *Filters, *Hydrocy-one filters, *Water treatment, Particulate matter, quaculture, Trout, Hydrogen ion concentration, ltraviolet radiation, Chlorine, Ammonium, Ni-ate, Water temperature, Dissolved oxygen, hloramine.

a four-tank recirculation system serviced by a ngle biological filter, hydrocyclone prefilters re-oved over 87% of the particulate matter greater an 77 micro m (0.003 in.) in diameter. Biological trification occurred on a substrate of 25 mm (1) diameter, Actifil polypropylene biorings con-ined in a 0.29 cu m (10 cu ft) fiberglass tank. The ur 0.9 cu m (32 cu ft) tanks were stocked with 200 rainbow trout (Salmo gairdneri), averaging 5.9 g (0.148 lb) each. Fish were thinned every 2 eeks to maintain approximately constant density. uring the first 62 days of the 248-day test when e filter was being conditioned, the fish had essen-ally no growth. Over the last 186 days the aver-ge weight increased from 71.4 to 294.1 g (0.157 to 648 lb) resulting in a specific growth rate of 76%/day. Recirculation and makeup water rates ere 130 and 5 L/minute (34 and 1.3 gal/minute), spectively. Chlorinated makeup water was assed through a small ultraviolet irradiator where hlorine was oxidized to chlorine. Ammonium-itrate, nitrate-nitrogen, temperature, dissolved xygen, pH, and total combined free chlorine plus hloramine levels were satisfactory throughout the st. The backwash interval for the biological filter as 3 weeks without any significant increase in ack pressure. (Author's abstract)
W85-03637

ONTROL STRATEGIES FOR BULKING LUDGE,
Vater Research Centre, Stevenage (England).
. J. Tomlinson, and B. Chambers.
Vater Science and Technology, Vol. 16, No. 10/11, Pt. 1, p 15-34, 1984. 5 Fig, 6 Ref.

Descriptors: *Water treatment, *Activated sludge rocess, *Reviews, Dissolved oxygen, Settleability, Bulking, Nutrient balance, Mixing, Anoxic zones.

The activated-sludge process relies on satisfactory performance of oxidation and gravity settlement stages. When the settleability of activated-sludge deteriorates, incomplete separation in the settlement stage can cause high concentrations of suspended solids in the final effluent. The occurrence of poor settleability, known as bulking, is experienced in more than half of the activated-sludge plants in England and Wales. Information on bulking is presented as a logical sequence of control measures which can be used by operators and designers of activated sludge plants to alleviate problems. Specific topics covered include effective use of settlement tanks; applied solids loading; factors affecting sludge settleability such as dissolved oxygen concentration, septicity of sewage, and nutrient balance; effect of aeration tank configuration on sludge settleability including the effects of degree of longitudinal mixing, and the effect of anoxic zones; effect of sludge loading on settleability; chemical treatment to control bulking; and other common operation problems of activated sludge plants including foaming and denitrification in secondary settlement tanks. Recent advances in the understanding of sludge bulking have made it possible to design activated-sludge systems which will produce sludges with good settling characteristics for most of the time. (Baker-IVI)
W85-03640

SUPPRESSION OF ACTINOMYCETE SCUM PRODUCTION - A CASE STUDY AT SENBOKU WASTEWATER TREATMENT PLANT, JAPAN,
Kyoto Univ. (Japan). Dept. of Sanitary Engineering.
M. Hiraoka, and K. Tsumura.
Water Science and Technology, Vol. 16, No. 10/11, p 83-90, 1984. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Senboku, *Japan, *Scum, *Actinomycetes, Bulking, Niocardia, Settling tanks, Activated sludge treatment.

The Senboku wastewater treatment plant had suffered from bulking caused by the Actinomycete, Nocardia amarae. The causes of the actinomycete scum production in this treatment plant and the methods successfully used to suppress the scum production are presented. The Senboku wastewater treatment plant is located in Osaka prefecture of Japan and was designed to treat an average flow of 65,830 cu m/day and was operated since 1970. Actual flow to this plant during this research was about 42,000 cu m/day. Wastewater was comprised of only domestic wastes. Much scum (about 60 cu m/d) was produced in the final settling tank. To decrease the suspended solids which flowed from the primary settling tank into the aeration tank, the removal efficiency of SS in the primary settling tank was increased by the use of the spare settling tanks. Two additional settling tanks were used to cut the peak flow in the daytime. Simultaneously the scum which was generated in the final settling tank was stored in the spare tank to remove the actinomycetes from the activated sludge system. After this, scum generation was not experienced. As a result of these steps, the settling property of the activated sludge was considerably improved. (Baker-IVI)
W85-03641

ENERGY USE CONSIDERATIONS IN THE ACTIVATED SLUDGE PROCESS IN LOS ANGELES, U.S.A.,
Los Angeles Bureau of Sanitation, CA.
W. F. Garber.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 107-117, 1984. 6 Fig, 8 Ref.

Descriptors: *Activated sludge process, *Los Angeles, *California, *Energy consumption, Wastewater treatment, Air diffusers, F/M ratio, Automation.

The City of Los Angeles has four secondary-tertiary treatment plants receiving wastewater flows of 1,590,000, 151,000, 114,000 and 75,000 cu m/d. Operational difficulties with fine bubble air diffuser combined with low energy costs had resulted in the use of 4-5% efficiency diffusers as standard design. Increasing energy costs made revaluation of higher efficiency diffusers necessary. Long term treatment plant tests of ceramic domes, fused silica tubes and jet diffusers indicated that long term 8-10% air diffusion efficiency was possible. Energy savings of the order of 40% could be achieved by such diffuser retrofit. The type of diffuser to use would depend upon ambient air and waste characteristics, tank design and the sizing of existing equipment such as blowers. Data from respirometer studies in operating plants indicated a further 10-30% decrease in energy use could arise from computer control leading to an equalized F/M ratio throughout each day. Further tests of this possibility are planned. (Author's abstract)
W85-03642

COMBINATION OF THE ACTIVATED SLUDGE PROCESS WITH FIXED FILM BIOMASS TO INCREASE THE CAPACITY OF WASTE WATER TREATMENT PLANTS,
Technische Univ. Muenchen, Garching (Germany, F.R.). Inst. of Water Quality Management and Sanitary Engineering.
W. Hegemann.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 119-130, 1984. 8 Fig, 4 Tab, 1 Ref.

Descriptors: *Activated sludge process, *Fixed film biomass, *Wastewater treatment, *Aeration, Biomass, Sedimentation, Flocculation, Clarifiers.

The volume of the activated sludge aeration tank is influenced by f/m ratio and attainable biomass concentration. Increase of biomass results in smaller tank volume. In the case of overloaded plants, restoration may be achieved by increase of biomass instead of construction of further tank volume. Pieces of porous plastic media filled into ordinary compressed air aeration tanks may serve as fixed film biomass support. By this method biomass concentration in the tank may be increased to two or three times normal values. At the same time the sludge volume index of the activated sludge flocs still present in the aeration tank is improved. Better sedimentation and thickening of the activated sludge occurs because smaller quantities of flocs are passed to the final clarifiers. Results of tests with different types of waste water in semi-technical scale pilot plants as well as in existing plants of different sizes are presented. (Author's abstract)
W85-03643

BIOLOGICAL PHOSPHORUS AND NITROGEN REMOVAL VIA THE A/O PROCESS: RECENT EXPERIENCE IN THE UNITED STATES AND UNITED KINGDOM,
Air Products and Chemicals, Inc., Allentown, PA.
S. Hong, D. Krichten, A. Best, and A. Rachwal.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 151-172, 1984. 12 Fig, 10 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Phosphorus removal, *Nitrogen removal, *Biological wastewater treatment, Activated sludge process, Anaerobic conditions, Biological treatment.

A modified activated sludge process, the proprietary A/O process, has been developed which removes phosphorus along with BOD (and if desired, nitrogen) from wastewater using only biological processes. The A/O system employs a short detention time (1 hour or less) anaerobic zone to promote biological phosphorus removal. The initial contact of soluble BOD with recycle sludge under anaerobic conditions stimulates polyphosphate containing microorganisms to generate energy from hydrolysis of polyphosphates in order to actively transport BOD from the bulk liquor to within the biomass. Process options include BOD oxidation, biological phosphorus removal, nitrification and denitrification. Results of several pilot studies and an 11,400 cu m/day demonstration plant operated for 3 years are given. A third generation of activated sludge plants, incorporating biological nitrogen and phosphorus removal, can be made available at both new and existing works

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at considerably lower cost than conventional alternatives. (Collier-IVI)
W85-03644

BIOLOGICAL PHOSPHORUS REMOVAL: STUDY OF THE MAIN PARAMETERS,
D. Malnou, M. Meganck, G. M. Faup, and M. du Rostu.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 173-185, 1984. 8 Fig, 1 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Phosphorus removal, *Biological wastewater treatment, Biological treatment, Bacteria, Acinetobacter, Nitrates.

The biological phosphorus removal phenomenon has been studied in a modified 'Phoredox' type pilot plant. The interpretation of the results obtained was facilitated by batch tests on the sludge. The influence of the duration of anaerobiosis, the presence of nitrates and various organic substances in the anaerobic zone were thus studied successively. The results obtained tend to confirm the hypothesis that biological phosphorus removal is due primarily to the bacterial strain Acinetobacter. Microbiological examination of the sludge has revealed the presence of these bacteria and that of acidogenic bacteria producing volatile fatty acids promoting the growth of Acinetobacter. Pure culture tests have confirmed the possibility of a greater phosphorus storage capability of Acinetobacter. (Author's abstract)
W85-03645

NITRIFICATION AND PHOSPHORUS REMOVAL FROM TRICKLING FILTER EFFLUENTS,
Krouger (I.) A/S, Soeborg (Denmark).
E. Bundgaard, and G. H. Kristensen.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 187-200, 1984. 7 Fig, 5 Tab, 6 Ref.

Descriptors: *Nitrification, *Phosphorus removal, *Wastewater treatment, *Trickling filters, *Herning, *Denmark, Chemical precipitation, Activated sludge process, Ferrous sulfate, Biological oxygen demand, Suspended solids.

Nitrification and simultaneous phosphorus precipitation in a separate activated sludge plant is considered the cheapest alternative for upgrading conventional trickling filter plants. Before upgrading the Herning (Mid Jutland, Denmark) treatment plant (200,000 Population Equivalents) a 12 month pilot plant experiment was performed. During operation of the pilot plant, important parameters were investigated, such as excess sludge production, sludge properties, and influence of the large part of chemical sludge when combining separate nitrification and simultaneous precipitation. It was found that a stable process could be operated with a bypass of 20-25% settled raw wastewater. Due to improvements in the sludge characteristics simultaneous precipitation with ferrous sulfate improved the effluent quality with respect to both phosphorus, BOD and suspended solids. (Author's abstract)
W85-03646

TWO-STEP NITRIFICATION OF AMMONIA-RICH WASTE WATER,
Bayer A.G., Leverkusen (Germany, F.R.).
I. Pascik, and T. Mann.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 215-223, 1984. 5 Fig, 3 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Ammonia, *Nitrification, *Industrial wastes, Nitrogen removal, Biochemical oxygen demand, Oxidation, Aeration.

Pilot plant studies have been carried out for the nitrification of petrochemical refinery waste water containing 700 to 900 mg/l ammonia. The aim was to work out a treatment concept that could be used to build a full scale plant for nitrogen elimination by nitrification and denitrification. The optimal treatment method found was the two-step nitrification method, where the first step (high NH4(+) load) results in a BOD-elimination and a partial nitrification (60 to 85% of the NH4(+) load), and the second step (low NH4(+) load) results in an oxidation of the remaining NH4(+) down to 10-25 mg/l NH4(+). By this process the aeration volume required for the nitrification was reduced by approximately 40%. The full-scale plant designed for the elimination of 8000 kg NH4(+) per day started operation in July 1981. (Author's abstract)
W85-03647

FULL SCALE EXPERIENCE WITH TERTIARY CONTACT FILTRATION,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
M. Boller.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 225-239, 1984. 15 Fig, 3 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Contact filters, *Filtration, *Phosphorus removal, *Switzerland, Filtration, Precipitation, Contact filtration, Suspended solids.

The first full-scale contact filtration plant for advanced phosphorus removal in Switzerland was built in 1979. In a twelve month investigation, the following design and operational aspects were considered: optimal chemical conditions for phosphorus removal, multimedia filter configuration, long-term performance of the total process combination (which included conventional treatment with simultaneous precipitation and contact filtration), and operating variables such as filtration velocity, filter run time and backwash water use. Under optimal conditions, contact filtration provided consistently low phosphorus and suspended solids levels at reasonable cost. (Author's abstract)
W85-03648

USE OF BIOFILTRATION FOR FURTHER WASTEWATER TREATMENT,
Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. Ruffer, and K.-H. Rosenwinkel.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 241-260, 1984. 8 Fig, 5 Tab, 12 Ref.

Descriptors: *Biofilters, *Wastewater treatment, *Mannheim, *Germany (Federal Republic), *Dry bed filters, *Subsurface filters, Biofiltration, Costs, Chemical oxygen demand, Biological oxygen demand, Activated sludge process, Oxygen demand, Aeration, Coagulation, Filtration, Activated carbon, Nitrogen removal.

The wastewater treatment plant of the City of Mannheim, Federal Republic of Germany, was expanded in October 1982 with the addition of a second stage based on dry bed filtration designed for an average wastewater flow of Q sub TW = 8.800 cu m/h and an average BOD5 of 70 mg/l. Five firms conducted experiments from 1980 to 1982 on purification systems for the effluent from the first biological stage. Systems tested were biofiltration in dry and submerged beds and activated two sludge systems. Filter materials used were inert material, activated carbon and Biolite. In one case a pretreatment by coagulation was employed. The influent of submerged filters without coagulation was supplied with technical oxygen because atmospheric oxygen could not meet the O2 demand; submerged filters with coagulation were supplied with atmospheric oxygen. The two sludge process employed a plastic medium (Flocor E) in an aeration tank of up to 40% total bed volume; aeration was achieved with compressed air. The best suspended solids retention results were obtained by coagulate filtration. Only negligible oxidation of nitrogenous compounds was observed during the filtration tests due to the short contact time between the wastewater and filter biomass. The dry bed filtration with Biolite achieved higher total COD elimination rates at increasing influent concentrations. Lowest total costs, including capital and operating costs were encountered for dry bed filtration. (Collier-IVI)
W85-03649

DRY BED FILTRATION AS A SECOND BIOLOGICAL STAGE FOR THE CITY OF MANNHEIM (1,200,000 PE),
Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
C. F. Seyfried.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 261-284, 1984. 12 Fig, 4 Tab, 21 Ref.

Descriptors: *Mannheim, *Germany (Federal Republic), *Wastewater treatment, *Dry bed filtration, *Biological treatment, Chemical oxygen demand, Activated sludge process, Filtration, Biological oxygen demand, Suspended solids, Costs, Aeration.

The large treatment plant (Q sub tr = 14,000 cu m/h) in Mannheim (Federal Republic of Germany) is being expanded using a dry bed filtration system. In the first stage of expansion a filtration system of 32 filters covering a total area of 2,784 sq m is being added to the existing sludge plant. Composite samples (24 h) of the effluent have to meet specifications of 80 mg/l COD and 20 mg/l BOD5. Before the contract was awarded extensive experiments were conducted on the plant grounds in Mannheim and the performance capability of the system was proven (Ruffer, H. and Rosenwinkel, K.-H. (1984) Wat. Sci. Tech., Vol. 16, No. 10/11, Part 1, p 241-260). At filtration rates of around 5 cu m/(sq m x h), the suspended solids in the effluent could be kept under an average of 8-9 mg/l, the COD under 80 mg/l, and the BOD5 under 20 mg/l. The advantage of the system lies in its ability to supply the biologically active filter with atmospheric oxygen, resulting in lower operating costs. This system, like other biologically operative ones, is limited by the short contact time; very high loading peaks show up again moderately in the effluent. (Author's abstract)
W85-03650

EXPERIENCES WITH POLISHING LAGOONS,
Ruhrverband, Essen (Germany, F.R.).
K. R. Imhoff.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 285-292, 1984. 10 Fig, 2 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Polishing lagoons, *Germany (Federal Republic), *Biological waste water treatment, Tertiary wastewater treatment, Wastewater lagoons, Lagoons, Biological oxygen demand, Chemical oxygen demand.

To improve the effluent quality of biological sewage treatment plants and to control algae growth, the addition of a tertiary treatment polishing lagoon with volume sufficient for a several day retention time is recommended. To achieve the required BOD of 20 mg/l and COD of 100 mg/l retention time should be at least one to two days. Studies of the operational results of eleven polishing lagoons in Federal Republic of Germany indicate that several ponds in series give better results than one large pond. On the average, 55% of BOD and 31% of COD are removed. Low loaded systems show smaller removal rates. In most cases the bottom should not be lined since percolation is the best possible tertiary treatment. With time percolation will diminish and eventually stop due to clogging. Sludge accumulation should be measured annually which of course depends on the capacity and efficiency of pretreatment. (Collier-IVI)
W85-03651

RELATIONSHIP BETWEEN SURFACE LOADING, DEPTH AND EFFLUENT SUSPENDED SOLIDS AT A RECTANGULAR, HORIZONTAL PILOT-SCALE SECONDARY CLARIFIER,
Technische Univ., Graz (Austria). Inst. fuer Siedlungs- und Industriewasserwirtschaft, Flussbau.
M. Ditsios.
Water Science and Technology, Vol. 16, No. 10/11, Part 1, p 293-302, 1984. 14 Fig, 1 Tab, 13 Ref.

Descriptors: *Secondary wastewater treatment, *Clarifiers, *Wastewater treatment, *Suspended solids, Activated sludge process, Clarification, Settling tanks.

e activated sludge process requires an adequate id-liquid separation in final clarification. In the se of a high groundwater table, final clarifiers ould be shallow and in the case of a scarcity of ea available, final clarifiers should be deep. In- stigations with a pilot scale activated sludge tem indicated that the depth of the sludge blan- in dry-weather conditions (h sub 2,4) and in t weather conditions (h sub 2,4 RW) both pend on hydraulic surface loading (q sub A), on urn sludge ratio (RV), and settled sludge lume (VSV). A qualitative dependence on dge volume index (ISV) was also observed. The pth of the clearwater zone (h sub 1) should be at st 0.5 m. (Collier-IVI)
85-03652

IPROVING THE PERFORMANCE OF OUSTON'S SOUTHWEST WASTEWATER EATMENT PLANT, U.S.A.,
ouston Dept. of Public Works, TX. Wastewater v.
T. Garrett, J. Ma, W. Yang, G. Hyare, and T. rman.
ater Science and Technology, Vol. 16, No. 10/ Part 1, p 317-329, 1984. 11 Fig, 1 Tab, 8 Ref.

escriptors: *Houston, *Texas, *Wastewater treat- nt, *Computer models, *Aeration, Bulking dge, Sludge, Model studies, Return sludge rate.

1981, the City of Houston's Southwest astewater Treatment Plant (144,000 cu m/d) was periencing occasional afternoon bulking with s of solids to the effluent. The plant employs dge reaeration with about even allocation of ak volume to mixed liquor and return sludge ration. A dynamic model of solids transfer from luent to mixed liquor to settling tank to return dge aeration and wasting was developed for use a desk-top computer. The model predicted that counter-intuitive reduction in the return sludge e would redistribute the solids to less in the xed liquor and more in the sludge reaeration nks, but would also generate a sludge blanket ring the transition period. However, if the ange were made when there would be several w-flow days, then the blanket would stay within e settling tanks. The Thanksgiving Holidays of 81 were chosen for the change in the return dge rate. Low flow occurred as expected and ere was no loss of solids. The effluent suspended lids improved as expected, but the SVI also proved from 172 ml/g to 72 ml/d. The reduc- n in the return sludge flow rate allowed extra draulic capacity for storm flows. The improved ntrol of solids was demonstrated by simulating a rm flow of 4.0 m/h overflow rate by taking ttling tanks out of service with resulting effluent SS or less than 20 mg/L. (Author's abstract)
85-03653

EUTRAL ORGANIC COMPOUNDS IN BIO- OGICALLY TREATED BLEACHED KRAFT ILL EFFLUENTS,
lp and Paper Research Inst. of Canada, Pointe aire (Quebec).
H. Voss.
nvironmental Science and Technology, Vol. 18, o. 12, p 938-946, 1984. 9 Fig, 2 Tab, 24 Ref.

escriptors: *Kraft mills, *Pulp wastes, Pulp and per industry, Organic compounds, Pollutant entification, Gas chromatography, Mass spec- ometry, Effluents.

as chromatography/mass spectrometry was used identify about 40 neutral organic compounds om a survey of biologically treated bleached aft mill effluents sampled from the aerated goon discharge at nine bleached kraft pulp mill es located across Canada. Terpenes, organosul- r compounds, chlorinated dimethyl sulfones, lorinated p-cymen-8-ols, and a group of methyl- bstituted 2-cyclopentenones were among the emical groups found. While the terpene content the various biotreated effluents was quite vari- le, the methyl-substituted 2-cyclopentenones ere observed to be relatively common residual ganics in such effluents. The mean concentration compounds was about 30 micro-g/L with ranges from 4 to 200 micro-g/L. Upon discharge of the treated pump mill effluent to recipient waters and subsequent dilution, the concentrations of the neutral organic compounds identified are expected for the most part to be at the submicro- gram per liter level. (Baker-IVI)
W85-03665

ANAEROBIC REACTORS FOR TREATMENT OF SYNTHETIC WASTEWATER SIMULATING THE ORGANIC COMPOSITION OF SUL- PHITE EVAPORATOR CONDENSATE,
Tampere Univ. of Technology (Finland). Dept. of Civil Engineering.
A. Luonsi, and J. Rintala.
Aqua Fennica, Vol. 14, No. 1, p 87-93, 1984. 7 Fig, 4 Tab, 12 Ref.

Descriptors: *Sulfite evaporator condensate, *An- aerobic digestion, Wastewater treatment, Pulp wastes, Nutrients, Trace elements, Biological wastewater treatment.

A laboratory-scale upflow anaerobic sludge blan- ket (UASB) reactor, random plastic packed anaer- obic filter (RPAF) and anaerobic contact (AC) reactor were used for anaerobic treatment of a synthetic wastewater which simulated the organic composition of sulfite evaporator condensate. A seed mixture of municipal digester sludge and sedi- ment sludge from a sulfite pulp mill discharge area was applied in startup. When starting a UASB reactor or RPAF reactor, it is possible to reach daily loadings of 10 kg COD/cu m in two months with good treatment efficiency. A further increase of the loading is likely to be successful, provided that sufficient amounts of macro and trace nutri- ents are available. A decrease in reactor perform- ance occurred in UASB and RPAF after two months and after four months operation in the AC reactor. In UASB and AC the disturbance was first noticed when formation and washout of bulking sludge occurred. RPAF performance showed no increased washout, which indicates that the solids retention capability of the filter was not adversely affected. In all three reactors the performance in- creased dramatically after adding trace nutrients. (Moore-IVI)
W85-03682

EFFECT OF NITROGEN AND FIBER CON- TENT ON THE DECOMPOSITION OF THE WATERHYACINTH (EICHHORNIA CRAS- SIPES (MART.) SOLMS),
Center for Marine Biotechnology, Fort Pierce, FL.
For primary bibliographic entry see Field 2H.
W85-03696

HUMAN WASTE DISPOSAL AND THE FAECAL POLLUTION OF THE RIVER NIGER DELTA WATERS,
Ife Univ. (Nigeria). Dept. of Microbiology.
T. O. Akinluyi, and O. Odeyemi.
Water International, Vol. 9, No. 1, p 37-41, Spring, 1984. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Water pollution control, *Wastewater treatment, *Domestic wastes, *River Niger Delta, *Nigeria, Potable water, Water supply development, Water management, Feces, Developing countries.

The sources of pollution and, in particular, the fecal pollution, existing in the Niger Delta waters of Nigeria are examined. The source of consuma- ble water in the Niger Delta area studied is a reservoir which contains significant quantities of pathogenic microorganisms mainly because the in- habitants are water locked and are literally forced to dispose of all their refuse into the waterways and to pass their fecal materials directly into water bodies. It is not feasible to construct a central sewage system in the riverine areas because the communities are separated by waterways and man- grove swamps, and the cost would be astronomi- cal. The pail system is presented as a solution to the problem of feces disposal in the riverine areas of the Niger Delta. Toilets whose seats are raised over sewage pails can be built in these riverine communities. The contents of these pails will be carried by specially constructed boats to a sewage treatment plant situated in a central location. Do- mestic wastes and other types of garbage can be collected in public containers and transported by these special garbage boats to the treatment plant. In the treatment plant, tertiary treatment, which includes facilities capable of removing dissolved nutrients before the effluent is released into water is recommended. The provision of potable water in the riverine areas is of extreme importance due to the tendency of the people to use polluted and brackish waters from the waterways for domestic purposes such as bathing, drinking and cooking. A way of providing potable water is to dig wells and pump water from the wells into overhead tanks where it is treated and tested before distribution to consumers. (Baker-IVI)
W85-03703

OXIDATION DITCHES - PRINCIPLES AND INNOVATIONS,
Birmingham Univ. (England). Dept. of Civil Engi- neering.
C. F. Forster, D. Barnes, and D. W. M. Johnstone.
Effluent and Wastewater Treatment Journal, Vol. 24, No. 7, p 258-263, July, 1983. 6 Fig, 5 Tab, 13 Ref.

Descriptors: *Oxidation ditches, *Wastewater treatment, Ditches, Lagoons, Oxidation lagoons, Aerators, Nitrogen.

Oxidation ditch plants have been used to treat both industrial and municipal wastewaters for a wide range of flows and loads. There are many modifi- cations to the original endless channel brush rotor aerator, to the extent that some plants bear little resemblance to the shallow race track configura- tion of conventional ditches. Ditch type plants offer an economic wastewater treatment alterna- tive and particularly for small and medium size plants have considerable merit. The systems are capable of controlling the form and concentration of nitrogen in an effluent; for some ditch systems operation of the plant may be critical to ensure reliability of the nitrogen control. The majority of plants have been designed at a low F/M ratio and hence maintain a high mass of mixed liquor. This confers some process stability but again operational control is required to minimize aeration energy costs. (Baker-IVI)
W85-03721

NOVEL EVALUATION OF ACTIVATED SLUDGE PROCESS IN CHEMICAL PLANT,
Instytut Ksztaltowania Srodowiska, Warsaw (Poland).
A. Golcz.
Effluent and Wastewater Treatment Journal, Vol. 24, No. 7, p 267-269, July, 1983. 4 Fig, 2 Tab, 3 Ref.

Descriptors: *Activated sludge process, *Wastewater treatment, Sludge, Microorganisms, Industrial wastes, Biomass, Biological wastewater treatment, Evaluation.

This new method for a biological evaluation of the activated sludge in the course of the process has been developed over many years of observations made of the biocoenosis growing under different technological conditions. It enables an assessment to be made of the biological values of the activated sludge in terms of two measurable factors: the indicator of quality and the indicator of quantity. The optimum value of the indicator of quality approaches unity. For the indicator of quantity, the optimum value ranges from 20,000 to 45,000 of Peritricha-Sessilia per 1 cu cm of sludge. When the ranges of the two indicators referred to as advanta- geous are exceeded, the biomass will grow rapidly and the removal efficiency will deteriorate. These two indicators will be of much greater utility in determining the optimum technological parameters for the treatment process, when they are supported by microscopic examinations. The new method enables one to make an estimation of the biological value of the activated sludge in the course of the treatment process, allows a determination of the

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optimum values of the activated sludge for the given technological conditions, establishes two measurable biological indicators of quality and indicator of quantity, and determines biological symptoms which indicate undesirable changes occurring in the character of the process. (Baker-IVI)
W85-03723

FLOCCULATION TIME OPTIMIZATION IN DIRECT WATER FILTRATION,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
S. Vigneswaran, S. Notthakun, and N. C. Thanh.
Effluent and Water Treatment Journal, Vol. 24, No. 7, p 270-274, July, 1983. 8 Fig, 1 Tab, 19 Ref. 8 Fig, 1 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Flocculation, *Filtration, Turbidity, Optimization, Pilot studies.

A pilot scale direct filtration study was performed to investigate the technical performance of direct filtration in terms of different independent parameters like coagulation dose, flocculation gradient, and flocculation time and puts forward a rational method of optimizing the flocculation time in direct filtration. The prinicipal units of the scheme included a spiral flocculator and a PVC-column filter. In order to control the particle characteristics, an artifical suspension of kaolin clay was used. The flocculation gradient during the passage of suspension was determined by measuring the headloss across the length of the spiral tube. The effluent after flocculation was allowed to flow through the filter and the filter performance was studied in terms of headloss and filtrate quality. The flocculation gradient caused in the spiral flocculator was shown not to depend on the length of the tube but on the velocity passing through it for the given diameter of the tube. The flocs obtained at a given flocculation condition were uniform in size. The spiral flocculator is thus a convenient and efficient means of controlling the flocculation gradient in a laboratory scale direct filtration study. For a fixed effluent quality, at a given flocculation gradient and alum dose, there is a minimum flocculation time which corresponds to the longest filter run length and is defined as the threshold flocculation time. The determination of this threshold flocculation time from lab-scale direct filtration study, would lead to an optimum solution for direct filtration, both technically and economically. (Baker-IVI)
W85-03724

IRRADIATION IN INDUSTRIAL WASTE TREATMENT,
Technical Univ. of Lodz (Poland). Inst. of Applied Radiation Chemistry.
J. Perkowski, L. Kos, and J. Rouba.
Effluent and Water Treatment Journal, Vol. 24, No. 9, p 331-334, September, 1984. 5 Fig, 4 Tab, 13 Ref.

Descriptors: *Wastewater treatment, *Irradiation, *Surfactants, Chemical oxygen demand, Biochemical oxygen demand, Oxygen demand, Hydrogen ion concentration, Industrial wastewater.

Effluents from many industries contain large amounts of anionic and nonionic surfactants, which impede or inhibit biological wastewater treatment and are toxic to the biocenosis of receiving waters. Studies on surface active agent destruction by irradiation were carried out using aqueous solutions of two substances used in the textile industry, Rokafenol N-6 and Pretepon G-extra. Studies were also carried out on treatment by irradiation of artificially prepared washing baths corresponding to average wash effluents from the textile industry. Co-60 was the source of radiation, and the applied radiation doses ranged from 2 to 110 kGy/s. The treatment by irradiation of some surface active agents (SAA) contained in aqueous solutions and industrial wastes is demonstrated to be both possible and effective. Apart from SAA destruction, gamma radiation reduces other parameters of waste contamination, such as pH, COD, and BOD. The rate and degree of the destruction of SAA and other parameters are considerably higher in oxygenated waste than in nonoxygenated ones. (Baker-IVI)
W85-03726

USE AND PROTECTION OF THE NORTH SEA AND CHANNEL BY ENGLISH WATER AUTHORITIES.
Effluent and Water Treatment Journal, Vol. 24, No. 9, p 335-340, September, 1984. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *North Sea, *English Channel, *Wastewater disposal, *Sludge disposal, *England, *Wales, *Scotland, *Northern Ireland, Wastewater treatment, Land disposal, Water quality control, Decision making, Planning, Ocean dumping.

England and Wales are served by ten water authorities which provide multifunctional services. Water management in Scotland and Northern Ireland are administered by different systems although there is close national cooperation. The water authorities are major effluent dischargers as well as being responsible for pollution control and water quality management. The arguments for and against discharging wastes into the sea are well documented. However, operational experience and studies in England and Wales have shown that the discharge of untreated sewage via properly designed and constructed long sea outfalls is a satisfactory method of sewage disposal. The water authorities use the dispersive and treatment capacity of the North Sea and Channel for the dispersal of about 5-10% of their crude sewage and about 15% of their sewage sludge. If an arbitrary decision is taken to stop the dispersal of sewage sludge in, and the discharge of crude sewage to, the North Sea and Channel it is possible to calculate the cost from data from England and Wales. Any environmental benefits derived from stopping the current practices might be more than offset by environmental losses occasioned by other methods of disposal, such as by increases in addition of sludge to landfill sites occupying space which could be used more wisely for the disposal of more hazardous wastes. (Baker-IVI)
W85-03727

ON-LINE MEASUREMENT OF ORGANIC CARBON IN WASTE WATER,
Montedison Chemical Co., Venice (Italy).
R. Basei.
Hydrocarbon Processing, Vol. 63, No. 10, p 42-44, October, 1984. 4 Fig, 4 Tab, 6 Ref.

Descriptors: *Wastewater analysis, *Chemical oxygen demand, *Biochemical oxygen demand, *Organic carbon, Industrial wastes, Oil industry.

Three on-line and laboratory analytical techniques (biochemical oxygen demand, chemical oxygen demand and total organic carbon) for measurement of organic loading in waste water are evaluated. The effluent used in the study consisted of a mixture of waste waters discharged from various processes: steam cracking, various petrochemical syntheses, polymerization, fiber manufacturing, petrochemical and oil storage, coal processing, utilities and workshops. Control of the organic loading in industrial wastewaters appears to be suitably carried out by TOC measurements. TOC measurement through combustion is a valid technique for laboratory measurements, or with fairly unclean waters. For on-line measurements of waste waters containing salts or corrosive products, the low temperature UV promoted chemical oxidation appears to be the most adequate and reliable technique since it overcomes such problems as corrosion, catalyst poisoning and batchwise sampling, bound to the combustion of salty and waste industrial waters. Once the validity of the method is established, the most critical part of the analytical system in on-line measurements appears to be the sampling system, which must be designed and built with the utmost accuracy. (Baker-IVI)
W85-03745

ANAEROBIC BIOLOGICAL WASTE TREATMENT,
Drexel Univ., Philadelphia, PA.
G. F. Parkin, and R. E. Speece.
Chemical Engineering Progress, Vol. 80, No. 12, p 55-58, December, 1984. 9 Fig, 11 Ref.

Descriptors: *Biological wastewater treatment, *Anaerobic conditions, Bacteria, Nutrients, Sludge disposal, Methane.

Anaerobic biological treatment offers several significant advantages for treating organic-laden wastewaters when compared with the more commonly applied aerobic treatment processes. It is an energy producer rather than an energy consumer. It produces only about 10% as much sludge requiring disposal. It requires only about 10% of the nutrients. It produces a valuable end product, methane. Anaerobic bacteria can recover from exposure to relatively high concentrations of toxicants, can acclimate to relatively high concentrations of these materials, and can biodegrade potentially toxic compounds at relatively high rates. The key is to provide high biomass concentrations and long solids retention times. Immobilized growth systems provide long solids retention times at relatively low hydraulic retention times. Minimizing response to transient toxicity requires biomass retention and rapid elution. Maximizing acclimation potential requires retention and gradual exposure. Maximizing biodegradation potential also requires biomass retention and, perhaps, dilution. An immobilized growth reactor such as an anaerobic filter with operational recycle meets these requirements. If toxic, nonbiodegradable organics are a concern, granular activated carbon could be used as the attachment media. (Baker-IVI)
W85-03763

5E. Ultimate Disposal Of Wastes

DIFFUSION OF NONREACTIVE AND REACTIVE SOLUTES THROUGH FINE-GRAINED BARRIER MATERIALS,
Waterloo Univ. (Ontario). Dept. of Earth Science.
R. W. Gillham, M. J. L. Robin, D. J. Dytynshyn, and H. M. Johnston.
Canadian Geotechnical Journal, Vol. 21, No. 3, p 541-550, August, 1984. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Bentonite, *Water pollution prevention, *Diffusion, *Clay liners, *Path of pollutant, Adsorption, Tortuosity, Retardance.

In many cases where fine-grained geologic materials are used as barriers to the migration of contaminated fluids, the principal mechanism of contaminant transport is molecular diffusion. Thus the effective molecular diffusion coefficient is the parameter of greatest importance when predicting migration rates and contaminant fluxes. Diffusion coefficients were measured for two nonreactive solutes (Cl-36 and H-3) and one reactive solute (Sr-85) in seven mixtures of bentonite and silica sand ranging from 0 to 100% bentonite by weight. Tortuosity factors were calculated from the results of the nonreactive diffusion experiments, and retardation factors for the reactive solute from measured distribution coefficient, bulk density, and porosity values. The results showed the diffusive transport of both the reactive and nonreactive solutes to be consistent with a Fickian diffusion equation. For practical purposes, and at the low values of bulk density used in the experiments, the effective diffusion coefficient of the reactive solute could be calculated with a reasonable degree of certainty from the measured retardation factor and an estimated value of tortuosity. The results showed that because of the interaction between the distribution coefficient, bulk density, and porosity, an increase in clay content beyond about 5-10% did not result in a further reduction of the diffusion coefficient of the reactive solute. (Author's abstract)
W85-03427

IS HAZARDOUS WASTE DISPOSAL IN CLAY VAULTS SAFE,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.

primary bibliographic entry see Field 5G.
5-03617

MPARISON OF THE MUTAGENICITY OF
VAGE SLUDGES,
ois Univ. at Urbana-Champaign. Inst. for Envi-
mental Studies.
K. Hopke, M. J. Plewa, P. L. Stapleton, and D.
Weaver.
vironmental Science and Technology, Vol. 18,
12, p 909-916, 1984. 4 Fig, 9 Tab, 12 Ref.

scriptors: *Sludges, *Mutagenicity, *Chicago,
uget, *Champaign, *Hinsdale, *Kankakee,
dge disposal, Hazards, Genotoxicity.

ere has been increasing interest in land applica-
of sewage sludges as a disposal method, as a
plemental treatment method, and as a means to
rease the organic content of disturbed soils such
strip-mined lands. In order to ascertain how
mmon it is to find substantial mutagenicity in
nicipal sewage sludge, and to determine the
cts of their mutagenicity, samples of five mu-
ipal sewage sludges from the Illinois cities of
ampaign, Chicago, Hinsdale, Kankakee, and
get were subjected to a multiorganism testing
gram. Chicago sludge has been the most exten-
ely tested by using the Salmonella/microsome
erse mutation assay, the micronucleus test in
descantia, the wx locus assay in Zea mays, and
er chromatid exchange induction in human lym-
ocytes. Mutagenic activity has been observed in
sludges from Chicago and Sauget, IL. Sludges
m primarily domestic sewage do not apparently
ntain significant mutagenic activity. Some
dges from municipal sewage treatments like
get are quite genotoxic and their disposal
uld be made with considerable care. (Baker-
I)
85-03662

CTORS IN DESIGN, LOCATION AND IN-
GRITY OF LANDFILLS,
Cartwright.
eat Lakes Waste and Pollution Review Maga-
e, Vol. 1, No. 1, p 20-24, April, 1983. 2 Fig, 3
b, 11 Ref.

escriptors: *Land disposal, *Waste disposal,
lazardous wastes, *Landfills, Regulations,
ners, Trenches, Planning, Waste management,
ater pollution control.

nd disposal of solid wastes has been practiced
r many years. The increasingly strict regulations
ssed in the 1960s and 1970s governing the dis-
arge of pollutants to the air and water placed
w emphasis on land disposal. The environmental
fects of land disposal are difficult to determine
cause the subsurface is complex and unable as
t to be monitored or described completely. Reg-
ations governing the disposal of wastes including
zardous wastes are designed to protect human
ath and ensure the quality of water resources.
ach regulatory agency has different rules, regula-
ons, and guidelines, that categorize wastes and
ndfills according to the type of wastes to be
ceived. In order to promulgate guidelines or
gulations using design criteria, a regulatory
ency must be sufficiently knowledgeable in its
eld to ensure that the particular method or design
ecified is the only appropriate means of achiev-
g the desired result. Specific information is
eeded regarding site size, water balance, trench
vers, and trench liners. Each land disposal site
ust be considered as unique, and the disposal
peration engineered specifically for that site.
Baker-IVI)
V85-03712

SE AND PROTECTION OF THE NORTH SEA
ND CHANNEL BY ENGLISH WATER AU-
HORITIES.
For primary bibliographic entry see Field 5D.
V85-03727

5F. Water Treatment and Quality Alteration

FACTORS OF SIMULTANEOUS CONSUMPTION AND SUPPLY PATTERNS AT LONG DISTANCE DRINKING WATER SUPPLY SYSTEMS (GLEICHZEITIGKEITSFAKTOR UND ABNAHMECHARAKTERISTIKEN BEI FERNWASSERSVERSORGUNGSSYSTEMEN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergutewirtschaft und Abfalltechnik.
E. Leiber.
Wasserwirtschaft, Vol. 74, No. 2, p 66-71, February, 1984. 7 Fig, 2 Tab, 2 Ref.

Descriptors: *Water conveyance, *Water use, *Drinking water, *Germany (Federal Republic), *Stuttgart, *Bad Wurttemberg, Data processing, Optimization.

Long distance water supply systems transport water over great distances to areas of water scarcity, and once there turn it over to the subscriber. The diminution of the individual delivery point is limited through the proper share quotient (l/s) however it is not subject to temporal or quantitative regulation. The characteristics of simultaneous drinking water consumption was studied in long distance water supply systems around Stuttgart and Bad Wurttemberg, Federal Republic of Germany. The applied data processing system is described, the factor of simultaneous supply is defined and first results are given. Information on the simultaneous consumption will be useful in optimizing drinking water system technical and management considerations. (Moore-IVI)
W85-03248

NEW DEVELOPMENTS FOR EMERGENCY WATER SUPPLY UNDER THE LAW ON SAFEGUARDING WATER SUPPLY (NEUE ENTWICKLUNGEN FUR DIE TRINKWASSERNOTVERSORGUNG NACH DEM WASSERSICHERSTELLUNGSGESETZ),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
W. Such.
Wasserwirtschaft, Vol. 74, No. 6, p 311-315, June, 1984. 7 Fig, 6 Ref.

Descriptors: *Emergency water supply, *Germany (Federal Republic), *Wells, Water supply development, Water tanks, Water conveyance, Firefighting, Urban areas.

Precautionary measures for the security of essential drinking water supplies to the population in case of defense, are being provided by the Federal Republic of Germany, coordinated by the Regional Crucial Point Program called Emergency Water Supply from Wells and Wellshafts especially for big cities. Single wells have been established at central points according to regulations of the Federal Ministry of Interior. Emergency wells for drinking water and fire fighting water and transportable folding tanks for emergency water supply have been developed. (Author's abstract)
W85-03270

INSPECTION METHODS FOR WATER TANKS AND RESERVOIRS,
Collins Engineers, Inc., Chicago, IL.
T. J. Collins.
Public Works, Vol. 115, No. 11, p 62-64, November, 1984. 5 Fig.

Descriptors: *Reservoirs, *Storage tanks, *Inspection, Maintenance, Water storage, Corrosion, Cracking, Concrete, Steel, Underwater.

The American Water Works Association standards recommend periodic inspections of water tanks by independent professional engineers, but most storage structure have not been inspected since they were first constructed. The types of distress found in water storage structures are primarily a function of the material type and environmental conditions to which the structure is exposed. The greatest source of deterioration for steel structures is corrosion, basically an electrochemical process in which current flow causes the corrosion. Reinforced concrete structures suffer from cracks occurring in the roof slabs and the portion of the walls near the ground surface. Use of prestressed concrete greatly helps prevent the formation of cracks. Concrete encased steel is still open to deterioration particularly interior features such as ladders, pipes, valves, and screens in all structures. Underwater inspections are necessary but a number of precautions must be taken so that the divers do not contaminate the system. All interior and exterior inspections should be documented for review by municipal personnel using above water and underwater 35 mm cameras. (Baker-IVI)
W85-03277

DISTRIBUTION PROBLEMS IN WATER SUPPLY,
East Worcestershire Waterworks Co., Bromsgrove (England).
L. J. Hughes, A. Hackett, M. D. Bayliffe, R. A. Chisholm, and D. Grunwell.
Water Science, Vol. 8, No. 1062, p 311-316, August, 1984. 5 Fig, 1 Tab, 1 Ref.

Descriptors: *Leakage, *Water distribution, *Worcestershire, *England, Water conveyance, Water demand, Water loss, Monitoring, Automation, Costs.

In 1978, the East Worcestershire Waterworks Company sought the technical and financial support of the Severn-Trent Water Authority and the Water Research Centre to investigate a less complex, low data density, second tier system dedicated to leakage detection. A collaborative effort produced a low cost technology solution to the problem of continuously monitoring a water distribution system for the detection of leakage. The Dial-Line system uses the public subscriber telephone network to allow a master station to communicate with outstations collecting data from leakage zone meters which continuously measure flows into those zones. The system collects data on both daily and minimum night flows in order to detect changes from day and night time flows. The initial results being obtained from the system and the interpretation of those results is discussed, and preliminary conclusions are drawn on both the economic viability of the system for leakage detection and also the degree of resolution of leakage obtained by this method in different sized zones. Now that Dial-Line system has settled into routine operation it appears to be a viable proposition. The installation and running costs on an annual basis for a 20 outstation system is described as less than the cost of obtaining one manual measurement per month for minimum night flow. (Baker-IVI)
W85-03320

AUTOMATION FOR INDUSTRIAL WATER TREATMENT,
R. M. Corti.
Water Service, Vol. 88, No. 1068, p 343-345, August, 1984. 4 Fig.

Descriptors: *Water treatment, *Automation, Water treatment facilities, Hydraulic equipment, Design criteria.

In automating multistage water treatment plants it must first be established whether the overall operation is based on supply control philosophy (SCP) or demand control philosophy (DCP). In SCP, a predetermined flow of water is delivered to the plant inlet at an average rate calculated to cover internal plant water losses. In DCP, the input to each stage must respond instantaneously to downstream changes in treated water demand. It is not possible to make the inlet flow control respond directly to variations in final treated water demand, owing to the internal losses, which lead to uncontrolled flow hunting within the system and rapid fluctuations in levels. Control of individual unit operations is discussed along with sequence controllers. Benefits of using PLC include the use of deferred design, substantial reduction in complex control panel wiring, flexibility within the

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system is increased, and peripheral equipment linked to the PLC is helpful. (Baker-IVI)
W85-03321

MEASURING DIFFERENTIAL PRESSURE ACCURATELY IN WATER DISTRIBUTION SYSTEMS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. Walski.
Water Engineering and Management, Vol. 131, No. 11, p 28-30, October, 1984. 4 Fig.

Descriptors: *Pitot tubes, *Water distribution, *Pressure-measuring instruments, Pressure, Measuring instruments, Flow, Water conveyance, Manometers, Transducers.

Water utility engineers occasionally have a need to measure flows in pipes in their water distribution system for such purposes as large meter calibration, water audits, and head loss tests. Most of the time the engineer must use a portable device for such measurements. Among the devices that can be inserted into a pipe, the pitot tube is the least costly and most accurate. Several types of devices can be connected to pitot tubes for determining differential pressure. These range from manometers to bellows-type differential pressure gauges. Distinct characteristics of differential pressure measuring devices which can be examined for purposes of evaluating them include accuracy and range, durability, overpressure, safety, power requirement, type of output, cost, size and weight, and simplicity. In general, transducers are the best choice for permanent installations where power is available, a recorder is used and the unit is housed. (Baker-IVI)
W85-03322

INNOVATIVE PROCESS FOR TREATING RECYCLED COOLING WATER,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W85-03334

MICRODETERMINATION OF SILICIC ACID IN WATER BY GEL-PHASE COLORIMETRY WITH MOLYBDENUM BLUE,
Kyushu Univ., Fukuoka (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W85-03340

EFFECT OF TEMPERATURE ON THE SORPTION OF LEAD AND CADMIUM BY ION EXCHANGE,
Zagreb Univ. (Yugoslavia). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5D.
W85-03415

APPLICATION OF A BASIC HYDRAULIC PRINCIPLE FOR THE WATER DISTRIBUTION IN THE NEW WATER WORKS EGAU OF THE LANDESWASSERVERSORGUNG (ANWENDUNG EINES ALTEN HYDRAULISCHEN PRINZIPS DER WASSERVERTEILUNG IM NEUEN EGAU-WASSERWERK DER LANDESWASSERVERSORGUNG),
Technischer Geschaftsfuhrer des Zweckverbandes Landeswasserversorgung, Stuttgart (Germany, F.R.).
D. Flinspach.
Wasserwirtschaft, Vol 74, No. 10, p 467-468 and 471-473, October, 1984. 5 Fig, 3 Ref.

Descriptors: *Egau waterworks, *Landeswasserversorgung, *Germany (Federal Republic), *Water treatment plants, *Water distribution, Groundwater pollution, Karst, Environmental protection.

North of Heidenheim approximately 15 km of the Ulm-Wurzburg motorway will pass through the highly karstic region, a zone of protection, of the Egau waterworks, belonging to the regional water authority, creating a risk of ground water contamination. To counter this danger, two completely independent principles for protection are to be used. Firstly, measures will be taken on the motorway itself to conserve water. Secondly, a new treatment plant has been installed at the Egau waterworks, which will enable the drinking water supply to be maintained even if the untreated water is contaminated. The main subject of discussion is the description of the new treatment plant, which is to be opened in October 1984. The function of the central distribution channel in the new treatment plant, where an old hydraulic principle is to be renewed, is dealt with in detail. (Author's abstract)
W85-03446

OBSERVATIONS ON AND RESULTS OF RATIONAL ENERGY USE AT THE NEUBRANDENBURG WATER AND WASTEWATER TREATMENT FACILITIES (ERFAHRUNGEN UND ERGEBNISSE BEI DER RATIONELLEN ENERGIEANWENDUNG IM VEB WASSERVERSORGUNG UND ABWASSERBEHANDLUNG NEUBRANDENBURG),
VEB Wasserversorgung und Abwasserbehandlung, Neubrandenburg (German D.R.).
For primary bibliographic entry see Field 5D.
W85-03514

STUDIES ON THE TECHNOLOGY OF UNDERGROUND WATER TREATMENT (UNTERSUCHUNGEN ZU DEN TECHNOLOGIEN DER AUFBEREITUNG VON WASSER IM UNTERGRUND),
Forschungszentrum Wassertechnik, Dresden (German D.R.).
D. Eichhorn.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 8, p 277-279, August, 1983. 4 Fig.

Descriptors: *Water treatment, *Underground water treatment, *Geohydrology, *Germany (Democratic Republic), Geologic fissures, Cations, Iron, Manganese, Oxidation, Protolysis, Coagulation.

The pleistocene porous rock in the German Democratic Republic possesses an ion-exchange capacity that can be utilized for underground water treatment by introducing treated water, by infiltration, into the conductor. The cation coating on the solid framework of the conductor is thereby changed such that later passage of water to be treated (natural groundwater or infiltrate) will produce cation elimination: e.g., the introduction of oxygenated water will remove iron. Infiltration of oxygenated water is achieved internally (into the producing well during breaks in production) or externally (through satellite wells). Oxygenation occurs through the introduction of air or pure oxygen. Field studies of introducing air through gravity pipes in the well and of pure oxygen under pressure proved successful. Column studies in the laboratory revealed important information on the speed of oxidization of iron absorbed into the soil as well as the associated protolysis and coagulation processes. Fissure model studies provided information on infiltration. Field studies concentrated either on internal or on external infiltration. They showed that activation of the groundwater conductor is a long-term process that significantly influences the effectiveness of the total procedure. Extensive preliminary studies to assess site suitability are necessary. On a suitable site, iron and manganese removal by this procedure is both technically and economically advantageous. (Gish-IVI)
W85-03526

STUDIES ON IRON AND MANGANESE REMOVAL IN A GROUNDWATER CONDUCTOR (UNTERSUCHUNGEN ZUR ENTEISENUNG UND ENTMANGANUNG IM GRUNDWASSERLEITER),
VEB Projektierung Wasserwirtschaft, Erfurt (German D.R.).
U. Hartmann, and H. Wingrich.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 8, p 280-285, August, 1983. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Water treatment, *Geohydrology, *Iron, *Manganese, Groundwater management, Groundwater pollution, Chemical precipitation, Germany (Democratic Republic), Harnekop, Gross Gliencke, Massnitz.

Dissolved iron as Fe(2+) in groundwater can cause bacterial growth at vertical filter wells, thereby reducing their effectiveness. Laboratory filter studies have shown that Fe(2+) can be bound to the solid framework of the groundwater conductor by an ion-exchange reaction. The introduction of oxygenated water oxidizes the Fe(2+), which is then precipitated; manganese is also thus precipitated. Oxidation of the iron and manganese must not occur near the well filter, since oxygen promotes bacterial growth, but must be carried out in the groundwater conductor. This is achieved through the infiltration of oxygenated water either directly into the producing well (internal infiltration) or via at least four satellite wells (external infiltration) or by a combination of the two procedures. Field studies were performed at Harnekop, Gross Glienicke, and Massnitz in the German Democratic Republic; combined infiltration was used at the first two locations and internal infiltration at the third. In all cases, iron and manganese were removed to within government standards. The procedure is suited in hydrogeological terms to fine- and medium-grain sand. A 90% removal rate can be expected for lightly organically polluted water. The procedure is not suited to water with heavy organic pollution. Its advantages include savings in investment and operating costs, the fact that the only necessary procedure is aeration, reduction in bacterial growth, and elimination of rinse water and sludge. Disadvantages are extensive preliminary studies, construction of satellite wells, use of treated water for infiltration in the start-up phase, and the fact that iron and manganese remain in the groundwater conductor. (Gish-IVI)
W85-03527

KINETICS OF IRON OXIDATION DURING GROUNDWATER FILTRATION IN THE GROUNDWATER CONDUCTOR (ZUR KINETIK DER OXYDATION VON EISEN BEI DER FILTRATION VON GRUNDWASSER IM GRUNDWASSERLEITER),
Institutul de Stiinte Biologice, Bucharest (Romania).
W. W. Aleksejew, and G. M. Kommunar
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 9, p 308-312, September, 1983. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Groundwater, *Geohydrology, *Water treatment, *Iron, *Oxidation, Mathematical equations, Oxygen, Carbonate rocks, Rocks, Filtration.

Practical application of the theory of water treatment in the groundwater conductor has been hampered by a lack of principles of calculation and forecasting of iron oxidation (IO) in the conductor; 45 mathematical equations are therefore presented to describe IO kinetics in the conductor. These include equations to calculate the mechanism of homogeneous IO in freshwater and weakly mineralized groundwater of the hydrocarbonate type as well as homogeneous/heterogeneous IO, which occurs under experimental conditions where Fe(2+) oxidation is performed with large amounts of surplus oxygen and a guarantee of its presence in the water. Calculation of the IO process during oxygen-containing groundwater filtration includes a system of differential equations to describe reductions in iron and oxygen concentrations that occur as a result of a series of connected oxidation reactions in the groundwater conductor. However, this nonlinear equation system can only be solved if simplifying assumptions are used. As an alternative, the process can be divided into two stages, each of which is described by a series of equations: in the first, exclusively homogeneous IO occurs; in the second, changes in Fe(2+) and O2 concentration take place entirely by means of the heterogeneous reaction of IO on the surface of the rock that constitutes the groundwater conductor. Finally, iron removal from groundwater with regard to the 'loading' of the rock of the groundwater conductor

h adsorbed oxygen is described. The work le of an underground iron-removal facility con- s of (a) loading the conductor and (b) extracting iron-free water. Both these phases are de- ibed mathematically. (Gish-IVI)
5-03533

INKING WATER SITUATION IN THE FED- AL REPUBLIC OF GERMANY AT THE ME OF THE ACCEPTANCE OF THE E.E.C. INKING WATER DIRECTIVE (DIE TRINK- ASSERSITUATION IN DER BUNDESRE- BLIK DEUTSCHLAND BEI UBERNAHME R EG-RICHTLINIE TRINKWASSER),
beitsgemeinschaft Umweltforschung, Berlin ermany, F.R.).
Darimont.
itschrift fur Wasser und Abwasser Forschung, l. 17, No. 5, p 201-204, October, 1984. 1 Fig, 21 f.

escriptors: *Water quality standards, *Drinking ter, *Germany (Federal Republic), *Interna- nal commissions, Water pollution control.

e E.E.C. Drinking Water Directive is mainly ed on mercantile authority. However, the new ndards are also understood to be a desirable provement in consumer protection at an interna- nal level. Problems with national observance of e limits become evident from a statistical repre- ntation of the drinking water situation in the deral Republic. They won't be solved by a gmatically fixed amendment to the Drinking ater Decree. In the long run only the tying up of e emission related ordinance into an emission ated catalogue of preventative measures can arantee observance of the E.E.C. standards. uthor's abstract)
85-03591

HLORINE RESIDUAL MONITORING IN HE PRESENCE OF N-ORGANIC COM- OUNDS,
CA Corp., Bedford, MA. GCA Technology iv.
M. Ram, and J. P. Malley, Jr.
urnal of the American Water Works Associa- n, Vol. 76, No. 9, p 74-81, September, 1984. 4 g, 8 Tab, 27 Ref. EPA project R809767.

escriptors: *Water quality control, *Disinfection, Residual chlorine, Monitoring, Nitrogen com- ounds, Organic compounds, Bacteria, Chlorine, ater analysis, Escherichia.

-chloroorganic compounds, formed when N-or- nic precursors are chlorinated, react similarly ith analytical reagents used to determine free ailable chlorine (FAC) and may lead to falsely sitive tests for FAC and an overestimation of the esumed level of disinfection. Bacterial kill meas- ements were carried out using apparent FAC siduals of 0.2 or 0.05 mg/L free chlorine as Cl2. isinfection periods of 15 and 5 min were used, spectively, at pH 7 and 25 C. The results indicat- l no decrease in the disinfection levels of Escheri- ia coli in solutions that contained N-organic ompounds compared with control solutions that d not contain such compounds. Eight of the 15 ompounds tested exerted more than 75% of the bserved chlorine demand during the first 15 min f contact, indicating variability in the reaction ates for the chlorination of the N-organic com- ounds. The apparent ratios of FAC to total resid- al chlorine varied considerably. The findings lend upport to the use of monitoring for 0.2 mg free hlorine residual as Cl2/L instead of actual bacteri- logical enumeration. The rate of bacterial disin- ection with 0.05 mg FAC as Cl2/L in a solution f 1 mg thymine/L was virtually identical to that f a control without thymine during a 5 min disin- ection. (Baker-IVI)
W85-03618

VERVIEW OF WATER TREATMENT PRAC- ICES IN THE UNITED STATES,
Camp, Dresser and McKee, Inc., Dallas, TX.
. H. Stacha, and F. W. Pontius.
Journal of the American Water Works Association, Vol. 76, No. 10, p 73-85, October, 1984. 11 Fig, 7 Tab, 54 Ref.

Descriptors: *Water treatment, *Reviews, Drinking water, Water quality control, Disinfectants, Automation, Water reuse, Water pollution.

In the United States, water utilities serve more than 200 million persons; there are more than 220,000 public systems in the states and territories. New developments and advances continue to be made in the quest for obtaining, producing, and maintaining safe, palatable water. The problems encountered in recent years are the concern about water supply contamination by toxic and hazardous chemicals, the development of alternative disinfectants, and the current cost of energy. New developments in water treatment technology to address these concerns are direct filtration, automation of treatment plant process control, and the indirect and direct reuse of wastewaters as water supply sources. Advances in the future will help ensure continued production of safe, palatable water. (Baker-IVI)
W85-03621

SCUBA DIVING: A TOOL FOR MANAGING WATER QUALITY,
Southern California Metropolitan Water District, La Verne.
E. G. Means, A. E. Preston, and M. J. McGuire.
Journal of the American Water Works Association, Vol. 76, No. 10, p 86-92, October, 1984. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Water quality control, *Storage reservoirs, *Scuba diving, *California, Lake Mathews, San Joaquin Reservoir, Garvey Reservoir, Monitoring, Diving, Water quality, Algae, Frogs.

The worth of scuba diving as a means of controlling water quality has been demonstrated in Southern California. The Metropolitan Water District of Southern California has trained and used a group of scuba divers for the past several years to control quality in its storage reservoirs. Persons selected for a diving team must be screened for possible health problems and given the best training available. Safety must be the foremost consideration in any diving program. The diving equipment must be of the highest quality. Photographic records of underwater phenomena are invaluable for documentation and presentation to management. Underwater sampling programs must be designed to take into consideration the unique problems of personnel who are operating in this difficult environment. Metropolitan has developed special equipment to expedite the identification of sample locations and collection of underwater data. Scuba diving in Lake Mathews has enabled Metropolitan to reduce the severity of taste and odor problems caused by attached blue-green algae. Underwater observations were crucial to the design and development of an effective copper sulfate treatment program. Scuba diving is also providing information on the problem of frogs present in the San Joaquin Reservoir as well as the problem of attached nuisance growths in finished water reservoirs. Underwater study at Garvey Reservoir made it possible to discover an alum postprecipitation problem and has consequently resulted in savings in chemical costs owing to the abandonment of an ineffective algae treatment scheme. (Baker-IVI)
W85-03622

CHEMICAL INDICATORS AND SURROGATE PARAMETERS IN WATER TREATMENT,
Stanford Univ., CA. Terman Engineering Center.
P. L. McCarty, and E. M. Aieta.
Journal of the American Water Works Association, Vol. 76, No. 10, p 98-106, October, 1984. 2 Fig, 13 Tab, 13 Ref. EPA grant CS-806736.

Descriptors: *Water treatment, *Water quality control, *Chemical indicators, Monitoring, Total organic carbon, Total oxygen demand, Total dissolved solids, Trihalomethanes, Conductivity, Chloroform, Barium, Copper, Heavy metals.

Producing good quality water from potentially contaminated supplies is made difficult by the high cost of measuring the wide range of chemical, biological, and physical parameters of concern. The collective parameters of total organic carbon (TOC) and electroconductivity (EC) and the individual chemicals barium, copper and chloroform appear to be good surrogate chemicals for monitoring the effectiveness of treatment systems, because they can be measured readily, reliably, and rapidly and are generally present in the waters being treated. Ultraviolet analysis or COD (chemical oxygen demand) may be substituted for TOC measurements, but each has limitations that need to be considered. For the lime treatment process, barium has good potential as a surrogate to provide a conservative estimate of heavy metals removal. For the air-stripping process, chloroform removal rates provide a conservative estimate of removals that are obtainable for a variety of volatile organic compounds. For GAC (granular activated carbon) treatment, both TOC and chloroform removals provide conservative estimates of the effectiveness of the process and the need for regeneration. For reverse osmosis (RO), total dissolved solids and EC are good indicators of process effectiveness for major ions, but not for heavy metals. Copper appears to be a conservative surrogate for removal of heavy metals by RO. Total organic carbon is a good indicator for the effectiveness of RO for total organic halogen (TOX) removal, but its removal efficiency is too high to be useful as a surrogate for many organic compounds. For RO, chloroform is a reasonable surrogate for many potentially hazardous individual organic compounds. Total organic nitrogen, TOX, and total trihalomethane formation potential are useful for indicating the presence of certain important classes of organic compounds. (Baker-IVI)
W85-03623

ACHIEVING BIOLOGICALLY STABLE DRINKING WATER,
Illinois Univ. at Urbana-Champaign.
B. E. Rittmann, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol. 76, No. 10, p 106-114, October, 1984. 6 Fig, 7 Tab, 67 Ref.

Descriptors: *Drinking water, *Water quality control, *Biological treatment, Bacteria, Microorganisms, Filters, Temperature effects, Water treatment, Ammonium, Manganese.

Microbiological theory is combined with European practice to demonstrate how biological processes within a water treatment plant can remove the organic and inorganic substrates that cause or contribute to biological instability. Theory and practice indicate that ammonium and manganese ions and biodegradable organic compounds can be removed by attached-growth processes such as fixed bed, fluidized bed, and rapid sand filters. Low temperatures do not preclude good treatment. A quantitative kinetic model, which accurately describes field results, provides a sound basis for successful design and operation of biological water treatment processes. Following a biological process with conventional processes is recommended to provide multiple barriers against the escape of microorganisms into the finished water. The main biodegradable substances (ammonium and organic material) are oxidized in fixed bed filters, fluidized bed filters, rapid sand filters, and GAC filters. Each process used attached, or biofilm, bacteria that accumulate to give a large solids retention time. The advantages of producing a biologically stable water include elimination of prechlorination and reduced chlorine dosages for postchlorination; reduced cost; reduced formation of trihalomethanes, tastes, and odors through chlorination; reduced regrowth; and reduced colony counts, dissolved oxygen depletion, taste and odor formation, and corrosion caused by slime growths in the distribution system. (Baker-IVI)
W85-03624

DEVELOPMENT OF REVISED PRIMARY DRINKING WATER REGULATIONS,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
J. A. Cotruvo, and C. Vogt.

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Journal of the American Water Works Association, Vol. 76, No. 11, p 34-38, November, 1984. 4 Tab.

Descriptors: *Drinking water, *Standards, *Regulations, Water quality control, Organic compounds, Radionuclides, Disinfectants, Trihalomethanes, Pesticides, Inorganic compounds.

Development of revised regulations will involve a comprehensive reassessment of the interim regulations and an examination of the experience gained from implementation of those regulations. These experiences are described and current considerations being evaluated for incorporation into the revised regulations are highlighted. Development of the regulations will be accomplished in five phases: phase 1 - volatile synthetic organics; phase 2 - synthetic organic chemicals, inorganic chemicals, and microbiological contaminants; phase 3 - radionuclides; phase 4 - disinfectant by-products, including trihalomethanes; and phase 5 - other synthetic organics, pesticides, and inorganics not considered previously. The revised regulations have been directed to address a variety of drinking water quality problems that could occur in public water systems across the US. The basic questions to be defined include the identification of specific contaminants to be regulated, the defining of levels which would be appropriate for the RMCLs and MCLS, and to determine what monitoring and reporting requirements would be appropriate to the needs. (Baker-IVI)
W85-03625

POSTPRECIPITATION IN DISTRIBUTION SYSTEMS,
South Water Filtration Plant, Chicago, IL.
J. J. Costello.
Journal of the American Water Works Association, Vol. 76, No. 11, p 46-49, November, 1984. 4 Fig, 24 Ref.

Descriptors: *Water distribution, *Precipitates, *Pipelines, *Clogging, Aluminum, Manganese, Magnesium, Microorganisms, Polyelectrolytes, Iron, Zinc, Lead, Calcium carbonate.

Precipitation of certain compounds can occur in the distribution system after the water has been treated. This is known as postprecipitation. A description of the causes of postprecipitation is followed by a discussion of the effects of the phenomenon on distribution pipelines. In severe cases, the carrying capacity of mains can be reduced by half or water quality at the tap can be adversely affected, causing customer complaints. Since postprecipitation occurs often, operators should be aware of problems that exist and take preventive action through altering treatment practices. Distribution systems should be sampled periodically to determine if problems are present. Specific types of postprecipitation include: calcium carbonate, iron, zinc and lead, aluminum, magnesium, polyelectrolytes, manganese and microbiological growth. (Baker-IVI)
W85-03627

ESTIMATING MEAN COLIFORM DENSITIES OF WATER DISTRIBUTION SYSTEMS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W85-03628

MUTAGENICITY OF COAL TAR PAINTS USED IN DRINKING WATER DISTRIBUTION SYSTEMS,
Perugia Univ. (Italy). Cattedra di Igiene.
For primary bibliographic entry see Field 8G.
W85-03659

INCREASED CHLOROFORM PRODUCTION FROM MODEL COMPONENTS OF AQUATIC HUMUS AND MIXTURES OF CHLORINE DIOXIDE/CHLORINE,
Minnesota Univ., Minneapolis. Dept. of Chemistry.
S. Lin, R. J. Liukkonen, R. E. Thom, J. G. Bastian, and M. T. Lukasewycz.
Environmental Science and Technology, Vol. 18, No.12, p 932-935, 1984. 2 Fig, 2 Tab, 26 Ref.

Descriptors: *Water treatment, *Chlorine, *Chloroform, *Humic acids, *Chlorine dioxide, Hydroxybenzoic acids, Organic compounds, Chlorination, Resorcinol, Hydroxybenzoic acids.

Oxidants such as chlorine dioxide or chloramine has been suggested as alternatives to chlorine, or to be used in combination with chlorine. If such alternatives are used, the chemical pathways for degradation of the organic components present in the water would also be expected to be altered. Increased levels of chloroform production were noted in some systems when aqueous solutions of chlorine and chlorine dioxide mixtures were added to model aqueous humus conponents. A detailed study of the reaction pathway for 2,4-dihydroxybenzoic acid was performed after it was observed that, under the identical reaction conditions, resorcinol gave the same product distribution. This observation suggested that the chloroform enhancement was due to a chlorine dioxide mediated decarboxylation and subsequent degradation pathway involving a hydroxybenzoquinone that was common both to the 2,4-dihydroxybenzoic acid and to resorcinol. On the basis of differing product distributions, there appears to be no commonality in the pathways for increased chloroform production for the 2,4- and 3,5-dihydroxybenzoic acids. This investigation shows how reaction pathways for organic substrates can be significantly altered in the presence of mixed oxidants. (Baker-IVI)
W85-03664

HUMAN WASTE DISPOSAL AND THE FAECAL POLLUTION OF THE RIVER NIGER DELTA WATERS,
Ife Univ. (Nigeria). Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W85-03703

WATER TREATMENT FOR RURAL AREAS WITH EMPHASIS ON SUDAN,
Khartoum Univ. (Sudan). Faculty of Engineering and Architecture.
I. M. A. Magid.
Water International, Vol. 9, No. 3, p 112-115, September, 1984. 12 Ref.

Descriptors: *Water resources development, *Sudan, *Water treatment, Rural areas, Filtration, Flocculation, Disinfection, Coagulation, Sedimentation, Developing countries.

In view of water scarcity and the prevalence of polluted sources in Sudan, water supply projects need to be encouraged and initiated for socio-economic development and progress of the nation, taking into consideration the need to choose a safe, adequate, convenient, continuous and reliable source. The main resources of water for the Sudan include surface water originating mosly from rainfall, ground water, and harvested rainwater. Water treatment for rural regions involves the transformation of raw water into potable, palatable, and wholesome water using fairly simple techniques implemented at reasonable cost. Construction of purification plants which are sophisticated, and difficult to build, operate and maintain should not be considered. Methods of treatment to be considered include disinfection, sedimentation, coagulation and flocculation, and filtration. (Baker-IVI)
W85-03706

SMALL-SCALE GRAVITY FLOW WATER SYSTEMS IN PHRAE PROVINCE, THAILAND,
Sacramento, CA.
T. Waters.
Water International, Vol. 9, No. 3, p 136-139, September, 1984. 2 Fig, 1 Tab.

Descriptors: *Water distribution, *Gravity flow, *Water treatment, *Thailand, *Phrae Province, Polyvinyl chloride pipes, Pipelines, Sedimentation, Sand filtration, Costs, Rural areas.

Low cost gravity flow water systems are a new technology for mountainous areas where inexpensive PVC pipe is available. Maintenance and assembly of the systems has been demonstrated to be within the capabilities of the rural Thai. The villagers have been able to independently design, finance, and construct systems serving from 10-30 houses. Technical details about the construction, maintenance, and finance of two systems in Ban Nam Jom Village are described. The systems include sedimentation and sand filtration tanks, and also galvanized iron reservoirs. One system, serving 22 houses, was constructed at a cost of US $904.72. (Baker-IVI)
W85-03709

WATER SUPPLY AND LEAD IN EASTERN ENGLAND,
L. A. Greene.
Effluent and Wastewater Treatment Journal, Vol. 24, No. 7, p 264-266, July, 1983. 1 Fig, 13 Ref.

Descriptors: *England, *Lead, *Drinking water, *Water conveyance, *Water quality control, Water treatment, Flushing, Pipes, Heavy metals, Carbon dioxide stripping, Hydrogen ion concentration, Caustic soda, Orthophosphate.

Regional water authorities and the independent water companies in the United Kingdom have been investigating the problems of lead in tap water since 1975. Of the 167 supply areas within the Anglian authority, 40 were identified as areas requiring early and detailed attention on the basis of more than 2.5% of properties within each area exhibiting lead in tap water levels in excess of 0.10 mg/l in random day time samples. Pilot water treatment investigations started in 1978 using caustic soda for pH elevation, following successful laboratory studies. Localized high pH effects at the point of application induced calcium carbonate precipitation with subsequent deposition on the main delivery pump impellers. Improvement was made in the process of carbon dioxide removal, resulting in pH elevation to the range pH 7.6 to pH 8.0. Carbon dioxide stripping with consequential pH elevation reduced lead in tap water levels of 30-40%, and dosing orthophosphate at a low level of 1 mg/l reduced levels by an average of 60%. The alternative to remedial water treatment is pipe replacement. Variability in lead concentrations at the tap as a function of contact time has also been noted. Flushing the system for about a minute is usually adequate to bring the lower lead concentrated water to the outflow. The flushed water should be used for toilet flushing or garden watering rather than allowing it to be wasted. (Baker-IVI)
W85-03722

BEAD CELLULOSE ANION EXCHANGERS FOR ULTRA PURE WATER,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
Z. Matejka.
Effluent and Wastewater Treatment Journal, Vo. 24, No. 7, p 275-277, July, 1983. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Water treatment, *Anion exchangers, Humic acids, Ultra-pure water, Bead cellulose, Sorption, Desorption.

The make-up water for supercritical boilers and rinse water for the electronic industry are examples where only water of the highest purity can be used. Removal of all contaminants (organic matter and inorganic ions) is usually accomplished by traditional pretreatment (involving filtration and clarification) followed by ion exchange. Bead cellulose anion exchangers are able to take up the higher molecular weight portion of the humic acids and to act as a simple and cheap substitute for clarification in the pretreatment of low organically loaded raw water. Equilibrium sorption and desorption tests, comparative dynamic runs with styrene and cellulose resins along with gel-chromatography analysis of the raw and treated water proved the suitability of the bead cellulose resins to act as effective scavengers for the high molecular weight port of the humic acids. This enabled the preparation of ultra pure water without raw water

eatment using traditional clarification. De-
ion of the substances from cellulosic resins
eeds almost quantitatively. Sorption capacity
rd low molecular weight acids is rather poor.
er-IVI)
-03725

ORIDE ANALYSES OF PATIENT WATER PLIES REQUESTED BY NORTH CAROLI-HEALTH PROFESSIONALS,
a Univ., Iowa City. Coll. of Dentistry.
. Levy, J. W. Bawden, B. S. Bowden, and G.
er.
erican Journal of Public Health, Vol. 74, p
-1414, 1984. 2 Tab, 20 Ref.

criptors: *Fluorides, *Water analysis, *North
olina, Public health, Fluoridation, Drinking
er.

ough physicians and dentists in North Caroli-
are encouraged to assay drinking water for
ride content, relatively small numbers in each
vider group are actively sampling water. The
uencies, patterns, and results of 1,900 patient
king water assays for fluoride content request-
n a six-month period by North Carolina health
fessionals were determined. Twelve per cent of
samples warranted adjustment from the full
ge fluoride supplement. Readings greater than
ppm were found throughout North Carolina,
not just in areas known to have naturally
urring elevated concentrations of fluoride. One
cent of the samples had levels exceeding the
A recommended guidelines for maximum con-
inant level. Less than 3% of physicians and 8%
entists submitted samples. Because of the large-
ural nature of North Carolina, many providers
luoridated areas treat many patients from non-
oridated areas; most providers treating young
dren should have occasion to assay water for
oride on behalf of their patients. (Moore-IVI)
5-03748

5. Water Quality Control

-LINE MONITORING DATA REPLACES ALYTICAL DATA,
rth Shore Sanitary District, Gurnee, IL.
. Winter, and D. F. Ogle.
rnal of the Water Pollution Control Federation,
l. 56, No. 11, p 1099-1103, October, 1984. 4 Fig,
ab, 7 Ref.

scriptors: *Quality control, *Monitoring, *Au-
nation, *Wastewater treatment, Suspended
ids, Optimization, Systems analysis, Cost analy-
Computers.

rough the use of a reliable suspended solids
nitoring system, increased plant performance is
ily obtainable. The suspended solids monitoring
tem can also improve cost benefits by decreas-
laboratory workload and freeing plant person-
from the mundane tasks of conventional sam-
ng methods. Further cost benefits in plant labor
uld be achieved by the use of data logging or
mputer monitoring of the suspended solids
tem to completely relieve the plant operating
d laboratory personnel from data handling
ores. The continuous suspended solids monitor-
g system will provide plant personnel with mixed
uor suspended solids data instantaneously and
th more precision than is achievable with con-
ntional suspended solids monitoring. Through
eamlining probe maintenance, downtime is mini-
zed. It also seems possible to automate solids
asting through computer control in conjunction
th the suspended solids system. The on-line auto-
ated system has been successfully operated for
5 years. The next phase of operation would be to
pand system capability by interfacing the on-line
obes with a process control computer and ex-
oring other potential monitoring and control pro-
ams, leading to increased plant automation.
Baker-IVI)
785-03332

EDUCING WATER POLLUTION WITH SUB-URFACE DRAINAGE,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
R. L. Bengtson, C. E. Carter, H. F. Morris, and J. G. Kowalczuk.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 80-83, January/February, 1984. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Subsurface drainage, *Water pollution control, *Louisiana, Drainage, Runoff, Potassium, Phosphorus, Soil erosion, Erosion control.

Annual precipitation in southern Louisiana is usually in excess of 1500 mm which is considerably more than is needed for evapotranspiration. The excess water either inflitrates into the soil causing a rise in the water table which may damage agricultural crops or it may run off from the area taking with it sediments and pollutants. A subsurface drainage-runoff-erosion experiment on clay loam alluvial soil near Baton Rouge, Louisiana, was conducted during 1980, 1981, and 1982. The experiment consisted of four surface drained plots, two of which were also subsurface drained. During the period 1 October 1980 to 30 September 1982, surface runoff was 497 and 352 mm for the surface only and subsurface drained plots, respectively, a 29% reduction due to subsurface drainage. Soil loss was 2177 and 1822 kg/ha for the surface and subsurface drained plots, respectively, a 16% decrease in soil loss due to subsurface drainage. From 1 May 1981 to 30 September 1982, the total potassium loss was 27.1 and 20.5 kg/ha, respectively, for a reduction of 24%. The total phosphorus loss was 3.1 and 2.1 kg/ha, respectively, for a reduction of 32% due to subsurface drainage. Subsurface drainage decreases surface runoff, soil loss, potassium loss, and decreases phosphorus loss. A complete subsurface drainage system on at least certain soil types may be the preferred best management practice for water quality control. (Baker-IVI)
W85-03367

NITROGEN LEACHING DURING SPRINKLER IRRIGATION OF A DUTCH CLAY SOIL,
Stichting voor Bodemkartering, Wageningen (Netherlands).
L. W. Dekker, and J. Bouma.
Agricultural Water Management, Vol. 9, No. 1, p 37-45, June, 1984. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Nitrogen, *Leaching, *Sprinkler irrigation, *Clays, *Netherlands, Short-circuiting, Soil water, Vertical flow, Fertilization, Irrigation practices.

Short-circuiting, which is vertical movement of free water through large continuous pores in an unsaturated soil matrix, was measured in the field in large columns from a cracked Dutch clay soil. The columns had been fertilized with chemical nitrogen fertilizer at a rate of 80 kg N/ha. Sprinkler irrigation (with an average intensity of 18 mm/h and applied quantities varying from 8 mm to 22 mm) resulted in strong nitrogen leaching from the columns. Losses, which averaged 30%, resulted from mass-flow due to short-circuiting. Redox measurements suggested that no denitrification occurred. Application of only 6 mm of water slightly reduced nitrogen losses to approximately 15%. Losses could be reduced to 8% by applying the fertilizer to a wet soil surface which had just been sprinkled, and by sprinkling again the next day. In that way, the fertilizer grains dissolve and nitrogen diffuses into the surface soil, allowing less nitrogen movement along the soil surface towards the vertical cracks during the next sprinkling. (Author's abstract)
W85-03480

MINIMIZING SALT IN DRAIN WATER BY IRRIGATION MANAGEMENT - ARIZONA FIELD STUDIES WITH CITRUS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3F.
W85-03481

MINIMIZING SALT IN DRAIN WATER BY IRRIGATION MANAGEMENT - LEACHING STUDIES WITH ALFALFA,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3F.
W85-03483

INFLUENCE OF THE GEOTHERMAL WATERS ON FISHES AND AQUATIC INVERTEBRATES, IN THE PLAIN OF BANAT (INFLUENTA APELOR GEOTERMALE, DIN CIMPIA BANATULUI, ASUPRA PESTILOR SI NEVERTEBRATELOR ACVATICE),
For primary bibliographic entry see Field 5C.
W85-03532

PHOSPHATE REMOVAL IN ACIDIFIED AND LIMED LAKE WATER,
For primary bibliographic entry see Field 5D.
W85-03544

IS HAZARDOUS WASTE DISPOSAL IN CLAY VAULTS SAFE,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
G. F. Lee, and R. A. Jones.
Journal of the American Water Works Association, Vol. 76, No. 9, p 66-73, September, 1984. 9 Fig, 1 Tab, 20 Ref.

Descriptors: *Waste disposal, *Groundwater protection, *Hazardous wastes, *Water pollution prevention, Leachates, Heavy metals, Groundwater pollution, Clay, Liners, Funding.

The safety and adequacy of clay-lined disposal pits for containing the migration of leachates from hazardous wastes into groundwater systems is discussed. It is suggested that all hazardous wastes be treated prior to disposal to detoxify them to the maximum extent possible. Heavy metal wastes should be segregated and immobilized by fixation before burial in a dry form. Approaches are discussed for establishing criteria for monitoring, maintenance, and remedial cleanup to ensure long term protection of public health and the environment. Several studies have been conducted which found that organics of the type frequently disposed on in pits interact with packed clay, causing the clay to crack. This interaction may explain why some clay-lined containment systems are failing prematurely. The permeability of liner clays and natural strata is generally determined with distilled or tap water rather than with wastes or leachates of the type that would be present at a specific hazardous waste disposal site. Funding of projects to provide disposal sites for hazardous materials is considered. (Baker-IVI)
W85-03617

REMOVING IRON AND MANGANESE FROM GROUNDWATER.
Journal of the American Water Works Association, Vol. 76, No. 11, p 67-92, November, 1984. 2 Fig.

Descriptors: *Groundwater, *Water treatment, *Manganese, *Iron, Seekonk, Massachusetts, Water quality control, Drinking water, Diffusion wells, Aeration, Degassing, In-ground treatment.

Iron and manganese are found in undesirable concentrations in more than one fourth of the municipal wells in the US. A system was installed in Seekonk, Massachusetts to remove these metals from three of its municipal wells. Raw water from one of the wells contained 6.2 mg manganese/L. After treatment, the manganese concentration was below the standard of 0.05 mg/L. The Vyredox method was employed. The method works by improving the condition of soil materials around a well. Every two to three weeks the production well is shut down for one day. Water with oxygen added and undesirable gases removed is recharged into the ground through special diffusion wells that form a treatment radius of 15-30 m. The oxygen-rich water causes precipitation of iron and manganese. After recharge, water with low concentrations of iron and manganese can be pumped until five to ten times more water has been pumped than

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was recharged. The Seekonk project was more complex than most installations of this type. The cost of treating the first well, including the pilot study, aeration-degassing equipment, recharge wells, and hydrogeological evaluations during construction, was $284,000. Compared with above ground filtration, the cost was very low which can be attributed to the modest building space requirements. Subsequent wells are added at lowered costs. Operating costs are modest as there are no chemical requirements and no sludge to dispose of, operator time is limited and the well redevelopment cost is reduced. (Baker-IVI)
W85-03629

FACTORS IN DESIGN, LOCATION AND INTEGRITY OF LANDFILLS,
For primary bibliographic entry see Field 5E.
W85-03712

EPA/RCRA LANDFILL REGULATIONS - A DISCUSSION,
For primary bibliographic entry see Field 6E.
W85-03714

LINERS TO PROTECT WATER RESOURCES,
L. C. Holcomb.
Great Lakes Waste and Pollution Review Magazine, Vol. 1, No. 2, p 24-27, June, 1983. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Liners, *Landfills, *Groundwater pollution, *Water pollution control, Water pollution sources, Waste disposal, Land disposal, Erosion, Leachates, Sunlight, Cracking, Clay.

Recent information on the ability of landfill liners to contain chemicals is reviewed. If one could assume that wastes have very little water content and would have no addition of water during disposal and would have no water seeping into the fill area after it was completed, there would be fewer anticipated problems with contaminated leaching exiting the fill. However, most wastes are wet. There are several methods to prevent mixing of wastes and leachate with groundwater or surface waters. The common method of removal of leachates is to provide an engineered leachate collection system to remove the liquids. Another method is to prevent water and leachate migration into or out of the waste material through the use of physical barriers to prevent the migration. It is probably better to utilize the natural attenuation properties of clay than place compacted clay in an old gravel pit that has only highly permeable natural soils at the site. There are several physical factors that may alone or in combination impact the integrity of a liner: erosion by weathering forces, root penetration of vegetation, channels created by small and large animals, sunlight drying and cracking of clay, natural subsidence may occur as the waste settles thus causing physical cracking of the protective soil barriers, and human development near or over the site may destroy the integrity of the soil barriers. (Baker-IVI)
W85-03715

CLEAN WATER - COUNTING UP THE SCORE,
S. L. Sylvester.
Great Lakes Waste and Pollution Review Magazine, Vol. 1, No. 4, p 7-10, October, 1983. 2 Fig, 1 Tab.

Descriptors: *Water pollution control, *State jurisdiction, Water quality control, Regulations, Permits, Management, Decision making, Funding, Toxicity.

For any state to have an adequate water quality control program the Citizens for a Better Environment (CBE) recommends that they have the following. In-depth training to state staff to do more than just review 2-C permit application forms adequately prior to the permit drafting process. For industries and municipalities with a high potential for the discharge of toxicants, a review of a detailed chemical process evaluation is necessary. Adequate funding levels must exist to provide valid field inspections and to spot check samples to be analyzed for all priority pollutants. A toxicologist must be provided in each state to evaluate chemicals and their toxicity to public health and the environment. Permittees must be required to have distinct control for genotoxic and bioaccumulators in their waste streams. States must have a clearly articulated toxic chemical review process for discharge permit development. Adequate lab facilities must exist with GC/MS capabilities and a qualified chemist to run the analysis. An annual compilation must be made by river basin of all data for ambient water chemistry, sediment and fish tissue analysis. Citizen access should be provided to all information in state files, not identified as confidential, on permittees and on water courses. (Baker-IVI)
W85-03716

BENTONITE LINERS AND CAPS FOR LAGOONS AND LANDFILLS,
G. R. Alther.
Great Lakes Waste and Pollution Review Magazine, Vol. 1, No. 5, p 10-13, December, 1983. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Bentonite, *Liners, *Landfills, *Waste disposal, *Groundwater pollution, Water pollution control, Lagoons, Leachates, Permeability.

Swelling bentonite has gained prominence in waste isolation projects in the last few years. By admixing swelling bentonite with soils of high permeability, the coefficient of permeability can be reduced to a K value of 10 to the minus 9 cm/sec. The bentonite is mixed into 5 to 15 cm of soil. All landfills require a cap once they are filled, to prevent the formation of a bathtub full of water and commensurate generation of excessive leachate. A cap consists of a 10-15 cm layer of soil-bentonite and covered by two or three feet of natural soil, to allow for vegetation. Before a liner is installed, a field and laboratory study should be conducted to determine the grain size distribution, permeability and stability of the soil, as well as its pH and, at times, specific conductance. The addition of bentonite to a permeable soil increases the clay content and plasticity of the native soil. When the bentonite is hydrated with freshwater, it fills the voids within the compacted native soil/bentonite mix if the two materials are thoroughly blended. Basically, two mechanisms contribute to permeability increase of soil/bentonite leached with a contaminated liquid. Soil minerals such as carbonate and sulfates may be soluble in the leachate, which would result in a loss of solids and an increase in consequent pore volume and soil permeability. Pore fluid substitution by a contaminated leachate leads to a smaller double layer of the partially bound water surrounding the hydrated clay platelets, reducing the effective size of the clay particles that clog the pore space between soil grains, and thereby increasing the size of the effective flow channels in the soil skeleton and the permeability. (Baker-IVI)
W85-03717

PROTECT AND MONITOR GROUNDWATER,
Fluor Canada Ltd., Calgary (Alberta).
R. B. Prichard, M. J. Kollmeyer, and H. D. Sharma.
Hydrocarbon Processing, Vol 63, No. 10, p 39-41, October 1984. 4 Fig, 3 Ref.

Descriptors: *Groundwater, *Water pollution prevention, *Chemical industry, *Monitoring, *Prentiss, *Alberta, Wastewater treatment facilities, Groundwater pollution, Chemical industry, Liners, Water quality, Groundwater movement.

One of Canada's most comprehensive groundwater protection and monitoring systems for an hydrocarbon processing industry facility is operational at Union Carbide's ethylene glycol plant, Prentiss, Alberta. Two wastewater storage ponds are equipped with synthetic liners to prevent seepage of contaminated water into local groundwater. Drain systems in sand layers beneath these two ponds intercept any seepage which does occur. Thirteen permanent groundwater monitoring stations have been installed at various points in and around the plant. Each groundwater monitoring station consists of two or three piezometers at different levels in a single borehole. Data from these stations are regularly reviewed by a qualified hydrogeologist to determine if there are any significant changes to groundwater flows or quality attributable to plant facilities or operations. (Moore-IVI)
W85-03744

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

CONSIDERATION OF SCENIC AND ECOLOGICAL ASPECTS DURING CONSTRUCTION OF THE RHINE-MAIN-DANUBE-WATERWAY (LANDSCHAFTSGESTALTERISCHE UND OKOLOGISCHE FRAGEN BEIM BAU DER RHEIN-MAIN-DONAU-WASSERSTRASSE),
Rhein-Main-Donau A.G., Munich (Germany, F.R.).
H. P. Seidel.
Wasserwirtschaft, Vol. 74, No. 3, p 114-117, March, 1984. 4 Fig, 5 Ref.

Descriptors: *Scenery, *Environmental effects, *Altmuehl River, *Germany (Federal Republic), *Rhine-Main-Danube Waterway, Embankments, Wetlands, Planning, Aesthetics, Waterways, Legal aspects.

Discussions on the construction of the Rhine-Main-Danube Waterway have centered on the themes of the scenic aspects and the ecology of the region. The valley of Altmuehl River (Federal Republic of Germany) is used as an example to explain the comprehensive plan to fit the Rhine-Main-Danube-Waterway into surroundings and into present ecological structures. The main factors considered in planning include: the avoidance of parallel structures in the valley; the permanent alteration of the elements of the configuration (banks and vegetation); the preservation of as much as possible of the old bodies of water with their fauna and flora; the formation of new bodies of water in the floodplain; the avoidance of fill and embankments in low-lying areas; and the formation of islands between the waterway and the old bodies of water and in the low-lying areas. The report demonstrates the problems during several stages of planning, legal procedures and construction and how these problems could be solved in cooperation with external specialists. Public opinion on the results of this effort have been positive. (Moore-IVI)
W85-03251

ELECTRONIC DP APPLICATIONS IN THE SAALE-WERRA WATER DISTRICT (DIE ANWENDUNG DER EDV IN DER WASSERWIRTSCHAFTSDIREKTION SAALE-WERRA),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
For primary bibliographic entry see Field 7C.
W85-03517

METHODOLOGY FOR PRODUCING AN INVENTORY OF SITES FOR SMALL HYDROELECTRIC SCHEMES. HAUTE-SAVOIE, A CASE STUDY (METHODOLOGIE D'UN INVENTAIRE DE SITES DE MICROCENTRALES CAS DE LA HAUTE-SAVOIE),
Centre National de Machinisme Agricole du Genie Rural, des Eaux et des Forets, Paris (France).
G. Degoutte, and J. Lavabre.
Houille Blanche, No. 5, p 347-354, 1984. 8 Fig.

Descriptors: *Hydroelectric plants, *Haute-Savoie, *France, *Site selection, Altitude, Rainfall distribution.

The methodology used consists basically in studying the laws giving producibles as a function of simple parameters such as: altitude, interannual module or cartographic coefficient. These laws

e obtained for theoretical sites (stations) for ch daily or monthly flow data are available. s type of approach can easily be extended to er regions. Finally, the work performed makes ossible, in a region with an inventory, to carry an initial feasibility study for a site for which re is no data other than average altitude, aver- pluviometry and fall height. (Author's ab- ct)
5-03587

3. Evaluation Process

DROBE'S MICRO HYDRO: REALITY AND TENTIAL,
pua New Guinea Univ. of Technology, Lae. pt. of Electrical and Communication Engineer-
M. Arneaud-Clarke, and M. New.
ernational Water Power and Dam Construction, l. 36, No. 11, p 22-24, October, 1984. 4 Fig, 2 b, 2 Ref.

scriptors: *Hydroelectric power, *Developing ntries, *Rural areas, *Morobe, *Papua New inea, Planning, Economic aspects, Water re- rces development.

r the thinly populated, hilly regions of Morobe ovince of Papua New Guinea, grid extension is t realistic, and any rural electrification program st be based on autonomous power sources. Use very small isolated hydro stations under such nditions has sometimes resulted in failure, usual- brought about through the lack of trained per- nnel and a failure to implement end-uses with an onomical return. The history of such hydropow- stations is given for Heldsbach, Zenag, villages the Pindiu sub-district, and Ogeramnang. A very rge amount of energy is potentially available in pua New Guinea. The key to its development s in its use for economic industrial production, that kWh can be translated into currency. It is ely that micro hydro schemes without a signifi- nt revenue earning component will receive no pport from the Morobe Provincial Government. ny given project is seen as part of a wider ocess in which the construction of roads, refor- tation and extractive industries, as well as local litics, all take part. While an integrated approach development is seen as necessary, it cannot be id to be in operation as yet. (Baker-IVI)
85-03325

APACITY AND TYPE OF UNITS FOR SMALL UN-OF-RIVER PLANTS,
adua Univ. (Italy). Ist. di Idraulica.
or primary bibliographic entry see Field 8A.
85-03327

CONOMIC EVALUATION OF MEASURES OR CONSERVING AND IMPROVING VATER QUALITY (OKONOMISCHE BEUR- EILUNG VON MASSNAHMEN ZUM CHUTZ UND ZUR SANIERUNG DER EWASSER),
Technische Univ., Dresden (German D.R.). Sek- on Wasserwesen.
. H. Schweiger.
Vasserwirtschaft-Wassertechnik, Vol. 33, No. 7, p 43-246, July, 1983. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Economic aspects, *Water conserva- ion, *Water quality management, Cost-benefit nalysis, Water quality standards, Conservation, Freiberger Mulde, Germany (Democratic Repub- ic).

Procedures for economic evaluation of measures for conserving and improving water quality (MCIWQ) that are found in the literature were analyzed in order to improve their effectiveness. MCIWQ include government regulation, monitor- ng, and clean-up; restricting pollution by water users; and controlling biological and chemical processes in natural waters. Objective economic evaluation of MCIWQ should include the effects in terms of industry, the relevant branch of industry, territory, and political economy of each specific water use on subsequent multiple uses. Chief crite- ria for evaluation are the functional value and the relative effectiveness, i.e., the ratio of result to expenditure compared with economic figures (e.g., indices, standards). Criteria for determining the relative effectiveness of investments are divided into systems of indices (with their derivatives) and single indices. The former group is particularly useful in evaluating MCIWQ together with the point rating system and complex expenditure, result, and effectiveness index (minimum or maxi- mum problem). The present state of cost-benefit analysis in water-quality management is inad- equate: concrete goals based on economics are usually lacking in relation to future quality stand- ards, and the economic effects of factors impacting water use are only sporadically assessed and usual- ly only in terms of the industrial economy. Results are given of a study in the Freiberger Mulde catchment area to investigate the relationships be- tween water quality, additional expenditures, and pollution. (Gish-IVI)
W85-03525

SOLAR ENERGY AND HYDROELECTRIC POWER GENERATION IN THE DEAD SEA: A DYNAMIC ANALYSIS,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Economics.
E. Hochman, J. LaFrance, and D. Zilberman.
Water Resources Research, Vol. 20, No. 11, p 1469-1476, November, 1984. 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Water resources development, *Solar energy, *Dead Sea, *Israel, *Hydroelectric power, Energy, Model studies, Resources develop- ment, Optimization, Economic aspects.

The economic theory of the use of natural re- sources is applied to derivation of an optimal plan for exploiting a new and somewhat novel source of energy, solar energy in a below sea level basin. The model determines the optimal size of the re- source utilization project and considers the influ- ence of project size and other model parameters on the optimal utilization path for the resource. This model is general enough to be applicable, with only minor modifications, to a wide variety of resource use problems. The assumption of a con- tinuously variable project size employed in this study is not really restrictive, since the numerical approximation and search procedure is actually more applicable to problems with a finite number of possible sizes. (Baker-IVI)
W85-03548

WATER RESOURCE PLANNING AND DEVEL- OPMENT IN THE NORTHERN JORDAN VALLEY,
Haifa Univ. (Israel).
M. Inbar, and J. O. Maos.
Water International, Vol. 9, No. 1, p 18-25, Spring, 1984. 2 Fig, 32 Ref.

Descriptors: *Jordan River Basin, *Water re- sources development, *Jordan, *Israel, *Lebanon, *Syria, Water demand, Water use, Water supply, Water quality, Water management.

Although relatively small, the Jordan River Basin epitomizes many of the problems of water resource management which occur in many other parts of the world on a broader but equally complex scale. The issues of water resource management in the Northern Jordan Valley are examined with a view toward obtaining a better understanding of the problems which were stirred up by the initiatives for the comprehensive development of that region. The argument put forward is, that the existing water resources, if rationally exploited and man- aged, are adequate for meeting the bulk of current demand for irrigation, industry and domestic uses of all co-riparian states in the catchment area. Matters of major concern are the imminent envi- ronmental and ecological issues which may com- promise the operation of any intensive multi-pur- pose water system. Regional water development schemes which are reviewed include the National Water Carrier Project in Israel, and the Great Yarmuk Project in Jordan. The Arab diversion plans and Israeli water development schemes in the Jordan Basin are also considered. Ecological and environmental considerations are noted. While in the long run population growth and agricultural development may require new and nonconven- tional sources of water for the region, it seems that quality rather than quantity will remain the over- riding criterion in the region's water resource man- agement. From an environmental standpoint, the growing urbanization in the catchment area and the addition of untreated sewage from uncon- trolled sources is a particularly critical issue. Fur- ther demographic growth and economic develop- ment in the region, and the attendant intensifica- tion of water uses, may warrant a growing degree of coordination among the co-riparian states in the not too distant future. (Baker-IVI)
W85-03701

WATER RESOURCES OF LATIN AMERICA.
Inter-American Development Bank, Washington, DC. Dept. of Economic and Social Development.
Water International, Vol. 9, No. 1, p 26-36, Spring, 1984. 6 Tab, 3 Ref.

Descriptors: *Water resources development, *Latin America, Planning, Water management, Decision making, Water use, Water demand, Water supply, Irrigation, Industrial uses, Legal aspects, Pricing, Water pollution effects.

In its heartland, Latin America has an enormous untapped water potential, concentrated in a few very large river systems. However, these resources are far from the population. The expansion of the demand for water in Latin American countries in recent years has been accompanied by changes in the structure of their economies, and shifts in the spatial distribution of population and productive activity. The most important change in economic stucture from the viewpont of water use has been the increasing role played by manufacturing indus- try in most of the economies of the region. The uses to which water is put are multiple and hetero- geneous and are discussed by sector, including domestic and urban consumption, industrial uses, irrigation, hydroelectric power generation, and other uses such as mining and refining of minerals. Proper management of the resource must deal with conflicting demands, water shortages in given areas, excesses of water in other areas, conflicts between users and the environment, and the damage done by tropical storms. Policy issues in the management of water resources in Latin Amer- ica are considered including legal aspects, pricing, pollution control, investment versus improved effi- ciency, and needs for current and complete infor- mation. (Baker-IVI)
W85-03702

MODERN INTERFERENCES IN TRADITION- AL WATER RESOURCES IN BALUCHISTAN,
International Inst. for Land Reclamation and Im- provement, Wageningen (Netherlands).
R. J. Oosterbaan.
Water International, Vol. 9, No. 3, p 106-111, September, 1984. 17 Fig.

Descriptors: *Baluchistan, *Pakistan, *Water man- agement, *Water resources development, Rainfall, Distribution, Planning, Decision making, Social as- pects, Developing countries.

Baluchistan, a province of Pakistan, is a mountain- ous region with little rainfall and no other major source of water. Nevertheless, the small amounts of rainfall, surface runoff, and groundwater are used to produce crops and to supply drinking water to man and beast. Water harvesting, diver- sion weirs, gravity drains and open wells are part of the traditional water-use system. The traditional water use system is balanced, but modern develop- ments are tending to upset this balance by redis- tributing the water resources. Islamic water laws attach no property rights to water resources; the laws only attach rights to the use of water by those who have constructed works to produce the water. Therefore, the builders of a diversion weir or a Karez, and their heirs, have exclusive rights to the water produced by these works. But if a new dam is built upstream of their works, the same law

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applies to the builders of this new dam. The fact that this new dam reduces the downstream quantities of water constitutes no legal problem. Modern water resources developments are thus allowed to interfere with existing traditional systems. Careful hydrological investigations before and after the introduction of new water management can reveal the negative side effects of various plans. (Baker-IVI)
W85-03705

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

MODE OF OPERATION OF THE NEW WATER-USE CHARGES AND INDUSTRIAL PRICES THAT BECAME EFFECTIVE JANUARY 1, 1984 IN THE WATER-MANAGEMENT SECTOR (ZUR WIRKUNGSWEISE DER AB 1. JANUAR 1984 GELTENDEN NEUEN WASSERNUTZUNGSENTGELTE UND INDUSTRIEPREISE DER WASSERWIRTSCHAFT),
Ministerium fuer Umweltschutz and Wasserwirtschaft, Berlin (German D.R.).
H. Schulze.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 5, p 114-117, July, 1984.

Descriptors: *Germany (Democratic Republic), *Pricing, *Industrial water, Water conservation, Water supply, Water demand, Drinking water, Wastewater treatment, Water management, Groundwater.

The German Democratic Republic on January 1, 1984 introduced new water-use charges and industrial water prices which provide economic stimulation of rational water use. The water-use charges distinguish between catchment areas according to the water supply/water demand situation; in the Saale and Mulde catchment areas, which supply much less water than they consume, charges are higher than in all other areas by 33.3% for groundwater and 50% for surface water. Charges are less for drinking water and for industries that need drinking-quality water than for industrial water. For groundwater removed to exploit minerals, to drain mines, or to be used for its thermal energy, 0.03 Marks/cu m is charged to provide a stimulus to research. The industrial prices for drinking water are 27.7% higher than previously, to provide an incentive to conserve water. These increases do not apply to the general population, but it is proposed that local authorities begin to change over from a flat-rate system of drinking-water charges to provide a similar incentive. Industrial prices for the use of public facilities for wastewater treatment are arranged such that it is cheaper for a company to have its own facility for treatment and reclamation of recyclable substances; prices are also staggered according to type and degree of pollution of wastewater. Increases alone will not produce the desired water-conserving effect; the local authorites, water-management facilities and users must be educated as to the significance of the new prices; and concrete goals set for their implementation. (Gish-IVI)
W85-03465

ECONOMIC EVALUATION OF MEASURES FOR CONSERVING AND IMPROVING WATER QUALITY (OKONOMISCHE BEURTEILUNG VON MASSNAHMEN ZUM SCHUTZ UND ZUR SANIERUNG DER GEWASSER),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 6B.
W85-03525

OLD WATER-NEW WATER: SETTING EQUITABLE WATER RATES FOR SUBURBAN CUSTOMERS,
Seattle Dept. of Water, WA.
J. W. Miller.
Journal of the American Water Works Association, Vol. 76, No. 9, p 34-41, September, 1984. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Water rates, *Seattle, *Washington, Suburban areas, Urban areas, Pricing, Economic aspects, Capital costs, Depreciation, Utilities, Maintenance, Operating costs.

A methodology is described for setting equitable water rates for suburban customers who purchase water from a municipal system that was developed by and is owned by a central city. The dilemma is that suburbanities often claim they are overcharged by a central city, and the central city, on the other hand, claims that the suburban areas are taking unfair advantage of the city that developed and paid for the original water system. There is also the issue of growth. In setting water rates, the city of Seattle treats the purveyors and the direct-service customers as two separate classes of customers. The basic cost-of-service principle is used in setting the water rates for each class of customer. The cost of serving purveyors as a class is determined by a detailed rate study. The biggest question in this process relates to how one determines what costs to allocate to what customers. The key decision in the process was that the utility basis of accounting would be used in determining the capital cost portion of purveyor revenue requirements. According to this new method, utility facilities and properties are valued, and an appropriate rate of return is applied to determine the return on capital. This return is then added to depreciation expense to determine the capital cost that will be assigned to the purveyor class of customers. In addition, allocated shares of operation and maintenance expenses and taxes are added to the capital cost allocation to establish the total revenue requirement from the purveyors. (Baker-IVI)
W85-03612

COMPUTING WATER SYSTEM DEVELOPMENT CHARGES,
CH2M Hill, Inc., Portland, OR.
D. W. Barden, and R. J. Stepp.
Journal of the American Water Works Association, Vol. 76, No. 9, p 42-46, September, 1984. 10 Tab, 3 Ref.

Descriptors: *Water costs, *Economic aspects, Water supply development, Utilities, Management, Operating costs, Maintenance, Cost allocation, Water rates.

The manner in which the base-extra capacity cost allocation method can be used to compute a schedule of water system development charges for new customers is described. The goal is to achieve a more equitable recovery of capital costs from new connections that are made to an existing water system. One general principal must be followed closely - the system development charge revenues should not be used to offset annual operations and maintenance costs. A development charge schedule must follow generally accepted rate-making practices. This requires the use of a good cost allocation methodology that recovers system costs from users in proportion to the cost of the service provided to a user or user class. The development of an equitable service charge requires generation of an appropriate measure of cost to be recovered from users, identification of system customers by customer class and determination of their usage characteristics or demands for different types of service, and the use of an acceptable cost allocation procedure that recognizes the service requirements of each customer class. Current operating costs should be recovered from current users through water rates and other user charges. In addition, the accounting system should be structured to segregate development charge revenues so that these funds can be used to finance new facilities, to modernize older facilities, or to fund annual debt service. A water utility should probably update development charges every five years or whenever major new additions to utility plants are made. (Baker-IVI)
W85-03613

WATER RATES AND THE RATE-SETTING PROCESS,
PSC Water Service, Inc., Palm Harbor, FL.
C. E. Woods.
Journal of the American Water Works Association, Vol. 76, No. 9, p 47-51, September, 1984. 8 Ref.

Descriptors: *Water rates, *Pricing, *Economic aspects, Utilities, Management, Cost allocation, Hearings, Legal aspects.

The financial plan, the notification process, the rate application, the hearing, the approval procedure, and the implementation of the rate order comprise the six stages of the rate-setting process. Each of these stages is discussed in some depth. While the main thrust of this discussion is the general water rate structure of a water utility, the principles apply to all charges made by the utility, including extension-of-sevice charges (customer advances, contributions of capital, and connection fees), ancillary charges for various user-paid-for services (jobbing, merchandise sales), and any other fee used by the utility to recoup a portion of its service costs. (Baker-IVI)
W85-03614

SINGLE TARIFF PRICING,
American Water Works Co., Inc., Charleston, WV.
E. W. Limbach.
Journal of the American Water Works Association, Vol. 76, No. 9, p 52-55, September, 1984. 4 Fig.

Descriptors: *Water rates, *Pricing, *Economic aspects, *West Virginia, Utilities, Management, Single tariff pricing.

A problem with disparate water rates was solved for an investor-owned utility in West Virginia by using single tariff pricing for 12 separate water districts. Each customer in the service area now pays the same rate for the same service, although there are only 578 customers in the smallest district and 58,000 in the largest. The new rate structure resulted in as much as a 41% decrease in rates in one small district and only an 8% increase in the largest. The concept could help solve the dilemma of other nonintegrated small water systems. The West Virginia Water Company serves approximately 85,000 customers in 50 communities located in central and southern West Virginia. Prior to the approval of single tariff pricing, the company's rates were determined on the conventional district-by-district basis. Although the rate of return requirement was based on a total capital structure of the company, the rates for each district were determined on the basis of the investment and expenses for each particular district. Consequently, the water rates varied markedly from district to district. With effective utility leadership the concept of single tariff pricing can work elsewhere as well as it does in West Virginia. It facilitates regionalization and provides a vehicle for solving the dilemma of small water utilities. (Baker-IVI)
W85-03615

COMMON DENOMINATOR: EQUIVALENT RESIDENTIAL UNITS,
Prince William County Service Authority, Woodbridge, VA.
J. J. Woodcock.
Journal of the American Water Works Association, Vol. 76, No. 9, p 56-62, September, 1984. 5 Fig, 4 Tab.

Descriptors: *Pricing, *Water rates, *Equivalent residential unit, Economic aspects, Peak demand, Cost allocation, Domestic water, Water system capacity.

The theory of rates based on the equivalent residential unit (ERU) is that a user's initial payment to buy in, or purchase, capacity in a water system should represent the actual purchase of a proportionate share of capacity, based on the user's estimated peak demand on that system. In addition, commercial users can be equated to a single-family residential unit. The ERU concept of setting fees has been documented. It allows for flexibility, particularly if a new type of use occurs or a new user classification is created, such as through the loca-

of a new business in the service area. The pt of attaching both variable and fixed reve- o a factor that relates all system users to the single-family residential unit is a method of ering costs that is both logical and fair for the ity of system users. Simply put, the ERU pt represents an equitable share in the cost of tem, based on the historical average use by customer class. The method of arriving at the can be altered depending on applicability, nformation, or political needs. Although the istrative expenses of handling the ERU con- are somewhat greater than for other methods, proved to be the best method for this author- terms of overall fairness and increased recov- f costs. (Baker-IVI)
03616

Water Demand

TORS OF SIMULTANEOUS CONSUMP- N AND SUPPLY PATTERNS AT LONG 'ANCE DRINKING WATER SUPPLY SYS- S (GLEICHZEITIGKEITSFAKTOR UND AHMECHARAKTERISTIKEN BEI FERN- SERSVERSORGUNGSSYSTEMEN),
gart Univ. (Germany, F.R.). Inst. fuer Sied- wasserbau, Wassergutewirtschaft und Abfall- ik.
primary bibliographic entry see Field 5F.
-03248

LTI-PURPOSE PROJECTS FOR WATER RAGE AND AQUEDUCTS IN BADEN- RTTEMBERG (MEHRZWECKPROJEKTE WASSERSPEICHERUNG UND WASSER- RLEITUNG IN BADEN-WURTTEMBERG),
gart Univ. (Germany, F.R.). Inst. fuer Was- au.
primary bibliographic entry see Field 8A.
-03443

TER RESOURCE PLANNING AND DEVEL- MENT IN THE NORTHERN JORDAN LEY,
a Univ. (Israel).
primary bibliographic entry see Field 6B.
-03701

. Water Law and Institutions

SERVATIONS FROM THE SOCIETAL NTROL OF NATURAL WATERS AND TER FACILITIES DURING THE 1983 RING DIKE AND RIVER INSPECTION (ER- HRUNGEN AUS DER GESELLSCHAFTLI- EN KONTROLLE DER GEWASSER UND R WASSERWIRTSCHAFTLICHEN ANLA- N WAHREND DER FRUHJAHRSDEICH- D FLUSSSCHAU 1983),
fuer Umweltschultz und Wasserwirtschaft tbus (German D.R.).
Gunther.
sserwirtschaft-Wassertechnik, Vol. 33, No. 9, p -298, September, 1983.

scriptors: *Inspection, *Germany (Democratic public), *Cottbus, *Dikes, *Rivers, Costs, Main- ance, Infrastructure.

e 1982 German Democratic Republic Water w placed responsibility for monitoring the con- on of natural waters and water facilities on al councils as well as on water-management ncies. During spring 1983, dike and river in- ction in the Cottbus District were carried out 160 inspection commissions comprising 2,027 resentatives of government and local water ncies, of industry, and of agriculture. Inspection vered 6,376 km of waters, 800 km of flood- otection dikes, 77 water engines, 2,339 water ilities, and 55 flood areas (90% of waters and in drains, 100% of dikes, 88% of other facilities, d 95% of flood areas). The inspection commis- ns found 88% of waters, 99.7% of dikes, and 0% of facilities to be in good condition. It was imated that repairs to be made and action to be ken to rectify inadequacies would cost 18.8 mil- lion Marks, of which 4.0 million would be paid by those responsible for maintenance of the relevant facilities. The inspection demonstrated the willingness of the public to participate and take responsibility for maintaining good conditions in the water-management field. Local authorities together with the inspection commissions should utilize this willingness more fully. Observations from this and the 1982 inspections were used to plan the fall 1983 inspection, in which quality and effectiveness were expected to be improved, and which were to be preceded by an exchange of information gathered by the various inspection commissions within the district. (Gish-IVI)
W85-03528

OBSERVATIONS FROM THE EXECUTION OF WATER INSPECTIONS IN THE SCHWERIN DISTRICT (ERFAHRUNGEN BEI DER DURCHFUHRUNG VON GEWASSERS- CHAUEN IM BEZIRK SCHWERIN),
Rat fuer Umwelschutz und Wasserwirtschaft Mageburg (German D.R.).
G. Bruhn.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 9, p 299-300, September, 1983.

Descriptors: *Inspection, *Schwerin District, *Germany (Democratic Republic), *Public participation, Maintenance, Drainage, Flood control, Rivers, Storm sewers.

Well-organized and regular water inspections with the capability of assessing defects are especially important for the Schwerin District in the German Democratic Republic because storms can cause flooding of agricultural areas, preventing the achievement of production goals. The spring 1983 inspection resulted in the immediate execution of 200 measures to quickly drain 7,600 hectares of cultivated land, so that after the heavy April and May rains farming schedules remained unaffected. Local council participation, especially by the mayors, was greater and more consistent than before in the inspection of municipal rivers and drains. In the future, the number of participants in the 381 inspection commissions will be increased from the 1,739 who worked on the spring 1983 inspection to 2,200. Information collected during the spring 1983 inspection led to the district inspection commission being charged with 45 tasks to improve conditions, including a schedule for their execution. A further 620 tasks, mainly short- or mid-term measures, for main sewers in agricultural areas and municipal waters, were given to 11 subdistrict inspection commissions. (Gish-IVI)
W85-03529

OBSERVATIONS FROM THE EXECUTION OF DIKE AND DRAINAGE DITCH INSPECTION IN THE MAGDEBURG DISTRICT (ERFAHRUNGEN BEI DER DURCHFUHRUNG VON DEICH- UND GRABENSCHAUEN IM BEZIRK MAGDEBURG),
Rat fuer Unweltschutz, Wasserwirtschaft und Erholungswesen Schwerin (German D.R.).
R. Franke.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 9, p 300-301, September, 1983.

Descriptors: *Inspection, *Germany (Democratic Republic), *Magdeburg District, *Public participation, *Dikes, *Drainage ditches, Maintenance, Storm sewers, Flood control, Costs.

The 1982 German Democratic Water Law charged local councils and their citizens with forming inspection commissions whose duties would be semi-annual inspection of the drain system and water facilities in their area, assessment of their function, charging the party responsible with eliminating defects, and control of measures necessary for restoring damages. The work of local inspection commissions during the 1982 and spring 1983 inspections in the Magdeburg District demonstrated public willingness to participate under the leadership of their mayors. The District has an extensive drain system, with 13,334 km of drains, or 1.81 km drain per 100 km agricultural land. In addition to drains, inspection covers flood-protection dikes and other water facilities. Favorable results of inspection include a saving of 2.3 million Marks through extending the main drain and reducing in 1982 the cost of constructing 11.1 km of central sewers by 300,000 Marks; 3,500 hectares of land were thereby drained. In 1983, sheep grazing and hay production on 80% of dikes and embankments has resulted in a saving in maintenance. During the spring 1983 inspection, 77.8% of rivers and drains were inspected, 97.6% of which were placed in the top two classifications in terms of their condition. It was found that damages in the river and drain systems were discovered quickly and were repaired at relatively low expense. Local inspection commissions were found to be sufficiently trained and capable of carrying out inspections and their subsequent evaluation. (Gish-IVI)
W85-03530

DEVELOPMENT OF REVISED PRIMARY DRINKING WATER REGULATIONS,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5F.
W85-03625

INSURANCE AGAINST LIABILITY FOR ENVIRONMENTAL POLLUTION - COVERAGES AND LIMITATIONS,
For primary bibliographic entry see Field 5C.
W85-03711

EPA/RCRA LANDFILL REGULATIONS - A DISCUSSION,
E. M. Ilgenfritz.
Great Lakes Waste and Pollution Review magazine, Vol. 1, No. 2, p 14-16, June, 1983. 3 Fig, 4 Ref.

Descriptors: *Landfills, *Waste disposal, *Regulations, Environmental effects, Monitoring, Groundwater pollution, Land disposal.

The EPA promulgated interim final regulations concerning land disposal on July 26, 1982. The design concepts and intent specified in the new regulations are examined plus the implementation of these design requirements at landfills. Implementation of the new regulations is already raising questions from the regulated community. The question of what constitutes an existing facility under the regulations needs to be clarified. Further discussion of liners and caps requires visualization of what EPA specifies in their life of the facility design concept. Another implementation question arising from these regulations will be placement of granular material over a synthetic liner on the slanting wall at the edge of a landfill. Monitoring of the effects of the landfill operation is a very significant aspect of the new regulations. Some portions of monitoring are obvious by visual or general site inspection. What is much less obvious is the monitoring of groundwater. The regulations have little to say as to what constitutes appropriate well construction, well diameter, location and quantity or material of construction. Nevertheless, these choices can have a major impact on the quality of data available for evaluation. In many areas of the new regulations there are significant disagreements on their practicality. (Baker-IVI)
W85-03714

6F. Nonstructural Alternatives

RESPONSIBILITY OF THE DEPARTMENT OF ENERGY, ENVIRONMENTAL PROTECTION, AND WATER MANAGEMENT OF THE DRESDEN CITY COUNCIL FOR GROUNDWATER CONSERVATION IN DRINKING-WATER SUPPLY AREAS (DIE VERANTWORTUNG DER ABTEILUNG ENERGIE, UMWELTSCHUTZ UND WASSERWIRTSCHAFT BEIM RAT DER STADT DRESDEN FUR DEN SCHUTZ DES GRUNDWASSERS IN TRINKWASSERGEWINNUNGSGEBIETEN),
Rat der Stadt Dresden (German D.R.).
K. Haubenreisser.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 6, p 207-209, June, 1983. 11 Ref.

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Descriptors: *Dresden, *Germany (Democratic Republic), *Water supply, *Drinking water, *Groundwater management, Water conservation, Management planning, Political aspects.

According to the Water Conservation Area (WCA) Ordinance, the Dresden (German Democratic Republic) city council is responsible for decisions on the designation of WCAs within the city limits; the council delegates responsibility to its Department of Energy, Environmental Protection, and Water Management (DEEPWM). The duties of DEEPWM include development of a drinking-water conservation zoning regulation (DWCZR) and setting up a plan of action for instituting bans and use limitations and regulating claims for compensation. A Conservation Zoning Commission (CZC) is working under the direction of DEEPWM in accordance with the WCA ordinance to facilitate decisions on designating WCA. The CZC also works on the content of attachments to the DWCZR for individual WCAs; this includes data on the water-supply area, waterworks, water use, number and location of wells, reasons for designating the area a WCA, and a detailed description of boundaries, together with any necessary water-use restrictions. The Dresden city council must ratify the DWCZR, and at the same time the plan of action for its realization will be voted on. DEEPWM is responsible for monitoring and controlling the implementation of DWCZR. Further efforts must be made to include industrial water supplies in WCAs. (Gish-IVI)
W85-03520

RESULTS OF RATIONAL WATER USE IN THE DISTRICT OF DRESDEN (ERGEBNISSE DER RATIONELLEN WASSERVERWENDUNG IM BEZIRK DRESDEN),
Wasserwirtschaftsdirektion Obere Elbe-Neisse, Dresden (German D.R.).
For primary bibliographic entry see Field 3E.
W85-03523

MODELING EFFICIENT WATER ALLOCATION IN A CONJUNCTIVE USE REGIME: THE INDUS BASIN OF PAKISTAN,
International Bank for Reconstruction and Development, Washington, DC. Agricultural and Rural Development Dept.
G. T. O'Mara, and J. H. Duloy.
Water Resources Research, Vol. 20, No. 11, p 1489-1498, November, 1984. 2 Fig, 10 Tab, 25 Ref.

Descriptors: *Indus Basin, *Pakistan, *Water use, *Water allocation, Water management, Pricing, Taxation, Conservation, Model studies, Groundwater, Surface water, Conjunctive use.

Efficient resource use where ground- and surface waters are used conjunctively may require special policies to rationalize the interaction between water use by farmers and the response of the stream aquifer system. Large gains in agricultural production and employment for the Indus Basin are possible given a more efficient allocation and management of surface and ground waters. These gains were estimated holding everything else constant and under conservative assumptions with respect to water supply. These gains require optimally coordinated use of surface and groundwaters. Necessary steps to achieve efficient conjunctive groundwater areas and eventual public control of private tube well withdrawals in the fresh groundwater areas may include the use of a combination of taxes, subsidies, quotas, fees, and prices. These steps can be regarded as adjustment costs in a transition toward more efficient resource utilizations. The subsidy costs might be unnecessary in practice, since simulation experiments have shown that improved agricultural technology shifts the optimal control from a subsidy to a tax. Large drainage investments will be required to achieve the gains shown, since these depend on large increases in canal diversions to saline groundwater areas. Until such drainage investments are in place, only limited gains are possible from increases in canal diversions. With present depths to water table of less than 20 feet, in almost all fresh groundwater areas, a need for taxation to discourage excessive withdrawals does not yet exist. (Baker-IVI)
W85-03550

NEEDED ECONOMIC FRAMEWORK FOR FLOOD PLAIN MANAGEMENT,
Florida Univ., Gainesville. Bureau of Economic and Business Research.
For primary bibliographic entry see Field 4A.
W85-03707

6G. Ecologic Impact Of Water Development

PROBLEM OF PRAWN FISHERIES IN EGYPT,
K.L.D.A.V. Coll., Roorkee (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W85-03235

SEASONAL CHANGES IN DISSOLVED-GAS SUPERSATURATION IN THE SACRAMENTO RIVER AND POSSIBLE EFFECTS ON STRIPED BASS,
Teufel and Associates, Davis, CA.
For primary bibliographic entry see Field 5C.
W85-03247

ENVIRONMENTAL INFLUENCES OF DAMS CONSTRUCTED DURING THE PAST 300 YEARS IN THE WESTERN 'HARZ' (DIE UMWELTEINFLUSSE VON 300 JAHREN TALSPERRENBAU IM WESTHARZ),
Harzwasserwerke des Landes Niedersachsen, Hildesheim (Germany, F.R.).
M. Schmidt.
Wasserwirtschaft, Vol. 74, No. 3, p 109-113, March, 1984. 2 Fig, 13 Ref.

Descriptors: *Harz Mountains, *Germany (Federal Republic), *Dam effects, Environmental effects, Reservoirs, Recreation, Flora, Fauna.

Observations of the 300 year old storage reservoirs and dams situated in the western part of the Harz Mountains reveal that practically no environmental influences occurred above the reservoirs. Downstream of the dams, changes were observed which, however, did not entail adverse effects on flora and fauna even in such cases where the amount of water was totally reduced. Due to the alterating water levels of the reservoirs, critical areas may occur temporarily, but they are very limited even in dry seasons. The many visitors frequenting the water reservoirs indicate that these artificial lakes not only increase the beauty of the landscape, but also influence favorably fauna and flora. To put it in a nutshell: the great variety of the western part of the Harz is to a large extent due to the existence of the water reservoirs. (Author's abstract)
W85-03250

CONSIDERATION OF SCENIC AND ECOLOGICAL ASPECTS DURING CONSTRUCTION OF THE RHINE-MAIN-DANUBE-WATERWAY (LANDSCHAFTSGESTALTERISCHE UND OKOLOGISCHE FRAGEN BEIM BAU DER RHEIN-MAIN-DONAU-WASSERSTRASSE),
Rhein-Main-Donau A.G., Munich (Germany, F.R.).
For primary bibliographic entry see Field 6A.
W85-03251

ENVIRONMENTAL ASPECTS FOR WATER POWER PLANTS ALONG THE RIVER LECH (UMWELTGESTALTUNG BEI WASSERKRAFTANLAGEN AM LECH),
Bayerische Wasserkraftwerke A.G., Munich (Germany, F.R.).
H. Schiechtl.
Wasserwirtschaft, Vol. 74, No. 3, p 118-121, March, 1984. 7 Fig.

Descriptors: *Hydroelectric plants, *Lech River, *Germany (Federal Republic), *Environmental effects, Design criteria, Powerplants.

During the past four decades, a number of water power plants has been put up along the river Lech between Fussen to Augsburg; this section being under the concession of BAWAG (Bayerischen Wasserkraftweke AG). With the present report, the author shows how and by what means water power plants can be designed to be ecologically beneficial, and he furthermore demonstrates that modern technics and conservation of environment are compatible with each other. The use of water power as an indigenous, non-polluting and constantly regenerating source of energy in the future is pointed out. (Author's abstract)
W85-03252

STRESS-RELATED CHANGES IN LAKE WHITEFISH (COREGONUS CLUPEAFORMIS) ASSOCIATED WITH A HYDROELECTRIC CONTROL STRUCTURE,
Waterloo Univ. (Ontario). Dept. of Biology.
M. A. Barnes, G. Power, and R. G. H. Downer.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 10, p 1528-1533, October, 1984. 4 Fig, 3 Tab, 22 Ref. NSERC grant A1728.

Descriptors: *Hydroelectric plants, *Control structures, *Environmental effects, *Whitefish, *Churchill Falls, *Labrador, Lobstick control structure, Stress, Fish, Reproduction, Liver.

When Smallwood Reservoir, Churchill Falls, Labrador, became operational in 1974, vast numbers of lake whitefish (Coregonus clupeaformis) were observed congregating below the Lobstick control structure. Substantial numbers of these fish were killed or injured by hydraulic forces generated during reopening of the control gates. Lake whitefish taken immediately downstream of the control structure were compared with fish from Smallwood Reservoir just above the control structure, Ten Mile Lake, a nearby natural lake unaffected by flooding, and Jacopie Lake, the east forebay. Lake whitefish that accumulate below the Lobstick control structure at the Churchill Falls hydroelectric facility exhibit many stress-related symptoms. Compared with fish from the reservoir or from the natural lake they score low on the following indices: liver somatic, gonad somatic, stomach content volumes, and condition factor, they have a low rate of circuli formation on the scales and they do not reproduce; proximate composition analyses identified reduced muscle protein levels and reduced ovarian protein and lipid. The liver may be the main site of lipid storage and the liver somatic index a sensitive condition indicator in whitefish. The reasons why whitefish reside in what appears to be a very stressful environment below the Lobstick control structure are difficult to assess, but may include the effects of a sudden pressure change, a decrease in dissolved oxygen, and mechanical injuries. (Moore-IVI)
W85-03312

HEALTH IMPACT OF THE KPONG DAM IN GHANA,
Volta River Authority, Accra (Ghana).
L. K. A. Derban.
International Water Power and Dam Construction, Vol 36, No. 10, p 13-15, October, 1984. 4 Fig, 1 Tab, 2 Ref.

Descriptors: *Kpong Dam, *Ghana, *Dam effects, *Public health, Environmental effects, Bilharziasis, Schistosomiasis, Relocation, Irrigation, Social aspects, Economic aspects, Resettlement.

The construction of the Kpong dam on the Volta river began in 1977 and and was completed in 1981; the dam was commissioned on 1982. The headpond covered an area of about 9000 acres. The formation of the headpond resulted in the inundation of large areas of habitation and agricultural land, and required the resettlement of 7000 people living in 60 villages in the area to be flooded. Pre-impoundment studies on the environmental impact emphasized socioeconomic aspects, public

lth, and hydrobiology. The most important ial impact was the resettlement of the people ated in the future headpond area. Care was en that the resettlement areas were not insani- y and the communities in the new villages were unduly exposed to debilitating diseases such as istosomiasis and intestinal helminthiasis. Strenu- s efforts were made to reduce the opportunities transmission of bilharziasis in the resettlement lages. An irrigation project was developed as rt of the Kpong hydro project. The irrigation eme will provide food and serve as a demon- ation farm project for the settlers. (Moore-IVI) 85-03323

SE STUDIES FROM INDIA ON THE ENVI- ONMENTAL IMPACT OF DAMS,
tional Projects Construction Corp., New Delhi dia).
V. Varshney.
ternational Water Power and Dam Construction, l. 36, No. 11, p 25-28, October, 1984. 3 Fig, 4 f.

escriptors: *Environmental effects, *Water re- urces development, *Reservoirs, *Dams, *India, vironmental Impact, Flood control, Drainage stems, Arid regions, Semi-arid regions, Develop- g countries.

udies are presented on the environmental impact dams, reservoirs and water resources projects nstructed in different regions of India. Specific tention is paid to Damodar Valley projects, the kair-Kakrapar project, the Parambikulam oject, the Tehri dam project, and the Silent alley project. Water resource projects have been en to have an appreciable impact on the local vironment, often leading to problems such as aterlogging, deforestation, dangers to wildlife d fisheries, undesirable aquatic vegetation, and lverse effects on the health of local inhabitants, eological instability, an increase in seismic activi- and, immense suffering to the local inhabitants. owever, the adverse effects are often exaggerat- d. All water resource projects also make a posi- ve contribution to the environment, and a bal- nced view should be sought in making any eval- ation. Adverse effects can be mitigated to a rea- nable extent by proper planning and efforts. Baker-IVI) 785-03326

FFECT OF CHANNEL ALTERATION ON ISH HABITAT,
lokkaido Univ., Sapporo (Japan). Lab. of Erosion Control Engineering.
. Takahashi, and S. Higashi.
apanese Journal of Limnology, Vol. 45, No. 3, p 78-186, July, 1984. 9 Fig, 1 Tab, 19 Ref.

Descriptors: *Fish populations, *Channeling, Aquatic habitats, *Shakotan river, *Japan, Aquat- c habitats, Rivers, Channels, Streams, Morpholo- y, Streamflow, Population dynamics.

To clarify how channel alteration affects fish habi- at, fish densities, stream morphology and flow onditions were researched at both altered and naltered sections in a stream. The Shakotan river s a small stream found in the Shakotan Peninsula ocated in the southwestern part of Hokkaido. The iver flows down the north slope of the Shakotan eninsula to the Sea of Japan for 15.4 km, and its rainage basin occupies an area of 75.6 sq km. In he unaltered section the stream bed was very ndulating, and differentiation of riffles and pools was clear. Waterflow was affected by morphologi- cal factors and became turbulent. In the altered section, the bed shape was flat, differentiation of riffles and pools was not clear, and waterflow was laminary as compared with the former section. The dominant fish was Oncorhynchus masou in the unaltered section, and Barbatula toni in the altered section. Why the former fish was not dominant in the altered section was discussed in relation to their feeding habits, the flow conditions, and multi- formity of environment. The low carrying capac- ity of O. masou in the altered section reflects the uniform environment which was produced by the channel alterations. (Baker-IVI) W85-03507

FISH SURVIVAL AT A COOLING WATER INTAKE DESIGNED TO MINIMIZE MORTAL- ITY,
Minnesota Pollution Control Agency, Roseville. Div. of Water Quality.
T. J. Goeman.
Progressive Fish Culturist, Vol. 46, No. 4, p 279-281, October, 1984. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Powerplants, *Fish management, *Intakes, *Impingement, *Mississippi River, *Wisconsin, Fish survival, Mortality, Cooling ponds.

Fish impingement on water intake screens is one environmental impact associated with cooling systems of electric power generation facilities. The study site was the Dairyland Power Cooperative J. P. Madgett Generating Station on Pool 5 of the Mississippi River near Alma, WI. The intake screening system at JPM consists of four vertical traveling screens, each having a surface area of 123.6 sq m for a total surface area of about 494 sq m. Impinging fish were elevated in water filled fish trays as the traveling screens rotated. Fish were then flushed from the fish trays into a fish sluiceway and returned to the river. Survival of impinged fish at JPM was species specific. Overall survival for all species was 17%. This low overall survival was greatly influenced by gizzard shad which accounted for 78% of the fish collected, but none survived. Survival of all species excluding gizzard shad was 75%. Approximately 90% of the ictalurids and percids survived impingement. (Baker-IVI) W85-03638

ASSESSMENT OF THE ENVIRONMENT EF- FECTS OF CONSTRUCTING THE THREE GORGE PROJECT ON THE YANGTZE RIVER,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. F. LaBounty.
Water International, Vol. 9, No. 1, p 10-17, 1984. 1 Fig, 22 Ref.

Descriptors: *Three Gorges Project, *Yangtze River, *China (Peoples Republic), *Environmental effects, Water resources development, Dam effects, Flood control, Habitats, Relocation, Nutrients, Estuaries, Mitigation.

The Three Gorge Project is a multipurpose project with the primary function of flood control. Other functions include power and navigation and could include irrigation. A 200 m high concrete gravity dam, currently being considered, would be located in the lower reach of the famous Three Gorges of the Yangtze River in Hubei and Sichuan Provinces. The reservoir will store about 70 x 10 to the 9th cu m and extend upstream about 780 km. The proposed powerplant would have an installed capacity of 25,000 MW, consisting of twenty-five 1000-MW units. The Three Gorge Project, when constructed, would be the largest water resource project anywhere on earth. Beneficial effects include elimination of flooding along the middle and lower reaches of the Yangtze River, a substantial increase in much needed electric power for south and central China, and creation of a large body of water which could be used for aquaculture. Consideration is also being given to diverting water to the North China Plain, one of the most important agricultural areas of China. Major adverse impacts include relocation of more than 2 million people from the reservoir area; loss of habitat for many kinds of Yangtze River aquatic life, including the unique Chinese sturgeon; and the possibility of reducing nutrient input to the downstream and estuarine fisheries. The possibility of minimizing adverse effects seems high, if the potential environmental impacts are identified and means of mitigation are carried out. (Moore-IVI) W85-03700

ENDANGERED LAKES OF SCIENTIFIC AND CULTURAL VALUE IN THE WORLD HERIT- AGE AREA OF SOUTH-WEST TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
L. C. Bowling, and P. A. Tyler.
Biological Conservation, Vol. 30, No. 3, p 201-209, 1984. 4 Fig, 14 Ref.

Descriptors: *Tasmania, *Australia, *Lake Morrison, *Lake Fidler, *Sulphide Pool, Meromictic lakes, Environmental effects, Hydroelectric plants, Dam effects, Saline water, Archaeology.

Lake Morrison, Lake Fidler and Sulphide Pool are small, ectogenically meromictic lakes which are cut off from a river curve by a silt levee deposited by the river itself. The commissioning of a dam at Strathgordon late in 1977, shortly after the lakes were discovered, poses a threat to the continuance of meromixis, because the constant high discharge maintains high flow in the river, denying access to the estuarine saltwedge. Lake Morrison has already reverted to holomixis, while sinking chemoclines and declining meromictic stabilities in the other two indicate impending loss of meromixis. At risk is not only the intrinsic nature of their meromictic systems, their ecology, and as yet undescribed microoganisms, but also the opportunity for the study of undisturbed sediments, which may yield a valuable chronological record of the period of aboriginal occupation of nearby Kutikina Cave. These were the most southerly humans on earth 20,000 years BC. Judiciously timed closures of the power station may be able to maintain meromixis in these lakes. (Moore-IVI) W85-03761

EFFECTS OF DREDGING ON THE MACRO- PHYTIC VEGETATION OF THE BORO RIVER, OKAVANGO DELTA, BOTSWANA,
Rhodes Univ., Grahamstown (South Africa). Dept. of Plant Sciences.
R. A. Lubke, P. E. Reavell, and P. J. Dye.
Biological Conservation, Vol. 30, No. 3, p 211-236, 1984. 7 Fig, 3 Tab, 19 Ref, 1 Append.

Descriptors: *Dredging, *Environmental effects, *Macrophytes, *Boro River, *Botswana, Okavango Delta, Spoil banks, Vegetation, Colonization, Species diversity, Floodplains.

The lower reaches of the Boro River were dredged in the early 1970s to increase water flow from the Okavango Swamps to the Diamond Mine at Orapa. Colonization of the spoil heaps was originally studied in 1973 and 1974, and then again in 1979. From transects taken across undredged portions of the river and accounts in the literature, a picture of the natural colonization and vegetation zonation of the Boro is constructed. Examination of dredged channels and spoil heaps by means of further transects showed how the artificially created environment was colonized and covered with vegetation after a period of 5 years. The fact that the original species diversity had not yet been attained can be accounted for in terms of the replacement of R-selected (ruderal) species by C-selected (competitive) species in a somewhat drier elevated floodplain environment. It is postulated that it will be some decades before the plant communities in these seasonally flooded melapos return to their original condition. (Author's abstract) W85-03762

7. RESOURCES DATA

7A. Network Design

RADAR PRECIPITATION ESTIMATES FOR A SOIL WATER BALANCE,
Texas Agricultural Experiment Station, Temple. Blackland Research Center.
W. A. Dugas, and G. F. Arkin.
Transactions of the ASAE, Vol. 27, No. 4, p 1034-1039, July/August, 1984. 5 Fig, 5 Tab, 9 Ref.

Descriptors: *Radar, *Remote sensing, *Precipitation, *Soil water balance, Rainfall distribution, Model studies, Crop production, Hydrologic budget.

Many agriculturally-related decisions require accurate and timely information concerning soil water status and its impact upon crop growth and development. The inherent spatial variability of precipitation makes it difficult to obtain detailed and timely information on aerial precipitation totals for

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determining soil water status. Relationships, stratified by time of year and precipitation type, to estimate precipitation for an area were developed from National Weather Service radar data and/or data from single rain gage. These relationships were used to estimate daily and weekly precipitation totals for input into a soil water balance model and comparisons were made between soil water values calculated using measured onsite precipitation and using precipitation estimated with the developed relationships. Errors in estimating daily and weekly aerial precipitation totals from radar data and/or from a single gage were large. When precipitation estimates were input to a water balance, soil water errors were reduced relative to precipitation errors. Soil errors were the same whether daily or weekly precipitation estimates were used as water balance inputs. Soil water values computed for a location with estimated precipitation were considered below measured soil water values because of underestimated early season precipitation. A single gage used to estimate aerial precipitation totals was as accurate as using the gage and the National Weather Service radar data. (Author's abstract)
W85-03394

7B. Data Acquisition

MONITORING OF THE GROUT CURTAIN OF FRAUENAU DAM (KONTROLLE DER UNTERGRUNDABDICHTUNG DES STAUDAMMES FRAUENAU),
Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
For primary bibliographic entry see Field 8E.
W85-03263

NONTIDAL WETLAND MAPPING IN SOUTH CAROLINA USING AIRBORNE MULTISPECTRAL SCANNER DATA,
South Carolina Univ., Columbia. Dept. of Geography.
J. R. Jensen, E. J. Christensen, and R. Sharitz.
Remote Sensing of Environment, Vol. 16, p 1-12, August, 1984. 3 Fig, 3 Tab, 17 Ref. DOE contract EY-76-C-09-0819.

Descriptors: *Remote sensing, *Wetlands, *Mapping, *Savannah River, *South Carolina, Vegetation, Aerial sensing, Multispectral scanner, Marshes, Swamps, Forests.

High resolution multispectral scanner (MSS) imagery of Savannah River nontidal wetlands were analyzed to identify 1) useful spectral bands for discriminating among National Wetland Inventory classes, 2) where the classes cluster in n-dimensional feature space, and 3) what wetland classification accuracies can be expected. Spectral measurements in the green (0.55-0.60 micro-m), red (0.65-0.70 micro-m), and near-infrared wavelengths (0.07-0.79 micro-m and 0.92-1.10 micro-m) provided the most useful information. Emergent marsh (both persistant and nonpersistant), scrub-shrub, mixed deciduous swamp forest, and mixed deciduous upland forest were found to cluster in somewhat predictable regions of 2- and 3-dimensional feature space. The overall classification accuracy of Steel Creek delta study area was 83% and was assessed by comparing the remote sensing derived thematic map with 1325 linear meters of transects sampled in situ. These results suggest that high resolution aircraft MSS data can provide detailed vegetation type information for mapping both thermally affected and rejuvenating nontidal wetland in the South Carolina Savannah River Swamp System. (Author's abstract)
W85-03301

EFFECTS OF CORN STALK ORIENTATION AND WATER CONTENT ON PASSIVE MICROWAVE SENSING OF SOIL MOISTURE,
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
P. E. O'Neill, T. J. Jackson, B. J. Blanchard, J. R. Wang, and W. I. Gould.
Remote Sensing of Environment, Vol. 16, p 55-67, August, 1984. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Remote sensing, *Microwaves, *Corn, *Plant water content, *Soil water, Canopy structure, Dielectric properties, Vegetation.

A field experiment was conducted utilizing artificial arrangements of plant components during the summer of 1982 to examine the effects of corn canopy structure and plant water content on microwave emission. Truck-mounted microwave radiometers at C (5 GHz) and L (1.4 GHz) band sensed vertically and horizontally polarized radiation concurrent with ground observations of soil moisture and vegetation parameters. Results indicate that the orientation of cut stalks and the distribution of their dielectric properties through the canopy layer can influence the microwave emission measured from a vegetation/soil scene. The magnitude of this effect varies with polarization and frequency and with the amount of water in the plant, disappearing at low levels of vegetation water content. Although many of the canopy structures and orientations studied in this experiment are somewhat artificial, they serve to improve our understanding of microwave energy interactions within a vegetation canopy and to aid in the development of appropriate physically based vegetation models.
W85-03302

VERSATILE DIRECTIONAL REFLECTANCE MODEL FOR NATURAL WATER BODIES, SUBMERGED OBJECTS, AND MOIST BEACH SANDS,
Environmental Research Inst. of Michigan, Ann Arbor.
G. H. Suits.
Remote Sensing of Environment, Vol. 16, p 143-156, October, 1984. 3 Fig, 15 Ref.

Descriptors: *Reflectance, *Remote sensing, *Beaches, *Surface water, Secchi disks, Optical properties, Turbidity, Suspended solids, Aquatic plants, Sand.

A reflectance model that represents the logical causal connection between the optical properties of the identifiable components of an ensemble, such as a water body or beach sand, and the spectral reflectance of that ensemble can be used for a number of important remote sensing applications without resorting to extensive field measurements. A directional reflectance model is derived with the Duntley equations providing the estimated illumination below the surface. The scattering phase functions utilize the 'model equivalent' Lambertian panel approximation for each scattering species. The model exhibits the property of optical reciprocity and offers consistent procedures for calculating directional reflectance of turbid water bodies of any depth, particulate content, and bottom vegetation cover, as well as the apparent reflectance of an isolated submerged object, such as a Secchi disc. Moist beach sands are modeled as a highly turbid water body by considering the sand grains to be suspensoids that are so dense that they rest upon each other and occupy a major fraction of the volume. Air voids between sand grains are considered to be a new species of scattering suspensoids. The model allows, as a natural extension, the computation of Secchi disc depths that can be related to remotely sensed data. (Moore-IVI)
W85-03303

INTAKES AS SAMPLING LOCATIONS FOR INVESTIGATING LONG-TERM TRENDS IN ZOOPLANKTON POPULATIONS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans, and L. E. Flath.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 10, p 1513-1518, October, 1984. Fig, 1 Tab, 12 Ref.

Descriptors: *Zooplankton, *Intakes, *Powerplants, *Sampling, *Lake Michigan, Entrainment, Crustaceans, Sediment-water interface, Copepods, Cladocerans, Cooling water.

Sampling from a limited number of representative, fixed locations such as water intakes is a method for investigating long-term trends of a water body. The representativeness of a power plant intake as a sampling location for investigating long-term trends in zooplankton populations was investigated at the Donald C. Cook Nuclear Plant. Cooling water is drawn through three intake pipes located approximately at the 7.3-m depth contour. Water enters a large intake forebay. Samples in the intake forebay were collected from a depth of 5.5 m. The intake and the inshore region (southeastern Lake Michigan) were sampled within a matter of days on 54 occasions between April 1975 and November 1981. Intake population estimates were significantly correlated with inshore region population estimates for all 26 zooplankton taxa categories analyzed. Differences in abundances in intake and inshore region samples were not significant for most euplanktonic taxa. The plant apparently entrained water and microcrustaceans from the sediment-water interface. Because vertically hauled plankton nets do not effectively sample the lower 1 m of the water column, intake sampling may provide a more accurate representation of nearshore region copepod and cladoceran community structure than traditionally employed methods for inshore region sampling. Intake sampling provides the opportunity to sample the inshore region at relatively low cost and during time periods (especially winter) when inclement weather prevents safe ship operation. (Moore-IVI)
W85-03311

AERIAL PHOTOGRAPHY FOR CONSERVATION INFORMATION AND EDUCATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
W. E. Wildman.
Journal of Soil and Water Conservation, Vol. 35, No. 9, September/October, p 297-299, 1984. 4 Fig.

Descriptors: *California, *San Joaquin Valley, *Sacramento Valley, *Aerial photography, *Water conservation, *Education, Water pollution control, Soil conservation, Flood control, Erosion, Soil erosion.

The use of aerial photography in several areas dealing with water supply and flood control is delineated. During the drought years from 1975 to 1977 in California, aerial photographs of 19 reservoirs around the Sacramento and San Joaquin Valleys were used to educate the water consumers to the fact that there was indeed a problem. Aerial photographs are also taken to obtain views of flood control systems and check on potential problems or breaks. Soil erosion, while not a major problem in California, can be shown in aerial photographs of sandy soils blowing in local areas. The light colored, windblown sand contrasts with the darker soil onto which it drifts. Pollution of various kinds is readily seen in these photographs. (Baker-IVI)
W85-03353

ELECTRONIC TRANSDUCER FOR CONTINUOUS WATER LEVEL MONITORING,
Southern Florida Water Management District, West Palm Beach, FL.
T. M. MacVicar, and M. F. Walter.
Transcations of the American Society of Agricultural Engineers, Vol. 27, No. 1, p 105-109, January/February, 1984. 7 Fig, 9 Ref.

Descriptors: *Water level, *Monitoring, *Transducers, *Piezometers, Measuring instruments, Water supply, Water management, Water resources development, Soil water, Groundwater.

The trend of recent hydrologic research has been to increase the detail of physical observations while reducing the spatial extent of the system being studied. This increase in the volume of data, together with the corresponding decrease in the separation between data sources, has encouraged the use of centrally located data acquisition systems. The lack of suitable sensing devices has severely limited the application of modern data logging techniques to field research in hydrology. A simple but reliable instrument for monitoring the underground water surface position was developed. The results of the field test of the transducer

cate that it can be used as a reliable means of ining piezometric data where the support in- mentation is available. The total cost of the uit, probe, insulation and moisture protective ting is less than $20. The lower cost of the ice, its simple design, ease of fabrication, and maintenance requirements represent significant rovements over piezometric instrumentation ch has been used in the past. There are certain ting characteristics which must be understood ore the transducer is recommended for specific lications. (Baker-IVI)
5-03371

UTRON METER CALIBRATION AND ROR CONTROL,
ricultural Research Service, Temple, TX.
primary bibliographic entry see Field 2G.
5-03375

UBLE-BUBBLERS COUPLED WITH PRES-RE TRANSDUCERS FOR WATER LEVEL NSING,
ricultural Research Service, Phoenix, AZ. ter Conservation Lab.
R. Dedrick, and A. J. Clemmens.
nsactions of the American Society of Agricul- l Engineers, Vol. 27, No. 3, p 779-783, May/ e, 1984. 5 Fig, 3 Tab, 7 Ref.

scriptors: *Water level, *Measuring instru- nts, *Pressure transducers, *Doubler-bubblers, irs, Flumes, Irrigation canals, Transducers.

e use of bubblers coupled with pressure trans- cers to sense water level are analyzed. Since ssure transducer response is affected by envi- mental factors as well as repeated use, transduc- output generally requires adjustments based on tain known conditions. The use of a single bler, two bubblers (one at a reference pressure d and one at the pressure head to be measured), l a new procedure, based on a pressure differen- , were analyzed. Transducer adjustments for n and offset changes can be made depending on bubbler configuration. The concept of measur- the pressure from two bubblers a known verti- distance apart and referencing these readings to t measured at atmospheric pressure was intro- ced. The head detection accuracy of the double- bler when using an inexpensive, nontempera- e compensated transducer, was 1 mm when nperature ranged from 10 to 49 C. Accuracy is lependent of the transducer since the system is calibrated each time a set of readings is taken. e procedure depends on a linear transducer re- nse to pressure head. The system requires an air pply, a means of flow control to each bubbler, d a technique for switching the pressure lines. vitching and subsequent recording or calculating n be done either manually or automatically. aker-IVI)
85-03385

ORTABLE RBC FLUMES FOR FURROWS ND EARTHEN CHANNELS,
gricultural Research Service, Phoenix, AZ. ater Conservation Lab.
J. Clemmens, M. G. Bos, and J. A. Replogle.
ansactions of the ASAE, Vol. 27, No. 4, p 1016- 21 and 1026, July/August, 1984. 5 Fig, 3 Tab, 11 ef.

escriptors: *Flumes, *Furrows, *Channels, ating flumes, Canals, Irrigation canals, Head loss.

new style of portable flow-measuring flume has en designed for furrows and unlined channels. nese flumes are relatively easy to install and erate. Sensitivity to leveling has been decreased placing the stilling well near the flume throat. ney are long-throated flumes and require very tle head loss for satisfactory operation. They are mple to construct since they consist of a short apezoidal section with a contraction inserted in e flume bottom. Rating tables are provided for veral standard sizes with capacities ranging from 5 to 50 L/s (0.05 to 1.8 cu ft/s). (Author's stract)
/85-03393

LANDSAT CLASSIFICATION OF THE HYDROLITTORAL AREAS OF THE BAY OF LIMINKA (GULF OF BOTHNIA, FINLAND),
Oulu Univ. (Finland). Dept. of Astronomy.
J. Raitala, J. Siira, and H. Arkimaa.
Aquilo, Vol. 20, p 14-23, 1984. 7 Fig, 7 Ref.

Descriptors: *Satellite technology, *Littoral zone, *Bay of Liminka, *Finland, *Gulf of Bothnia, Bays, Remote sensing, Mapping, Vegetation, Landsat.

The use of Landsat satellite imagery is studied in the hydrolittoral areas of the Bay of Liminka. All the water areas larger than 0.5 hectares were easily identifiable thereby permitting an accurate estimation of the extent of different hydrolittoral area types. It is possible to detect spectral differences between water areas relatively free of vegetation and those containing extensive vegetation. This data could theoretically permit an estimation of temporal variations in the littoral areas and their development on every 18th day. In selected cases such information could be used to assist in making regional planning decisions. Both scientific investigation and planning of water areas for recreational and residential use and as a source of livelihood or as a dumping place all require accurate base information about water areas in the form of orientation and classification maps, and such information can in principle, be obtained most readily by using Landsat data and the computer aided analysis of same. The exact pragmatic nature of the Landsat studies depends on the future development of Landsat analysis. (Baker-IVI)
W85-03491

COMPARATIVE UTILITY OF MICROWAVE AND SHORTWAVE SATELLITE DATA FOR ALL-WEATHER CHARTING OF SNOW COVER,
Lamont-Doherty Geological Observatory, Palisades, NY.
D. Robinson, K. Kunzi, G. Kukla, and H. Rott.
Nature, Vol. 312, No. 29, p 434-435, November, 1984. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Microwaves, *Remote sensing, *Snow cover, *Shortwave imaging, Satellite technology, Scanning Multichannel Microwave Radiometer, Hydrology, Climatology, Nimbus-7.

Charting snow cover by shortwave imaging requires visual analysis which is complicated by cloud coverage and poor surface illumination. Microwaves, however, being almost unaffected by clouds and independent of solar illumination, are potentially useful for monitoring the extent and variation in snow cover, in climatological and hydrological studies. Data from spaceborne passive microwave sensors have previously been used to chart regional overland snow cover; but charting hemispherical snow coverage was not feasible until high spatial resolution and multiple channels were combined in the Scanning Multichannel Microwave Radiometer (SMMR) launched in 1978 on the Nimbus-7 satellite. SMMR data was compared with shortwave images obtained over Asia to justify further use of microwave sensors in automated charting of seasonal snow cover under all weather conditions. Agreement between the two methods is found in approximately 75% of the tested grid points. (Author's abstract)
W85-03492

AUTOMATION OF THE MEASUREMENT OF CHLORIDES IN NATURAL AND WASTEWATERS (DIE AUTOMATISIERUNG DER MESSUNG VON CHLORIDEN IN NATURLICHEN WASSERN UND IN ABWASSERN),
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow (USSR).
S. W. Antonow, and I. A. Ostrowerch.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 9, p 313-314, September, 1983. 1 Fig.

Descriptors: *Chlorides, *Automation, *Chemical analysis, Ion-selective electrodes, Measuring instruments, Laboratory equipment, Water analysis, Wastewater analysis.

The Chloridomer ACHP-205 device has been developed in the USSR for the continuous measurement and recording of the chloride concentration in natural and wastewaters. It can be used in any such water that does not contain impurities that would affect its ion-selective electrodes. The device is installed in one casing and is composed of four units: the hydraulic unit for measuring the physical parameters of the water to be analyzed (temperature, pressure, flow speed), which must allow determination of the chlorine-ion activity by means of an electrode system (an ion-selective measurement electrode and a silver chloride reference electrode); the control unit; the measurement converter, which transforms the electrode system into a unified DC output signal; and the recording unit, which reads off the chloride concentration on a strip chart. The instrument possesses additional output signals of 0-10 and 0-100 mV that allow additional recorders. Tests were conducted at three chemical plants, which demonstrated that the ACHP-205 can be used in the presence of the most harmful ions, HCl3(-), SO4(2-), and CO3(2-) even when their concentration is 300 times greater than normal; in the presence of NO3(-) at 20 times normal concentration; and with oxidizing agents present. The device's measurement range is 20-1,500 mg/l chloride. (Author's abstract)
W85-03534

AIRBORNE REMOTE SENSING FOR FRESHWATER AND ESTUARINE MONITORING,
Freshwater Biological Association, Ambleside (England).
J. Hilton.
Water Research, Vol. 18, No. 10, p 1195-1223, 1984. 14 Fig, 2 Tab, 87 Ref.

Descriptors: *Remote sensing, *Water quality control, *Estuaries, *Monitoring, Aerial photography, Water quality, Aquatic life, Water pollution, Lakes, Rivers, Land use, Limnology.

A state of the art review of remote sensing hardware and parameters which can be measured by airborne remote sensing techniques in the aquatic environment is presented. The range of determinands which can be measured and the scale of cover available using remote sensing techniques means that it is now possible to gain a great deal of information on water bodies (standing water or estuaries). The great strength of these techniques is in their synoptic abilities and cost effectiveness. Their potential, particularly in conjunction with traditional techniques, is enormous and the newer range of sensors, e.g., lidar and spectroradiometers, promise enormous benefits to both research and monitoring and surveillance. Measurable parameters in the remote sensing of water quality include macrophyte surveys, fish counting, redd counting, turbidity, algal distribution, algal speciation, algal productivity, suspended solids, water color, trophic state or level of eutrophication, dissolved oxygen, pH, salinity, spectral signatures, oil slick detection and thickness estimates, dissolved organic pollutants, temperature, water surface wind speed and direction, wave height, spectral frequency, wave length and direction, water surface height, water movement and circulation, bathymetry, lake identification, area and volume change measurements, river channel delineation and erosion assessment, diffuse sources and land use, and water pollution integrated studies. (Baker-IVI)
W85-03538

PE-PVC-SUCTION CUP IN SANDWICH CONSTRUCTION FOR TAKING SEEPAGE WATER SAMPLES, (EINE KUNSTSTOFF-SAUGKERZE IN SANDWICHBAUWEISE ZUR GEWINNUNG VON SICKERWASSERPROBEN),
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Hydrogeologie und Hydrochemie.
B. Merkel, and R. Promper.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, No. 5, p 204-205, October, 1984. 1 Fig, 7 Ref.

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Descriptors: *Unsaturated zone, *Sampling equipment, *Suction cups, *Seepage, Soil water, Water sampling.

Water samples can be taken from the unsaturated zone either from soil samples or with the help of lysimeters or suction cups. The material suction cups are built from has a large influence on the sample water quality. Using two different porous plastic materials in a sandwich design seems to be a good compromise between chemical and hydraulic demands. (Author's abstract)
W85-03592

7C. Evaluation, Processing and Publication

ELECTRONIC DP APPLICATIONS IN THE SAALE-WERRA WATER DISTRICT (DIE ANWENDUNG DER EDV IN DER WASSERWIRTSCHAFTSDIREKTION SAALE-WERRA),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
R. Schwalenberg.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 6, p 193-194, June, 1983.

Descriptors: *Saale-Werra Water District, *Germany (Democratic Republic), *Data processing, *Planning, Microcomputers, Computers, Management planning.

Current electronic data processing (dp) applications in the Saale-Werra (German Democratic Republic) water district include long-term planning and control of the water supply; scientific and technological preliminary studies in the catchment area; forecasting and operative control; management, planning, and accounting; and mathematical/statistical analyses. The district uses a third generation minicomputer system (KRS 4200) with maximal configuration (16-K-word main memory supplemented by 4 98,304-word magnetic drum storage units and 4 360-m-long, 11-M byte magnetic tape units; 2 tape readers (1,000 and 200 characters/sec); 2 tape punchers (each 50 characters/sec); and 2 100-characters/sec line printers). According to the 1981-1985 five-year plan's directive on rational water use, dp applications and development should concentrate on water management development planning, increasing availability of the water supply, operative and long-range analysis of water resources by increased use of microelectronics, improving water pollution control, and reducing costs and raw-materials and energy usage. The plan also calls for gradual implementation of the ASU automatic system for management improvement in the water industry. Near the end of the five-year plan time period, a microcomputer system will replace the KRS 4200 (the robotron K 1630 with 128-K-word main memory). This system allows more complex dp tasks to be performed; a parallel printer and additional storage can be added. (Gish-IVI)
W85-03517

MINICOMPUTER PROGRAM FOR WATER-LEVEL CALCULATION AND FORECASTING AND ITS TESTING ON THE ODER BETWEEN EISENHUTTENSTADT AND KIETZ (KLEINRECHNERPROGRAMM ZUR WASSERSTANDSBERECHNUNG UND -VORHERSAGE UND DESSEN ERPROBUNG AM ODERABSCHNITT EISENHUTTENSTADT-KIETZ),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 2E.
W85-03518

CALCULATION OF AREAL PRECIPITATION VALUES AND THE REPRESENTATIVENESS OF PRECIPITATION MEASURING NETWORKS (ZUR BERECHNUNG VON GEBIETSWERTEN DES NIEDERSCHLAGES UND DER REPRASENTATIVITAT VON NIEDERSCHLAGSMEBNETZEN),
Meteorologischer Dienst der DDR, Berlin. Forschungsinstitut fuer Hydrometeorologie.
For primary bibliographic entry see Field 2B.
W85-03519

8. ENGINEERING WORKS

8A. Structures

DESIGN OF RESERVOIR BASINS IN FLAT VALLEYS WITH SPECIAL CONSIDERATION OF ENVIRONMENTAL ASPECTS - PRESENTED BY THE RIVER ALTMUHL DIVERSION (UMWELTFREUNDLICHE GESTALTUNG VON STAUBECKEN IN FLACHEN TALRAUMEN-DARGESTELLT AM BEISPIEL DER ALTMUHLUBERLEITUNG),
Bayerisches Staatsministerium des Innern, Munich (Germany, F.R.). Oberstem Baubehoerde.
H. Beier.
Wasserwirtschaft, Vol. 74, No. 3, p 103-108, March, 1984. 8 Fig, 3 Ref.

Descriptors: *Reservoirs, *Altmuhl, *Brombach, *Germany (Federal Republic), *Valleys, Design criteria, Planning, Environmental effects, Recreation, Landscaping, Aesthetics.

The location of the reservoir basin is in many cases predetermined by nature, particularly in mountain areas. When dams are constructed in flat valleys, the location of the basin can be based upon ecological considerations. By the construction of large reservoir basins in the flat valleys of Upper Altmuhl and Brombach a landscape is to be modeled in a way that provides rich living conditions for numerous species of animals and plants. It will also be used for various recreation activities. The design accomplishing these requirements is illustrated. Planning and construction for reservoirs in flat valleys can make multipurpose, environment-friendly configurations possible. (Moore-IVI)
W85-03249

IDEAS REGARDING THE RENOVATION/RESTORATION OF OLD DAMS (UBERLEGUNGEN ZUR SANIERUNG ALTER TALSPERREN),
Nordrhein-Westfaelen Ministerium fuer Ernaehrung, Landwirtschaft und Forsten, Duesseldorf (Germany, F.R.).
A. Spillner.
Wasserwirtschaft, Vol. 74, No. 3, p 122-126, March, 1984. 6 Fig, 5 Ref.

Descriptors: *Dam restoration, *Safety, Dam stability, Design criteria, Evaluation.

A great number of dams have been in continuous operation for many decades. It is for the sake of well-being of the public to determine systematically the need for renovation/restoration of old dams, to establish a check-list and to work out possible alternatives for the proposed works; and at the same time to assess the advantages and disadvantages of such works, in order to safeguard for the future the manifold utilization of these dams. (Author's abstract)
W85-03253

PRACTICABILITY OF DAM REHABILITATION (PRAKTISCHE MOGLICHKEITEN UND GRENZEN DER TALSPERRENSANIERUNG),
Lahmeyer International G.m.b.H., Frankfurt-am-Main (Germany, F.R.).
H.-P. Keitel.
Wasserwirtschaft, Vol. 74, No. 3, p 127-131, March, 1984. 6 Fig.

Descriptors: *Dam rehabilitation, *Algeria, *Bou Hanifa Dam, *Fergoug Reservoir, Dam safety, Dam construction, Gates, Reservoir silting, Rockslides, Developing countries.

The rehabilitation of existing dams is gaining in importance compared with the construction of new dams. Rehabilitation is distinct from modernization in that it is performed for reasons of safety, not economy, and is a cure for a problem. Two dams in northwest Algeria were rehabilitated. At the Bou Hanifa rock-wall dam (constructed like a dry stone wall), both the flood-control facility and the bottom outlet were rehabilitated. It was not possible to lower the reservoir water level, so rehabilitation of the flood-control gates was co ducted in two stages: a temporary solution, which 10 of the 16 gates were permanently sh and the remaining 6, which are evenly distribut along the weir, received new oil-driven hydraul cylinders; and a permanent solution, in which tw piers will be installed to divide the weir into thir and the 16 gates will be replaced by 3 fishbell gates. A rockslide from the left shoulder of th dam into the reservoir was stabilized by shorin the rockslide up with limestone fill, and raising th reservoir sole by 22 m, necessitating a lengthenin of the bottom outlet. At the Fergoug reservo silting resulted in a reduction in capacity from th original 17 million cu m to 3 million cu m. To million cu m of silt will be removed by two suctio dredgers and the volume of water required for s transport will be limited to 1.5 times the s volume. Some of this water may be reclaimed the future through downstream dams. The techno logical and economic feasibility of rehabilitation the third world depends largely on engineers' wil ingness to find and implement unconventional sol tions. (Gish-IVI)
W85-03254

RECONSTRUCTION OF BITUMINOUS SLOP LININGS AT DAMS AND PUMPED-STORAG RESERVOIRS (REGENERIERUNG VON AS PHALTAUBENDICHTUNGEN BEI STAUDAM MEN UND PUMPSPEICHERBECKEN),
Strabag Bau-A.G., Cologne (Germany, F.R.).
W. Haug.
Wasserwirtschaft, Vol. 74, No. 3, p 132-13 March, 1984. 6 Fig.

Descriptors: *Dam reconstruction, *Bitume *Linings, Oxidation, Solar radiation, Mastic, Bitu minous concrete, Pumped storage, Reservoir Dams.

The cause and manifestations of aging in bitum nous slope linings at pumped storage reservoirs a discussed together with methods of reconstructin the linings. The most important influences on agin are air (oxidation of bitumen) and sunlight, whic exerts a catalytic effect. This means that agin effects are seen almost exclusively above the wate surface; they usually occur after 20-30 yr of us The mastic as the uppermost is the first to sho signs of aging and becomes brittle after 10-15 y this does not compromise the sealing effect of th bituminous lining. All tears in the lining excep shear tears begin at the surface and only penetrat to a limited depth, which is dependent on the typ of lining construction, the proportion of bitumen i bituminous concrete, and aging characteristics o the bitumen. Almost all bituminous linings are full functional after 30 yr of use, but increasing mainte nance and repair costs eventually make reconstruc tion the sensible solution. Because aging is eviden at the surface, cheap cosmetic measures using ines perienced workers are sometimes attempted, but i order to be effective, reconstruction requires care ful work and experienced personnel. Reconstruc tion is achieved by cutting off the mastic and lining layers to a depth that guarantees homogeneity fo the new layer of lining. The new layer should hav an effective thickness of 6 cm; in order to cove the smoothing out of rough spots, about 200 kg/s m material is required. (Gish-IVI)
W85-03255

INTERACTION BETWEEN AN ARCH DAM AND ITS FOUNDATION (WECHSELWIR KUNG ZWISCHEN STAUMAUER UND UN TERGRUND),
Technische Hochschule Aachen (Germany, F.R.) Lehrstuhl und Inst. fuer Grundbau, Bodenme chanik, Felsmechanik und Verkehrswasserbau.
W. Wittke, and K. Gell.
Wasserwirtschaft, Vol. 74, No. 3, p 137-141 March, 1984. 10 Fig, 6 Ref.

Descriptors: *Dam stability, *Dam foundations *Arch dams, Rock mechanics, Permeability, Geologic fractures, Seepage, Foundations.

Based on a model for the mechanical behavior an the permeability of jointed rock the concept o

ity analyses for arch dams according to the so
d integrated model is presented. By means of
examples it is shown that taking into account
nteraction between an arch dam and its foun-
n the forces due to seepage through the rock
cannot be neglected. In a particular case it is
ssary to set the values for the subsoil standard
mechanics based on previously studies. In the
years, a set of rock construction projects were
ed out that in most cases represent excess
nditure. Therefore is is important that research
ne rock mechanics of a site be available and
one takes this information into account in dam
lity analysis. (Moore-IVI)
-03256

**E OF CONCRETE DAMS - LOADING AND
IGN (DIE GRUNDUNGSFUGE VON STAU-
UERN - BEANSPRUCHUNG UND KON-
UKTIVE AUSBILDUNG),**
nieurburo Dr. Kupfer, Munich (Germany,
).
inse.
serwirtschaft, Vol. 74, No. 3, p 142-146,
ch, 1984. 10 Fig, 7 Ref.

criptors: *Concrete dams, *Dam foundations,
design, Design criteria, Grouting curtain,
safety, Stress.

forces and their distribution acting on the base
oncrete dams are dependent upon the behavior
oupled system dam/foundation. In the analysis
the loadings acting on the dam and on the
are to be considered. The base of a dam has to
haped in such a way that all forces can be
smitted. Tension stresses which may cause un-
itional cracks can be avoided by artificial
s. The location and the connection of the
ting curtain with the dam are important fac-
of the dam's safety. (Author's abstract)
5-03257

**SIGN BASES OF THE ARCH DAM 'ZIL-
RGRUNDL' (GRUNDLAGEN FUR DEN
TWURF DER BOGENSTAUMAUER ZIL-
RGRUNDL),**
ernkraftwerke A.G., Salzburg (Austria).
Vidmann.
sserwirtschaft, Vol. 74, No. 3, p 147-152,
rch, 1984. 6 Fig, 1 Tab, 7 Ref.

criptors: *Zillergrundl, *Arch dams, *Dam
ndations, Foundation rocks, Gneiss, Dam
gn, Dam stability.

arch dam Zillergrundl, almost 190 m in height,
presently under construction. Founded on
iss, the vertical tension stresses at the upstream
toe depend greatly on the deformation of the
ndation rock. For the purpose of securing free-
from distortion irrespective of rock deforma-
s and without any damage to the curtain wall,
loor upstream of the dam and an upstream
ipheral joint were provided. Experience gained
ing construction of the arch dams Schlegeis and
Inbrein was used in the design. (Author's ab-
ct)
5-03258

**CENT INVESTIGATION METHODS FOR
M FOUNDATIONS (NEUERE UNTERSU-
UNGSMETHODEN FUR DIE GRUNDUNG
N ABSPERRBAUWERKEN),**
sperren-Neubauamt Nuernberg (Germany,
.).
r primary bibliographic entry see Field 8E.
5-03259

**IDENTIAL MONITORING OF DAMS (AUS-
GEFAHIGKEIT VON KONTROLLMESSUN-
N AN ABSPERRBAUWERKEN),**
hrverband, Essen (Germany, F.R.).
H. Idel.
sserwirtschaft, Vol. 74, No. 3, p 167-171,
rch, 1984. 6 Fig, 14 Ref.

escriptors: *Dams, *Monitoring, *Dam stability,
rth dams, Density, Module of elasticity, Rockfill
ms, Concrete dams, Masonry dams.

Periodical professional observation and well timed evaluation of evidential results, gives the certainty there is low risk for dams caused by unnoticed damage. With earthfill dams monitoring the earth-pressure, dry density, and module of elasticity is going to be improved and simplified. Within rock and concrete or masonry dams it is now possible to measure very small dislocations by means of electrical or mechanical sliding micrometers and to get more information for a judgement. (Author's abstract)
W85-03261

ANALYSIS OF CONTROL MEASURES IN THE FINSTERTAL ROCKFILL DAM (ANALYSE DER KONTROLLMESSUNGEN IM STAU-DAMM FINSTERTAL),
Tiroler Wasserkraftwerke A.G., Innsbruck (Austria).
H. Schwab.
Wasserwirtschaft, Vol. 74, No. 3, p 172-179, March, 1984. 9 Fig, 10 Ref.

Descriptors: *Rockfill dams, *Finstertal Dam, *Austria, *Monitoring, Dam construction, Deformation, Strain, Reservoir stages, Stress, Materials.

The Finstertal rockfill dam (149 m in height), owned by the Tiroler Wasserkraftwerke Aktiengesellschaft, was constructed from 1977 to 1980. Its comprehensive monitoring system is fitted out with 798 measuring points. An outline is given of the deformations at the end of construction, at maximum storage level in the first impounding (autumn 1981), and at the lowest level in 1983. Further, the complex stress-deformation proceedings for derivation of structural material properties in the plain-strain condition are analyzed. (Author's abstract)
W85-03262

NEW MAIN LOCK AND DAM KROTZENBURG (DIE NEUE MAIN-STAUSTUFE KROTZENBURG),
Neubauabteilung fuer den unteren Main, Aschaffenburg (Austria).
J. Mirschenz, and B. Bruck.
Wasserwirtschaft, Vol. 74, No. 4, 203-210, April, 1984. 6 Fig, 5 Ref.

Descriptors: *Krotzenberg, *Germany (Federal Republic), *Locks, Construction, Main River, Rehabilitation.

The lock at Krotzenburg is the last lock remaining from the first lock and dam system on the river Main between Offenbach and Aschaffenburg, which was installed in the years 1913 to 1920. Due to the low water depth of only 2.50 m above the sills, for lack of real forebays with lay-bys and because of the obsolete technical equipment, it represented a bottle-neck. The construction work on the new Krotzenburg lock began in May, 1979. The left weir was erected in the same year (1980) as the right weir, and at the same time the construction of the ship lock construction was begun. The opening of the new lock was scheduled for the end of 1983. (Moore-IVI)
W85-03264

RESERVOIR MURG IN GAGGENAU (MURG-STAU GAGGENAU),
Ingenieurburo Alwin Eppler, Dornstetten (Germany, F.R.).
A. Eppler, J. Misselwitz, and J. Renner.
Wasserwirtschaft, Vol. 74, No. 5, p 269-272, May, 1984. 6 Fig, 1 Ref.

Descriptors: *Murg Reservoir, *Gaggenau, *Germany (Federal Republic), Urban areas, Landscaping, Urban planning, Flood control, Reservoirs, Low flow.

Due to the immense widening of the Murg riverbed in the Gaggenau city area at low and mean water flow, wide areas fell dry during many months of the year. A solution of this problem had to be found in the course of the city center sanitation program. The problem was solved by building a dam on the Murg to create a reservoir. Along with the town-planning and landscaping aspects, the hydraulic considerations, such as the safe discharge of the flood flows and a uniform flow through the reservoir were of primary importance. (Author's abstract)
W85-03268

INFLUENCE OF GEOLOGY AND GEOTECHNOLOGY ON DAM DESIGN (DER EINFLUSS VON GEOLOGIE UND GEOTECHNIK AUF DEN ENTWURF VON TALPERREN),
Tiroler Wasserkraftwerke A.G., Innsbruck (Austria).
For primary bibliographic entry see Field 8E.
W85-03269

LANDSCAPE DESIGN HELPS SELL INNOVATIVE WASTEWATER EFFLUENT DISPOSAL SYSTEM,
For primary bibliographic entry see Field 5D.
W85-03275

SWAN LAKE: A SMALL HYDRO SCHEME FOR KETCHIKAN,
Beck (R.W.) and Associates, Seattle, WA.
G. Mekuria.
International Water Power and Dam Construction, Vol. 36, No. 10, p 16-81, October, 1984. 7 Fig, 2 Tab.

Descriptors: *Hydroelectric plants, *Alaska, *Ketchikan, *Swan Lake, Design criteria, Planning, Water management, Arch dams, Electrical transmission.

A 22.5 MW Swan Lake hydro project in southeast Alaska went on line in February 1984, ending the City of Ketchikan's dependency on non-renewable fossil-fuel for base load energy. Project features described include the elliptical arch dam, powerhouse, power conduit, switchyard, and 115 kV transmission line. The project is located in a heavily forested, mountainous area, and includes a 53 m high double curvature elliptical thin arch dam, a reservoir impounded by the dam 1.2 km from the natural outlet of the lake; a 701 m long power conduit excavated entirely in rock; a power intake structure located upstream of the dam; a conventional surface powerhouse containing two 11.25 MW hydro generating units; a Supervisory Control and Data Acquisition system; a microwave communication network; a 115 kV overland transmission line extending 50 km to the substation in Ketchikan; and maintenance personnal accommodation and port facilities. (Baker-IVI)
W85-03324

CAPACITY AND TYPE OF UNITS FOR SMALL RUN-OF-RIVER PLANTS,
Padua Univ. (Italy). Ist. di Idraulica.
L. Da Deppo, C. Datei, V. Firoetto, and A. Rinaldo.
International Water Power and Dam Construction, Vol. 36, No. 11, p 33-38, October, 1984. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Design criteria, *Hydroelectric plants, Water resources development, Evaluation, Optimization, Planning, Turbines, Hydraulic equipment, Electrical equipment.

A design criterion is presented for selecting the capacity and number of units for small run-of-river hydro plants. Attention is focused on the critical discussions about the validity of efforts applied to optimization studies for the design of such plants with reference to some reservations found in the literature. Possible waste of resources is established by applying the proposed approach and considering the relevant literature. An analysis was made of two plants, with a broad range of features of hydraulic and electric machinery. The first plant, characterized by a lower head, consists of Kaplan turbines with double regulation. The main feature of the design is the high efficiency shown even at low discharges as a fraction of the maximum discharge. The second plant, characterized by a higher head, consists of vertical or horizontal

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Francis turbines with adjustable regulation. The strong dependence of efficiencies upon the discharge, as a fraction of nominal flow, is exploited for this set of units up to the limit of null efficiency for still important flow rates. Four discharge duration curves, qualifying important hydrological regimes, have been used for design of capacity and type of units. (Baker-IVI)
W85-03327

REMEDIAL MEASURES FOR DEBRIS FLOWS AT THE AGASSIZ MOUNTAIN INSTITUTION, BRITISH COLUMBIA,
Piteau (D.R.) and Associates Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 2J.
W85-03426

PIEZOMETER-FRICTION CONE INVESTIGATION AT A TAILINGS DAM,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
R. G. Campanella, P. K. Robertson, D. Gillespie, and E. J. Klohn.
Canadian Geotechnical Journal, Vol. 21, No. 3, p 551-562, August, 1984. 8 Fig, 1 Tab, 10 Ref.

Descriptors: *Piezometers, *Friction cones, *Tailings dams, *Dam construction, *Brenda Mines, *Peachland, *British Columbia, Pore pressure, Pressure-measuring instruments, Drainage, Seepage.

Static piezometer-friction cone penetration tests (CPT) were carried out at the tailings dam at Brenda Mines, Peachland, British Columbia, to evaluate soil characteristics and pore pressure conditions in the dam and on the beach. The valley in which the tailings dam and tailings pond are situated has a steep gradient and is relatively narrow, requiring a high dam to provide the necessary storage volume. The dam will have an ultimate crest length of approximately 2000 m, a maximum base width of approximately 550 m, and a maximum height above the downstream toe of about 167 m. Several types of electric quasistatic cones were pushed to depths of 40-70 m at various locations in the dam and on the beach. The cones used included both the Fugro electric friction cone and piezometer cone, and a University of Britis' Columbia designed piezometer-friction cone. These tests represent a part of the overall geotechnical investigation to assess the suitability of the proposed embankment design for a final height of 167 m. No pore water pressures in excess of hydrostatic were observed in any of the soundings. Measurements of equilibrium pore water pressures with depth at three locations on the beach allowed a clear picture to be developed of the pore pressure gradients within the dam. All the CPT soundings in the beach area indicated a downward gradient with almost constant equilibrium water pressure with depth. This high downward gradient is indicative of the effectiveness of the drainage facilities in the dam and has signifcantly contributed to the relatively high bearing of the slimes owing to increased effective stress. Ice was encountered within the beach area. Other problems and experiences concerning quasistatic cone logging for a tailings dam are also discussed. (Collier-IVI)
W85-03428

UNCONVENTIONAL CONCEPTS FOR DYKES AND DAMS ON SOFT CLAY FOUNDATION,
Norges Geotekniske Inst., Oslo.
O. Eide, S. Lacasse, B. Kjaernsli, and P. S. Hafskjold.
Canadian Geotechnical Journal, Vol. 21, No. 3, p 581-586, August, 1984. 9 Fig, 8 Ref.

Descriptors: *Dykes, *Dams, *Dam construction, *Clays, Buttress dams, Embankments, Piles.

As an alternative to a stage-construction embankment dyke equipped with vertical drains, two buttress-type concrete dams are proposed for deep, soft clay deposits where the building of embankment dykes would involve serious difficulties and sizable expenditures. These concepts avoid the loading of the soft clay deposit with high embankments and thus reduce problems of stability and settlement. High embankment dykes may not be feasible in the case of sloping ground, even gently so, because of the lack of stability in a flake-type sliding. The advantages of the proposed concept include the absence of soil improvement measures, shorter construction time, and reduced settlements. Specific drawbacks relate to the lack of experience with buttress-type dams on soft clay foundations. (Author's abstract)
W85-03429

CHECK WEIR AT KEHL/STRASSBURG AND THE LATERAL POLDERS OF THE RIVER RHINE NEAR ALTENHEIM (DAS KULTURWEHR KEHL/STRASSBURG UND DIE SEITENPOLDER DES RHEINS BEI ALTENHEIM),
Wasser- und Schiffahrtsamt Freiburg (Germany, F.R.).
For primary bibliographic entry see Field 4A.
W85-03437

PUMPING STORAGE SCHEME GRAND'MAISON (FRANCE) (PUMPSPEICHERANLAGE GRAND'MAISON (FRANKREICH)),
G. Scheuch.
Wasserwirtschaft, Vol. 74, No. 7/8, p 386-388, July/August, 1984. 5 Fig.

Descriptors: *France, *Pumped storage, *Grand'-Maison, Hydroelectric power, Hydroelectric plants, Costs, Barrages.

In the Dauphine Alps, a pumping storage scheme is presently under construction, being an impressive combination of three separated water power stations. The maximum head between the upper and the lower storage basin is about 1000 m. The earthfill dam with a height of 140 m has a volume of 12.5 million cu m and is at the same time representing a very unusual barrage in France. The total construction costs amount to about 3 billion French Francs. (Author's abstract)
W85-03442

MULTI-PURPOSE PROJECTS FOR WATER STORAGE AND AQUEDUCTS IN BADEN-WURTTEMBERG (MEHRZWECKPROJEKTE FUR WASSERSPEICHERUNG UND WASSERUBERLEITUNG IN BADEN-WURTTEMBERG),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
J. Giesecke.
Wasserwirtschaft, Vol. 74, No. 9, p 411-428, September, 1984. 14 Fig, 5 Tab, 39 Ref.

Descriptors: *Baden-Wurttemberg, *Germany (Federal Republic), *Aqueducts, Mittlerer Neckarraum, Irrigation, Heated water, Rainfall distribution, Water resources development, Storage reservoirs.

All measures with respect to water resources policy are based on the need of water for the population, for agricultural and industrial purposes; but also as protection against destructive effects which water may have. By means of storage, it is possible to achieve a balance in quality, quantity and time between water availability and water demand. Multi-purpose projects comprise various objectives. Alternatively to the storage of water, various types of aqueducts become necessary to transport water over large distances to areas with water shortage from such areas disposing of excessive water. A number of multi-purpose projects with respect to the policy of water quantity and water quality exist in Baden-Wurttemberg. Here, the highly industrialized so-called 'Mittlerer Neckarraum' has to be specially mentioned. In this area, unfavorable precipitation and discharge conditions, large quantities of wastewater, high demand of drinking and industrial water have to be dealt with as well as the disposal of waste heat deriving from thermal power stations and agricultural irrigation systems. (Author's abstract)
W85-03443

BOTTOM AERATION TO PREVENT SPILLWAY CHUTES FROM CAVITATION EROSION (SOHLENBELUFTUNG GEGEN KAVITATIONS-SEROSION IN SCHUSSRINNEN),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
P. Volkart.
Wasserwirtschaft, Vol. 74, No. 9, p 431-435, September, 1984. 7 Fig, 19 Ref.

Descriptors: *Cavitation, *Aeration, *Concrete, *Chutes, Bubbles, Construction materials, Spillways, Epoxy, Design criteria, Hydraulics.

Cavitation erosion in chute spillways occurs when cavitation bubbles collapse close to the spillway bottom under high implosion pressure, creating roughness and scars in the concrete. Susceptible spots are the gate slot, seams, ribs, transitions from smooth to rough surface and shallow to steep slope, and convex curves. For water flow speeds on the spillway of 15-18 m/sec, the use of high quality concrete is sufficient to prevent erosion; up to 22 m/sec, epoxy or steel coatings or steel-fiber reinforced concrete can be effective. Bottom aeration is recommended for flow speeds to 35 m/sec and even to 50 m/sec: a ramp installed on the spillway lifts the stream of water, and a ventilation system introduces air into the cavity between the chute bottom and the elevated stream. The aeration area consists of a section with a compact lower boundary of the projectile jet (shear zone with speed rearrangement); a flow section, in which the jet is broken up from below and sprayed out (spray zone); and a section in which the air enriched jet meets the chute bottom (mixing zone). Detailed planning, including model studies, should be performed to determine the most suitable aeration system; influencing factors are ramp geometry, type of ventilation, distance the jet is projected, and cross-distribution of speed and pressure. Ramps fall into three categories; the slot, the deflector, and the step. In practice, the preferred type is a combination of step and small deflector, though in wide chutes, a combination of all three types may be used. It is possible to calculate the specific aeration through modelling and evaluating published data provided that the geometry of the aerator and that of the air application is accounted for. The aerator should cover the entire width of the spillway. The distance between aerators depends on flow speed and amount of air introduced and is usually between 30 and 100 m. Further research is required to clarify certain physical principles of the procedure. (Gish-IVI)
W85-03444

60 YEARS OF THE RIVER INN POWER PLANT TOGING-JETTENBACH (60 JAHRE INNKRAFTWERK TOGING-JETTENBACH),
H. P. Hack.
Wasserwirtschaft, Vol. 74, No. 10, p 475-479, October, 1984. 7 Fig, 6 Ref.

Descriptors: *River Inn, *Toging-Jettinbach power plant, *Hydroelectric power, *History, *Bavaria, *Germany (Federal Republic), Canals, Engineering, Electric powerplants, Water resources development.

The power station Toging-Jettenbach was built 6 years ago, during a period of extreme economic difficulties. At that time it was the biggest canal power plant in Central Europe and a pioneer work in hydro engineering. After 60 years of operation we are looking back on a successful period, in whose beginnings the foundations of the industrial development of Southeast Bavaria were laid. (Author's abstract)
W85-03447

CONDITION AND RECONSTRUCTION OF DAMS (ZUSTAND UND REKONSTRUKTION VON TALSPERREN),
E. Ander.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 4, p 74-76, May 1984. 3 Fig.

Descriptors: *Dam reconstruction, *German (Democratic Republic), Dam safety, Dam founda

s, Concrete, Maintenance, Dam design, Cavita-
, Erosion.

e reconstruction of existing dams in the German
nocratic Republic (GDR) is an important part
vater-management policy. The age structure of
is in the GDR, 69 built before 1920, 52 between
0 and 1945, largely determines the reconstruc-
program since most damage is caused by
g. Typical damage includes softening of the
wn, erosion of flood-control facilities and of
crete where water level varies, loosening and
truction of concrete reinforcing layers, washing
y of joints, weathering and leaching of soluble
ding materials, formation of tears in bituminous
e linings, and corrosion of fittings. Causes of
other than aging, include inadequate study of
foundation, faulty design, construction, or use
ew materials, disregarding water quality, and
dequate maintenance. In the last 10 years,
ned preventive maintenance has increased. All
air/reconstruction decisions are based on scien-
methods and study of the foundation, the dam
f, and its facilities. Centralized evaluation of
analysis of existing conditions and coordination
he reconstruction program is necessary. Recon-
ctive procedures include renewal of dam drain-
systems using chemical processes; injection of
crete, cement, and plastics for repairs and rein-
cement; and use of reinforcement on bottom-
et pipelines to prevent cavitation. (Gish-IVI)
5-03450

**JDIES ON SECURING AND INCREASING
E EFFECTIVENESS OF OLDER DAMS
ITRAGE ZUR SICHERUNG UND ERHO-
NG DER EFFEKTIVITAT ALTERER TAL-
ERREN),**
itut fuer Wasserwirtschaft, Berlin (German
.).
primary bibliographic entry see Field 4A.
5-03451

**OBLEMS IN RECONSTRUCTING GRAVITY
MS - STRESS-DEFORMATION ANALYSIS
R AN ADDED CONCRETE COATING
OBLEME DER REKONSTRUKTION VON
WICHTSSTAUMAUERN-SPANNUNGS-
RFORMUNGSANALYSE FUR EINEN VOR-
TZBETONMANTEL),**
itut fuer Wasserwirtschaft, Berlin (German
.).
eifert, K. Girod, A. Musch, and W. Schumann.
sserwirtschaft - Wassertechnik, Vol. 34, No. 4,
9-84, May, 1984. 12 Fig, 4 Ref.

scriptors: *Dam reconstruction, *Gravity dams,
ress deformation, *Germany (Democratic Re-
lic), Concrete, Drainage, Dam construction,
ss, Model studies, Computers.

method for reconstructing masonry gravity
is of the type found in the Mittelgebirge, a
ntain range in the German Democratic Repub-
includes sealing the entire upstream side of the
wall with an added concrete coating 2.5-m
k near the crown and 6 m thick at the base
h expansion joints every 5 or 10 m. Stress-
ormation calculations were performed by a
te-element method computer program, and se-
ed generalized investigations of stress-induced
ical phenomena were carried out using a model
ss-section. Tearing out the old concrete shield
ot required; a forced compounding of new and
elements (e.g., by means of anchoring) would
to the detriment of the stress regime in the old
and is unnecessary due to the low level of
tive displacement. The dam crown should be
onstructed so that it can absorb relative dis-
cement without damage, and sealing measures
required in the foundation area for the joint
ween the new coating and the concrete shield
he old dam as is a new drainage system for both
joint and the joint between the old concrete
ld and the wall of the old dam. (Gish-IVI)
5-03452

**PECTS OF EVALUATING THE REHABILI-
TION OF THE FOUNDATION AT THE
LDENBURG DAM (EINIGE ASPEKTE ZUR**

**AUSWERTUNG DER UNTERGRUNDSANIER-
UNG AN DER TALSPERRE MULDENBERG),**
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
V. Helbig.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 4, p 86-88, May, 1984. 5 Fig, 3 Tab, 4 Ref.

Descriptors: *Muldenberg dam, *Germany (Democratic Republic), *Dam foundations, Grout curtains, Sealing, Cement injection, Foundation rehabilitation, Dam construction.

Statistical models were used to evaluate primary data obtained during 15 yr of sealing work (injection process) carried out at the Muldenberg dam in the German Democratic Republic. Sealing consists of a double-row grout curtain; for the first 90 m, 2 drillings/m were injected with cement suspension, while for the remainder, other than in the two bottom-outlet areas, 4 cement and 2 chemical drillings/m were used. Both bottom-outlet areas were additionally injected through drillings inclined 45 or 68 degrees to the curtain axis. Chemical drillings were done one to two years after the cement injections between the two rows. The volume of cement injection at Muldenburg (2,600,00 kg) was the lower than any reported in the literature. The drilling as m/sq m curtain surface and total drilling meters were the highest reported figures at 6.3 and 67,200, respectively; reasons for this were the small distance of 0.5 m between drill holes and the fact that the curtain has two rows. When figures for chemical and control drillings and for drilling into the curtain area were included, the drilling distance totalled 498,000 m; this was required by stepwise compression from top to bottom in 2.5-m sections. (Gish-IVI)
W85-03454

INCREASE OF CAPACITY OF THE WEIDA-TAL DAM SYSTEM (DIE STEIGERUNG DER LEISTUNGSFAHIGKEIT DES SYSTEMS DER WEIDATALSPERREN),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
For primary bibliographic entry see Field 4A.
W85-03455

REHABILITATION OF THE BITUMINOUS SLOPE LINING AT THE OHRA DAM (SANIERUNGSARBEITEN AN DER BITUMINOSEN AUBENHAUT DER OHRA-TALSPERRE),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
S. Loer, and W. Kaden.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 4, p 91-93, May, 1984. 5 Fig, 2 Ref.

Descriptors: *Linings, *Bitumen, *Dam rehabilitation, *Ohra Dam, *Germany (Democratic Republic), Rockfill dams, Expansion joints, Mastic, Maintenance.

A procedure for rehabilitating bituminous slope lining without replacing the entire lining was used at the Ohra dam, Saale-Werra district, German Democratic Republic. The Ohra dam is representative of a series of rockfill dams that require such work. The lining displayed damage to the expansion joints, to the bituminous concrete in the upper of the two layers comprising the upper lining, and to the surface sealing; all types of damage included cracks, peeling, loosening of adhesive, cavities, and erosion. The goal of rehabilitation was to restore the upper lining to its function as a protective layer against erosion, to seal cracked expansion joints and to construct new ones, and to repair other damage. Damaged joints were cut down to the lower lining, cleaned manually and dried, and sealed with tape. Cavities/hollows in the upper lining were cut into rectangular form, cleaned, painted with an adhesive base, and filled with lean, cold bituminous mastic. The availability of suitable equipment is essential for effective rehabilitation; in this case, the carborundum saw for cutting the damaged surface and joints and the 'replastering' device for filling cavities were design and built specifically for the project. This technique and equipment will enable dam operators to carry out small repairs of damage in its early stages using their own personnel. (Gish-IVI)
W85-03456

REPAIRS AND RECONSTRUCTION OF DAMS IN THE CSSR (REPARATUREN UND REKONSTRUKTION VON TALSPERREN IN DER CSSR),
Brno Univ. (Czechoslovakia). Faculty of Natural Sciences.
M. Brousek.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 4, p 94-96, May, 1984. 9 Fig, 9 Ref.

Descriptors: *Czechoslovakia, *Dam construction, *Reconstruction, Maintenance, Earth dams, Concrete dams, Gravity dams, Butress dams, Flood control.

Repairs and reconstructive measures at several dams in Czechoslovakia are briefly described. Such measures prolong the life of a dam and are significantly less expensive than building new facilities and researching and making available new sources of water. The Pilska earth dam, built in 1853, was expanded at the end of the 1950's to meet an increased water demand: the height was increased by 1 m, the downstream side reinforced, and the flood-control facility expanded. Current repairs at the Jevisovice masonry dam (25.5 m high, built 1894-1896) aim to improve stability by anchoring in the underlying rock. Measures to reduce seepage at the Labska masonry dam constructed between 1910 and 1916 began in 1966 and lasted 16 yr. Repairs required for similar reasons at the Bystricka masonry dam (built 1908-1912) were performed in 1965-1967. Stability at the Vir I concrete gravity dam on the Svratka river was endangered by failure to account for geological conditions; to combat this, resistance to displacement was raised by inserting specially designed wedges between the downstream dam foot and special pier struts. At the Vir II concrete butress dam, the entire concrete coating had to be replaced in 1975. Reconstruction of flood-control facilities was carried out at the Mostiste and Terlicko dams, because inadequate design had resulted in damage occurring during flood conditions. (Gish-IVI)
W85-03457

SIMPLE THEORY FOR DESIGNING TIDAL POWER SCHEMES,
Institute of Oceanographic Sciences, Birkenhead (England).
D. Prandle.
Advances in Water Resources, Vol. 7, No. 1, p 21-27, March, 1984. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Tidal powerplants, *Design criteria, *Tidal range, Turbines, Sluices, Tidal amplitude, Powerplants.

Basic parameters governing the design of tidal power schemes are identified and converted to dimensionless form by reference to (i) the mean tidal range and (ii) the surface area of the enclosed basin. Optimum values for these dimensionless parameters are derived and comparison made with actual engineering designs. A theoretical framework is thus established which can be used (i) to make a rudimentary design at any specific location or (ii) to compare and evaluate designs for various locations. Both one-way (flood or ebb) and two-way (flood and ebb) schemes are examined and, theoretically, the two-way scheme is shown to be more efficient. However, in practice, two-way schemes suffer disadvantages arising from (i) two-way flow through both turbines and sluices and (ii) lower average turbine heads. An important dimensional aspect of tidal power schemes is that, while energy extracted is proportional to the tidal amplitude squared, the requisite sluicing area is proportional to the square root of the tidal amplitude. In consequence, sites with large tidal amplitudes are best suited to tidal power development whereas for sites with low tidal amplitudes sluicing costs may be prohibitive. (Author's abstract)
W85-03476

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Field 8—ENGINEERING WORKS

Group 8A—Structures

LOWERING OF THE WATER LEVEL AT WATERTIGHT REINFORCEMENTS (WASSERSPIEGELSENKUNG BEI DICHTEN DECKWERKEN),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
E. Lattermann, and M. Alexy.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 6, p 209-211, June, 1983. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Earth dams, *Dam construction, Concrete construction, Construction materials, Dams, Water level fluctuations.

The use of watertight materials (e.g., cement, concrete) as a reinforcing layer applied to earth dams to protect them from mechanical breakdown is increasing. Calculations are presented to solve two problems for watertight reinforcements, filters, and the raising and lowering regimes of the outer water level: setting of a permissible water-level lowering (WLL) speed for a given excess interior water pressure (EIWP); and determination of the greatest EIWP for a given WLL speed. Approximation procedures for determining maximal excess pressure resulting from outer WLL are given together with possible applications and examples. The maximal EIWP level is dependent on three major factors: WLL speed, the permeability factor of the filter, and the arrangement of discharge openings. Other influencing factors include the inclination of the dam, the seepage path that is independent of the water level under the reinforcing layer, and the interval between WLL incidents. These calculations should aid in reinforcement design and in optimizing water-level raising and lowering regimes for existing dams. (Gish-IVI)
W85-03521

OBSERVATIONS FROM THE SOCIETAL CONTROL OF NATURAL WATERS AND WATER FACILITIES DURING THE 1983 SPRING DIKE AND RIVER INSPECTION (ERFAHRUNGEN AUS DER GESELLSCHAFTLICHEN KONTROLLE DER GEWASSER UND DER WASSERWIRTSCHAFTLICHEN ANLAGEN WAHREND DER FRUHJAHRSDEICH- UND FLUSSSCHAU 1983),
Rat fuer Umweltschultz und Wasserwirtschaft Cottbus (German D.R.).
For primary bibliographic entry see Field 6E.
W85-03528

OBSERVATIONS FROM THE EXECUTION OF WATER INSPECTIONS IN THE SCHWERIN DISTRICT (ERFAHRUNGEN BEI DER DURCHFUHRUNG VON GEWASSERSCHAUEN IM BEZIRK SCHWERIN),
Rat fuer Umwelschutz und Wasserwirtschaft Mageburg (German D.R.).
For primary bibliographic entry see Field 6E.
W85-03529

OBSERVATIONS FROM THE EXECUTION OF DIKE AND DRAINAGE DITCH INSPECTION IN THE MAGDEBURG DISTRICT (ERFAHRUNGEN BEI DER DURCHFUHRUNG VON DEICH- UND GRABENSCHAUEN IM BEZIRK MAGDEBURG),
Rat fuer Unweltschutz, Wasserwirtschaft und Erholungswesen Schwerin (German D.R.).
For primary bibliographic entry see Field 6E.
W85-03530

SEISMIC STABILITY OF THE MINGECHAUR DAM,
N. D. Krasnikov, G. S. Tolkachev, A. P. Troitskii, V. I. Khor'kov, and A. I. Smil'tnek.
Hydrotechnical Construction, Vol. 18, No. 1, p 8-13, January, 1984. 5 Fig, 2 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 8-13, January, 1984.

Descriptors: *Dams, *Mingechaur Dam, *Kura River, *USSR, *Seismic properties, Construction materials, Soil physical properties, Slope stability, Slopes, Earthquake engineering.

The seismic stability of the Mingechaur Dam on the Kura River (USSR) was investigated. The investigations included: a determination of the dynamic deformation characteristics of the dam materials; a calculation of the frequency and modes of free vibrations of the dam and inertial loads acting on it; a calculation of the static and dynamic stress-strain state of the structure; an evaluation of the dynamic stability of the structure and possibility of the liquefaction of the saturated soils of the dam; and a check of the stability of the slopes of the dam under seismic loads. On the basis of these investigations it was concluded that the saturated soils of the Mingechaur Dam under a seismic action corresponding to the design earthquake with intensity of eight to be dynamically stable, and the Mingechaur Dam to be meeting the requirements of the exisiting design criteria with regard to the seismic stability of its slopes and soils. (Shieh-IVI)
W85-03578

STUDY OF THE SEEPAGE AND PIPING STABILITY OF DOLOMITE SOIL AND EVALUATION OF ITS SUITABILITY FOR A DAM CORE ON A ROCK FOUNDATION,
For primary bibliographic entry see Field 8D.
W85-03579

CANALS UNDER BLIZZARD CONDITIONS,
E. A. Smirnov, A. F. Litninyuk, and V. N. Karnovich.
Hydrotechnical Construction, Vol. 18, No. 1, p 25-29, January, 1984. 2 Fig, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 20-23, January, 1984.

Descriptors: *Canals, *Blizzards, *Snow, *Irtysh-Karaganda Canal, *USSR, Drifting snow, Design criteria.

Recommendations regarding canal design, construction and operation under blizzard conditions are presented. These are based on the Soviet experience with the Irtysh-Karaganda Canal (USSR). The principal issue of concern is that of drifting snow. Procedures are discussed for handling this problem. The generalized approach includes calculation of the volume of regional snow transport; determination of the snow inflow to stretches of the canal; and, design of exposed canal stretches in order to minimize snow accumulation. Emphasis is placed on the need to consider the probability of occurrence of snow transport and it is suggested that extreme values, i.e., severe blizzards, be used as the basis of design calculations. (Keenan-IVI)
W85-03581

STUDY OF A WATER-HAMMER PROTECTION SYSTEM IN LINE (ETUDE D'UN SYSTEME ANTI-BELIER EN LIGNE),
Ecole Nationale Superieure d'Arts et Metiers, Paris (France).
F. Massouh, and R. Comolet.
Houille Blanche, Vol. 5, p 355-361, 1984. 10 Fig, 7 Ref.

Descriptors: *Water hammer, *Plumbing, *Pipes, Wave velocity, Water transport, Water distribution.

A water-hammer protection device is presented. This device is based on the principle of reducing wave velocity in a piece of pipe through which the wave passes. The wave velocity is reduced using both the properties of tubes with high-distendibility wall and air compressibility. Theoretical analysis of wave velocity is developed, and verified experimentally on a prototype by means of a volumetric method which is also presented. Finally, from a comparison between water-hammer measurements in an actual pipe network with or without the prototype, it is possible to assess the efficiency of this protection device. (Author's abstract)
W85-03588

'TRAP-DAMS': ARTIFICIAL SUBSURFACE STORAGE OF WATER,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Land Improvement and Drainage.
For primary bibliographic entry see Field 3B.
W85-03699

8B. Hydraulics

DYNAMIC PROCESSES IN PIPELINE SY TEMS AND THEIR CONSEQUENCES (DYN MISCHE VORGANGE IN ROHRLEITUNGE UND IHRE AUSWIRKUNG),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wa serbau.
For primary bibliographic entry see Field 8C.
W85-03265

DISCHARGE COMPUTATION IN GRAVE RIVERS (ABFLUBBERECHNUNG IN KIE FUHRENDEN FLUSSEN),
Eidgenoessische Technische Hochschule, Zuri (Switzerland). Versuchsanstalt fuer Wasserba Hydrologie und Glaziologie.
For primary bibliographic entry see Field 2E.
W85-03267

BOTTOM AERATION TO PREVENT SPILL WAY CHUTES FROM CAVITATION EROSIO (SOHLENBELUFTUNG GEGEN KAVITATIO SEROSION IN SCHUSSRINNEN),
Eidgenoessische Technische Hochschule, Zuri (Switzerland). Versuchsanstalt fuer Wasserba Hydrologie und Glaziologie.
For primary bibliographic entry see Field 8A.
W85-03444

EFFECT OF SEDIMENT-TRANSPORTIN FLOW ON THE DESIGN OF HYDRAULI STRUCTURES,
V. G. Sanoyan.
Hydrotechnical Construction, Vol. 18, No. 1, p 3 36, January, 1984. 6 Fig, 18 Ref. Translated fro Gidroteknicheskoe Stroitel'stvo, No. 1, p 23-2 January, 1984.

Descriptors: *Sediment transport, *Hydrau design, *Flow, *Mud flows, Suspended sedimen Unsteady flow, Nonuniform flow, Design criteri

A new design procedure was developed for h draulic structures to convey sediment-transporti flow, especially mud flows, based on the properti of open-channel flow maximally saturated wi sediment. In many, it is necessary to determine t transportation capacity of a flow with respect solid matter under conditions of unsteady, no uniform flow. The amount of solid matter per u volume is directly proportional to the total m chanical energy of the flow per unit mass throu that volume. This relationship was expressed f one-dimensional flow and design relations for h draulic structures were developed for transporti mudflows. The main design goal is the requireme that sediments not be deposited during passa through the structure. (Keenan-IVI)
W85-03582

SUMMARY OF RESEARCH WORK ON CAV TATION (ESSAI DE SYNTHESE DES R CHERCHES SUR LA CAVITATION),
Institut National des Sciences Appliquees de Ly Villeurbanne (France). Lab. de Traitement Signal et Ultrasons.
G. Gimenez.
Houille Blanche, No. 5, p 323-337, 1984. 124 Re

Descriptors: *Cavitation, *Fluid mechanics, Flo Boiling, Bubbling.

A general description of the cavitation phenom non is given. Having indicated under what cond tions cavitation can occur, the author gives t reasons why this phenomenon is deleterious b also describes situations where it is needed. T problem of the distinction between cavitation a boiling together with the question of nuclei a then covered. The various effects of cavitation a examined in detail and a chronological summary the work carried out on the dynamics of bubbles given. The present situation with respect to r search in the field of cavitation, particularly France, is summarized. A brief report on the a tivities of the Cavitation working group recent

ied within the Fluid Mechanics division of the ete hydrotechnique de France concludes the er. (Author's abstract)
5-03586

PIRICAL CONTRIBUTION TO THE DY OF SWELL PROPAGATION IN A EAKWATER (CONTRIBUTION EMPIRI- E A L'ETUDE DE LA PROPAGATION DE HOULE A L'INTERIEUR DES DIGUES),
oratoire Public d'Essais et d'Etudes, Casablan- Morocco).
Iakimi, A. Diouri, and M. Kaissoun.
ille Blanche, Vol. 5, p 369-373, 1984. 2 Fig, 3

criptors: Jorf Lasfar, *Morocco, *Breakwaters, ell propagation, *Waves, Wave propagation, lls, Piezometers, Tetrapods, Riprap, Hydrau-

surements were carried out during the build- of the Jorf Lasfar (Morocco) breakwater in r to study the hydraulic system set up within breakwater by swell. The breakwater is of a sical type: a slope, exterior shell, 20 cu m apods, riprap substratum, with a central core of rted material. Four piezometers were placed in the breakwater for the study of the stabiliza- of the crown and the effects of subpressure. forces depend on the roughness of the water ne foot of the breakwater and the manner in ch swells are propagated and die out. Most of energy of the swells is dissipated by the shell. amplitude of the largest fluctuation in the kwater is 1.7 m when the exterior swell is 9 m. period of the fluctuations in the breakwater is tically double the period of the swell. (Collier-
)
5-03589

TER HAMMER: CAUSES AND EFFECTS,
ner Associates, Carlisle, PA.
. Kroon, M. A. Stoner, and W. A. Hunt.
nal of the American Water Works Associa- , Vol. 76, No. 1, p 39-45, November, 1984. 16 15 Ref.

criptors: *Water hammer, *Fluid mechanics, ves, Pipes, Water conveyance, Surges, Surge trol devices.

principles and causes of water hammer are ewed as a reminder that engineers, operators, managers of water systems should have at least ntuitive understanding of this hydraulic phe- enon. Potential water hammer problems uld be considered when any pipeline design is uated, and a thorough surge analysis should be ertaken in many instances to avoid costly mal- ctions in a distribution system. A basic under- ding of the water hammer is sought by examin- a single water hammer event in a simple one system. The system consists of a large reser- , a single pipe with continuous diameter, and a ve at the downstream end. The pipe is assumed ave negligible pressure drop caused by friction. pressure drop in the system occurs across the ve which is assumed to operate instantaneously. ious surge control devices are considered ch help alleviate the problems associated with er hammer. These include vacuum breaker ves, relief valves, standpipes or surge tanks, air les and accumulators. (Baker-IVI)
5-03626

TERNATIVE APPROACH TO LINEAR AND NLINEAR STABILITY CALCULATIONS AT NITE REYNOLDS NUMBERS,
versity Coll., London (England). Dept. of thematics.
T. Smith, D. Papageorgiou, and J. W. Elliott.
rnal of Fluid Mechanics, Vol. 146, p 313-330, 4. 5 Fig, 26 Ref.

criptors: *Fluid mechanics, *Reynolds number, ydrodynamic stability, Boundary conditions, annel flow, Mathematical studies.

extended version of the interactive boundary- er approach which has been used widely in steady-flow calculations is applied here to the linear and nonlinear stability properties of channel flows and boundary layers in the moderate-to-large Reynolds-number regime. This is the regime of most practical concern. First, for linear stability the agreement found between the interactive approach and Orr-Sommmerfeld results remains fairly close even at Reynolds numbers as low as about 1/10 of the critical value for plane Poiseuille flow, or 1/5 for Blasius flow. Secondly, nonlinear unsteady calculations and comparisons with full solutions obtained by enlarging the same method are also presented. Overall the work suggests that, at the finite Reynolds numbers where real interest lies, the dominant physical processes of instability in channel flow and boundary layers are of boundary-layer form, with interaction, and it suggests also an alternative numerical technique for determining those processes. This alternative technique uses the interactive boundary-layer method as the central means for obtaining full unsteady Navier-Stokes solutions. (Author's abstract)
W85-03749

DEVELOPMENT OF FINITE-AMPLITUDE DISTURBANCES IN POISEUILLE FLOW,
Akademiya Nauk SSSR, Novosibirsk. Inst. Teoreticheskoi i Prikladnoi Mekhaniki.
V. V. Kozlov, and M. P. Ramazanov.
Journal of Fluid Mechanics, Vol. 147, p 149-157, October, 1984. 8 Fig, 17 Ref.

Descriptors: *Turbulence, *Poiseuille flow, Fluid mechanics, Channel flow, Pipelines, Hydrodynamics, Vortices, Flow.

Systems with internal flow such as pipelines and channels are widespread in practice, and investigation of the flow structure at transition to turbulence is a very important problem for such systems. The process of three-dimensional distortion of previously two-dimensional disturbances was investigated in a rectangular channel. The three-dimensional structures at the breakdown station of the two-dimensional wave were studied by flow visualization. The transition to turbulence happens in a spatial development of the hydrodynamic stability waves like Tollmien Schlichting waves, via three-dimensional distortions, the formation of vortices in the shape of the letter Lambda, and their breakdown into turbulence. The spanwise size of a Lambda-shaped vortex seems to be invariant, independent of frequency of the disturbances, and the parameters of the flow, but apparently dependent on the channel width. (Moore-IVI)
W85-03750

8C. Hydraulic Machinery

DYNAMIC PROCESSES IN PIPELINE SYSTEMS AND THEIR CONSEQUENCES (DYNAMISCHE VORGANGE IN ROHRLEITUNGEN UND IHRE AUSWIRKUNG),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
J. Giesecke.
Wasserwirtschaft, Vol. 74, No. 4, p 216-224, April, 1984. 12 Fig, 1 Tab, 9 Ref.

Descriptors: *Water hammer, *Pipelines, Gate valves, Velocity, Pressure waves, Mathematical equations, Hydrodynamics.

The fundamentals of a water hammer calculation are presented by means of a single-file pipe between a storage tank and a gate valve, whereby flows with and without friction, different closure times of the gate valves as well as different pressure wave velocities were observed. An example for the application of the water hammer calculation underlines the simple handling of the diagrams which refer to dimensionless units. (Author's abstract)
W85-03265

PRESSURE SURGES IN WATERSYSTEMS OF HIGH PRESSURE PLANTS (DRUCKSCHWANKUNGEN IM WASSERFUHRUNGSSYSTEM VON HOCHDRUCKANLAGEN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
G. Lein.
Wasserwirtschaft, Vol. 74, No. 5, p 255-260, May, 1984. 8 Fig, 2 Ref.

Descriptors: *Hydroelectric plants, *Surge tanks, *Surges, Frequency response, Effective load.

In water power plants with a surge tank it is advisable to check the total system - without partitioning into different parts - with respect to transients in an early stage of the project. In this way the effective loads which have to be expected can be received in time. For complicated systems it may be advantageous to regard the oscillating condition (frequency response) before calculating real control operations. (Author's abstract)
W85-03266

HISTORICAL OVERVIEW OF CROSS-FLOW TURBINE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
S. Khosrowpanah, M. L. Albertson, and A. A. Fiuzat.
International Water Power and Dam Construction, Vol. 36, No. 10, p 38-43, October, 1984. 4 Fig, 14 Ref.

Descriptors: *Turbines, *Cross-flow turbines, *History, Developing countries, Water resources development, Dissolved oxygen, Hydroelectric plants.

The historical development of the cross-flow turbine both theoretically and experimentally is discussed. Specific references are made to the most recent work done on the machine at Colorado State University. The turbine has unique and inherent advantages in that the nozzle and runner discs can be made of steel plate and the blades can be cut from steel pipe, making design and construction simple. The most valuable feature of the cross-flow turbine has been said to be the favorable shape of its efficiency curve, particularly with the use of divided guide vanes. This is particularly important for small run-of-the-river power plants. Objects entering the blades in the first stage tend to be washed out after half a revolution of the runner by the outgoing water, assisted by centrifugal force. The first cost of a cross-flow machine is less than that of any kind of turbine used for low head hydropower. The maintenance and operating cost of the cross-flow is lower than that of any other turbine. Suitable specific speed for use on generators, corn mills, saw mills, farm machinery, workshops, and pumping installations is available. There is a possible effect on stream ecology through increasing dissolved oxygen content. Adaptability to draft tubes, freedom from cavitation and low civil work costs are also significant factors. There are thousands of sites in the remote areas of the less developed countries at which the cross-flow machine would be highly appropriate for small scale hydropower development. (Baker-IVI)
W85-03328

MODERN SMALL WATERTURBINE/TUBECASING-PUMP (EINE MODERNE KLEINWASSERTURBINE BZW. ROHRGEHAUSEPUMPE),
R. Wieser.
Wasserwirtschaft, Vol. 74, No. 7/8, p 383-385, July/August, 1984. 5 Fig.

Descriptors: *Turbines, *Tubecasing pumps, *Pumps, Irrigation, Developing countries, Hydroelectric power, Costs, Crop yield, Dams, Pumping plants.

The recent rise in price of crude oil and natural gas necessitates the economic exploitation of waterpower resources worldwide. In many developing countries there is a lack of good nutrition; in these states it is necessary to increase the production of food. This is possible by a broad application of field irrigation. The author presents a proposal for a low-cost waterturbine for a small discharge and its favorable arrangement on simple dams. He also

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describes a tubecasing-pump of similar design in a tropical pumping station. (Author's abstract)
W85-03441

EXPERIENCE IN THE OPERATION OF HYDRAULIC STRUCTURES AND EQUIPMENT OF HYDROELECTRIC STATIONS,
I. S. Gurbanov.
Hydrotechnical Construction, Vol. 18, No. 1, p 37-38, January, 1984. 2 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 28-29, January, 1984.

Descriptors: *Turbines, *Hydroelectric plants, *Hydraulic equipment, *Angara River, *USSR, Bratsk hydroelectric station, Bearings, Shafts, Bushings, Seals.

The guide bearing fixing the position of the turbine shaft at the Bratsk hydroelectric station is made with eight water lubricated rubberized bushings. Specifications are offered for the bearings, turbine shaft, the end seal of the turbine shaft, the rubber ring assembly in the end seal, and the bonding of the joints. For conditions of the Angara and other rivers with clean water it is advised that turbine bearings with water lubricated rubberized bushings be used. The end seals eliminate shaft wear and with correct manufacture and installation will operate reliably for a long time. A shortcoming of the turbine bearings is the absence of devices for adjusting the clearance, which complicates repair and operations. (Baker-IVI)
W85-03583

ALIGNMENT OF THE ROTOR OF A VERTICAL UNIT,
G. S. Shchegolev, and V. M. Zabelkin.
Hydrotechnical Construction, Vol. 18, No. 1, p 39-46, January, 1984. 3 Fig, 2 Tab, 14 Ref. Translated from Gidrotechnicheskoe Stroitel'stvo, No. 1, p 29-34, January, 1984.

Descriptors: *Hydraulic equipment, *Hydroelectric plants, *Turbines, Bearings, Mathematical equations, Probabilistic process, Vibration, Shafts.

Vibration of a unit is due, to a considerable extent, to wobbling of the shaft in the zone of the turbine and generator bearings. The expediency of using calculations of dimension chains coupled with the probability method has been previously described for determining the possible accuracy of assembling turbines. The possible misalignment of the necks of the turbine and generator shafts with prescribed tolerances is determined. A comparison of the calculated value with the permissible value makes it possible to establish beforehand the need to use a compensator to reduce the volume of finishing works when correcting the shaft line during assembly. The practice currently being used of assigning the wobble tolerances of a turbine shaft neck based on summation of part of the errors by the maximum-minimum method leads to overestimated values, which are artificially reduced by introducing additional conditions. Calculation of wobbling by probabilistic summation of all manufacturing tolerances shows that even with the use of the maximum accuracy capabilities of machining equipment, the field of scatter of the amount of displacement of the axes considerably exceeds the standards established on the basis of assembly and operating experience. The main component of shaft wobble occurs from nonparallelism of the mated planes of the thrust bearing parts relative to the datum surface to which the shaft flange is connected. It is now possible to dispense with combined boring of holes in the flange connections of the turbine and generator shafts. (Baker-IVI)
W85-03584

8D. Soil Mechanics

SEEPAGE THROUGH TILL FOUNDATIONS OF DAMS OF THE EASTMAIN - OPINACA - LA GRANDE DIVERSION,
Societe d'Energie de la Baie James, Montreal (Quebec).
For primary bibliographic entry see Field 2F.
W85-03418

HYDRAULIC STABILIZATION OF EARTH STRUCTURES,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
R. J. Mitchell, J. D. Madsen, and T. W. Crawford.
Canadian Geotechnical Journal, Vol. 21, No. 1, p 116-124, February, 1984. 11 Fig, 1 Tab, 15 Ref.

Descriptors: *Stabilization, *Soil water, *Slopes, Foundations, Vacuum wells, Foundations, Vacuum blankets, Computer models, Pore water, Mine tailings.

Hydraulic stabilization of soil masses was evaluated using computerized methods; these methods were applied to the cases of foundation pretreatment of soil clays and rotational landsliding. Application of these methods to vacuum pretreatment of soft clay foundations and to temporary stabilization of slopes using vacuum wells indicate that the vacuum methods are effective. The finite difference program, RACO, was developed to solve the radial consolidation equations, and average pore water pressures along the plane strain axes were calculated to input the slope stability program BISON1. With sealed vacuum wells maintained at -60 kPa excess pressure, a proposed 2 m high embankment could be constructed after about 4 months. Temporary stabilization of stratified Winnipeg slopes could be best achieved using double rows of vertical vacuum wells which were, as expected, more efficient, increasing the safety factor to 1.13 after 3 days and to 1.2 in the long term. Vacuum wells can be used where the soft or weak zone is at some depth below the surface. The vacuum blanket method is the most effective for pretreatment of very soft, normally consolidated, foundation soils because it develops a surface strength, similar to that of a moderately desiccated crust, in the soil and because it produces uniform settlements and no increase in shearing strength. Methods of hydraulic stabilization of soil masses can be useful to stabilize mine tailings placed underground or in surface tailings impoundments. (Collier-IVI)
W85-03419

PILE CAPACITY FOR ECCENTRIC INCLINED LOAD IN CLAY,
Technical Univ. of Nova Scotia, Halifax. Dept. of Civil Engineering.
G. G. Meyerhof, and A. S. Yalcin.
Canadian Geotechnical Journal, Vol. 21, No. 3, p 389-396, August, 1984. 9 Fig, 17 Ref.

Descriptors: *Pile capacity, *Loading, *Clay, *Bearing capacity, *Piles, Bridge construction, Bed load, Soil physical properties, Civil engineering, Soil engineering.

Pile foundations of engineering structures, such as bridges, offshore structures, and retaining walls, are frequently subjected to eccentric and inclined loads. Model tests on single rigid piles under eccentric inclined loads in clay show that the eccentricity and inclination of the load significantly influence the ultimate bearing capacity of the piles. Model tests on rigid freestanding pile groups in clay show that the ultimate bearing capacity varies with eccentricity and inclination of the bed load in a way similar to that of single piles, including the contribution of the base resistance of the group. The influence of eccentricity and inclination of the load on the ultimate bearing capacity can be represented by simple interaction relationships between the ultimate loads and moments and between the axial and normal components of the ultimate load. (Collier-IVI)
W85-03422

REINFORCED EARTH RETAINING WALL UNDER VERTICAL AND HORIZONTAL STRIP LOADING,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
J. T. Laba, J. B. Kennedy, and P. H. Seymour.
Canadian Geotechnical Journal, Vol. 21, No. 3, p 407-418, August, 1984. 20 Fig, 12 Ref. Natural Sciences and Research Council of Canada grant A2748.

Descriptors: *Reinforced earth, *Retaining wall *Bridge abutments, *Horizontal loading, *Vertic loading, Civil engineering, Soil physical propertie Failure planes, Soil mechanics.

Uses of reinforced earth as a retaining structu have included retaining walls and bridge abu ments. For proper design, the reinforcing elemen must possess adequate tensile strength as well the capacity to bond with the soil through friction A study was carried out on the structural respons of a reinforced earth retaining wall model subjec ed to the action of a surcharge strip load aligne parallel to the wall head. The model consisted of plexiglass box 556 mm wide x 760 mm long x 52 mm deep; the backfill soil material used was coar dry Erie sand. Effects of both vertical and horizo tal load components were investigated. Under th action of a vertical surcharge strip load, place inside the Rankine's active wedge, the location the maximum traction forces in the reinforcin elements, and therefore the location of the poten tial failure plane, can be well approximated b using Culman's method. The horizontal strip loa component acting inside the Rankine's activ wedge tends to move the potential failure plan that developed because of the vertical load fo ward towards the wall, and past the leading edg of the load footing. A horizontal strip load direc ed away from the wall face has an overall effect decreasing the traction force in the reinforcin elements; the rate of decrease in this force was th smallest along the potential failure plane previou ly induced by the vertical surcharge strip loa The formation of two regions in the soil ma below but close to the edges of the load footin where the element stress has a local maximum shows some similarity with the theoretical stre distribution that exists in a semi-infinite elasti medium. (Collier-IVI)
W85-03423

PIEZOMETER-FRICTION CONE INVESTIGATION AT A TAILINGS DAM,
British Columbia Univ., Vancouver. Dept. of Civ Engineering.
For primary bibliographic entry see Field 8A.
W85-03428

UNCONVENTIONAL CONCEPTS FOR DYKE AND DAMS ON SOFT CLAY FOUNDATION
Norges Geotekniske Inst., Oslo.
For primary bibliographic entry see Field 8A.
W85-03429

SEEPAGE REGIME OF THE HYDRAULIC FILL DAM OF THE MINGECHAUR HYDRO POWER DEVELOPMENT,
V. A. Melent'ev, O. N. Nosovova, I. M. Mityushina, N. S. Sergeeva, and G. A. Chugaeva.
Hydrotechnical Construction, Vol. 18, No. 1, p 1 8, July, 1984. 4 Fig, 1 Tab, 12 Ref. Translated fro Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 3-8 January, 1984.

Descriptors: *USSR, *Kura River, *Mingechau Dam, *Seepage, *Hydraulic-fill dams, Water leve Piezometers, Dams.

On-site observations used to monitor the condition of the Mingechaur hydraulic-fill dam on the Kur River, USSR, were initiated in the mid-1950's a the time of construction. These revealed no evi dence of seepage until the 1965-70 era, at which time, the readings of individual piezometers mon toring seepage indicated a general rise of the lin of seepage. Theoretical and experimental studie were conducted to establish the cause and to deter mine the stability of the dam slopes and the earth quake resistance of the structure. Anomalous var ations in the piezometers were noted and wer concluded to be unrelated to intensification of th seepage flow. Static calculations of slope stability and determinations of earthquake resistance show the dam to be safe. (Keenan-IVI)
W85-03577

TUDY OF THE SEEPAGE AND PIPING STA-ILITY OF DOLOMITE SOIL AND EVALUA-ION OF ITS SUITABILITY FOR A DAM ORE ON A ROCK FOUNDATION,
. F. Aripov, S. V. Bortkevich, and M. P. alyshev.
ydrotechnical Construction, Vol. 18, No. 1, p 16-, January, 1984. 5 Fig, 2 Tab, 2 Ref. Translated om Gidroteknicheskoe Stroitel'stvo, No. 1, p 14-', January, 1984.

escriptors: *Dolomite soil, *Dam construction, Seepage, *Piping stability, Dam cores, Construc-on materials, Permeability coefficient.

he suitability of dolomite soil for the watertight ore of a dam was determined by a series of xperiments with regard to its seepage and piping roperties. The investigations were carried out on ree particle-size varieties of dolomites. Experi-ental results indicate that the values of the per-eability coefficient of the compacted soil (dry ensity > or = 1800 kg/cu m) stabilized shortly ter the start of seepage experiment. A study of e chemical composition of the soil showed that uring seepage only sodium chloride and gypsum ere leached out and the dolomite content re-ained constant. Seepage of water through com-acted dolomite soil was not accompanied by ther mechanical or chemical piping. The seepage ability of dolomite soil at the contact with the undation was also investigated. Experimental re-lts indicate that in the case of constructing a dam om the mixture of the investigated varieties of olomite soil with dry density > or = 1800 kg/cu on an impervious rock foundation, the condi-ons of water seepage will be satisfactory. (Shieh-VI)
V85-03579

E. Rock Mechanics and Geology

NTERACTION BETWEEN AN ARCH DAM ND ITS FOUNDATION (WECHSELWIR-UNG ZWISCHEN STAUMAUER UND UN-ERGRUND),
echnische Hochschule Aachen (Germany, F.R.). ehrstuhl und Inst. fuer Grundbau, Bodenme-anik, Felsmechanik und Verkehrswasserbau.
or primary bibliographic entry see Field 8A.
V85-03256

ASE OF CONCRETE DAMS - LOADING AND ESIGN (DIE GRUNDUNGSFUGE VON STAU-AUERN - BEANSPRUCHUNG UND KON-TRUKTIVE AUSBILDUNG),
ngenieurburo Dr. Kupfer, Munich (Germany, .R.).
or primary bibliographic entry see Field 8A.
V85-03257

ECENT INVESTIGATION METHODS FOR AM FOUNDATIONS (NEUERE UNTERSU-HUNGSMETHODEN FUR DIE GRUNDUNG ON ABSPERRBAUWERKEN),
Talsperren-Neubauamt Nuernberg (Germany, .R.).
. Rissler.
Vasserwirtschaft, Vol. 74, No. 3, p 153-157, larch, 1984. 5 Fig, 14 Ref.

Descriptors: *Inspection, *Dam foundations, *De-ormation, Dam stability, Foundation rocks, Dams.

At the periodic inspection of the stability of old masonry dams there are frequently problems be-ause the condition of the foundation rock is not ufficiently known. Therefore it is suggested that he judgement should be based on the measure-ent of deformations. The complex behavior of he rock mass must be considered. This is discussed sing recent research results. (Author's abstract)
V85-03259

EALING OF THE HEAVILY JOINTED SAND-TONE STRATA AT BROMBACH-DAM (AB-DICHTUNG DES STARK KLUFTIGEN SAND-STEINGEBIRGES AN DER BROMBACHTAL-SPERRE),
Ruhrverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 8F.
W85-03260

MONITORING OF THE GROUT CURTAIN OF FRAUENAU DAM (KONTROLLE DER UNTER-GRUNDABDICHTUNG DES STAUDAMMES FRAUENAU),
Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
F. List.
Wasserwirtschaft, Vol. 74, No. 3, p 180-186, March, 1984. 10 Fig.

Descriptors: *Grout curtains, *Monitoring, *Frauenau Dam, *Germany (Federal Republic), Rockfill dams, Dam foundations, Dam construction.

The 82-m high Frauenau Dam was built in 1977-1981 to provide a drinking water supply for eastern Bavaria. In the middle of the natural material rockfill dam there is an additional impervious element, a 0.6 m thick clay-concrete wall. The subsoil in the area of the Frauenau Dam is composed of the Bavarian Forest gneiss. The foundation of Frauenau dam in the Bavarian Forest Mountains was provided with numerous measurement devices for monitoring the efficiency of the grout curtain. The subsoil conditions, the grout curtain and the measurement system itself are described, with the results of the measurements during first impoundment. The measurement results verify the good function of the grout curtain. (Moore-IVI)
W85-03263

INFLUENCE OF GEOLOGY AND GEOTECHNOLOGY ON DAM DESIGN (DER EINFLUSS VON GEOLOGIE UND GEOTECHNIK AUF DEN ENTWURF VON TALPERREN),
Tiroler Wasserkraftwerke A.G., Innsbruck (Austria).
W. Pircher.
Wasserwirtschaft, Vol. 74, No. 5, p 275-282, May 1984. 8 Fig, 19 Ref.

Descriptors: *Bedrock, *Dam design, *Dam foundations, *Engineering geology, Geological formations, Discontinuities, Karst, Permafrost, Seepage, Grout curtains, Deformation.

An overview is given of engineering procedures to treat and improve unsatisfactory geological conditions in the bedrock underlying dam foundations. The development of such methods has allowed the design of higher and more economical dams at more difficult sites. Geological difficulties include thrusts and other discontinuities, karst formations, volcanic bedrock (because of its complex structure), soft bedrock, weathered, decomposed, or narrow-fissured rock, porous material, and permafrost. The most important procedures for dams resting on porous material involve preventing seepage and its consequence (water losses, excess pore water pressure, erosion) and including sealing, lengthening the seepage path, removal of stress, and drainage. Excavation work must provide an adequate weight-bearing base for the dam. Since the 1950s, grout curtains have become increasingly important. Corrective measures for a rock foundation are oriented toward increasing stability, reducing deformation, and controlling seepage. Excavation of the foundation surface must achieve a constant profile without breaks in drop to avoid local differences in deformation and stress; particular attention must be paid to high flanks. Flanks reinforcement may be carried out through rock ties, injected concrete coating with a steel frame and rock nails, or supporting pilings or walls; deformations near the foundation must be cleaned out and filled with concrete, and shear surfaces must be doweled. (Gish-IVI)
W85-03269

THREE-DIMENSIONAL GEOLOGIC MAPPING: A BASIS FOR HYDROGEOLOGIC AND LAND-USE EVALUATIONS,
Illinois State Geological Survey Div., Champaign.
J. P. Kempton, and K. Cartwright.
Bulletin of the Association of Engineering Geologists, Vol. 21, No. 3, p 317-335, August, 1984. 9 Fig, 22 Ref.

Descriptors: *Geologic mapping, *Hydrogeology, *Land use, Mapping, Stratigraphy, Lithology, Groundwater recharge, Geology, Terrane, Saturation zone.

A stack-unit map is a lithostratigraphic map that provides information on the presence and distribution of one or more geologic materials to a selected depth. Each stack unit represents a particular succession of units (designated by standard symbols in a stacked sequence) present to the specified depth. Stacks units can be represented by pattern and color combinations as well as by an outline map with each stack unit labeled within the limit of its boundary. Mapping detail and depth limit are governed by various factors including availability of data and criteria for each anticipated land-use interpretation. Stack-unit maps, when combined with physiographic information (a terrane map) and hydrogeologic data and principles, provide the basis for the preparation of a new generation of interpretative maps. These interpretive maps depict such hydrogeologic information as regional groundwater recharge rates and estimated depth to the top of the zone of saturation. In turn, incorporation of these hydrogeologic evaluations improves traditional interpretive maps that show suitability of geologic materials for waste disposal and general construction, and other land uses. Three-dimensional mapping has evolved to meet the expanding need for geologic information that can be interpreted directly for land use or resources development. Some stack-unit maps and mapping symbols are tailored specifically to the engineering geologist and other informed users; interpretive maps based on stack-unit maps provide specific land-use evaluations directly and can be used by planners, developers and engineers with little geologic background. (Author's abstract)
W85-03272

PREDICTED AND MEASURED STRESSES AND DISPLACEMENTS AROUND THE DARLINGTON INTAKE TUNNEL,
University of Western Ontario, London. Faculty of Engineering Science.
K. Y. Lo, and B. Lukajic.
Canadian Geotechnical Journal, Vol. 21, No. 1, p 147-165, 1984. 16 Fig, 3 Tab, 10 Ref.

Descriptors: *Darlington Nuclear Station, *Tunnel construction, *Engineering geology, Tunnels, Rock mechanics, Rock properties, Deformations, Stress, Displacement, Rheology.

Underground structures at the Darlington Nuclear Station include a cold water intake tunnel and discharge facilities. The C.W. Intake Tunnel is D-shaped in section with a span of 8 m and a length of 925 m beneath Lake Ontario. The tunnel is located in a horizontally bedded limestone with variable shaly interbeds. The geotechnical investigation included in-situ rock stress measurements and laboratory determination of strength and deformation properties as well as time-dependent behavior. Design of the tunnel, in particular provisions for 'rock squeeze,' is described in detail. The results of field measurements of stresses and displacements were compared with premonitoring analysis. Postmonitoring analyses were also performed using the as-constructed condition. The results of measurements of stresses and displacements induced by the tunnel excavation are in general agreement with the predicted behavior, indicating that the rock mass behavior is essentially elastic. Displacement monitoring showed that the rate of time-dependent deformation decreased to a small value after three months. The design provision of 90 day's waiting period was adequate and the additional provision for a stress relief slot was, therefore, omitted during construction of the tunnel. (Collier-IVI)
W85-03421

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DEFORMATION OF THE ROCK MASS DURING CONSTRUCTION OF THE NUREK HYDROELECTRIC STATION,
E. S. Skripko.
Hydrotechnical Construction, Vol. 18, No. 1, p 21-24, January, 1984. 2 Fig, 4 Tab, 3 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 1, p 17-20, January, 1984.

Descriptors: *Dam construction, *Nurek Hydroelectric Station, *Vakhsh River, *USSR, *Rocks, *Deformation, Dam foundations, Hydroelectric plants, Settling, Geology.

Observations of the deformations caused by construction of the Nurek hydroelectric station (on the Vakhsh River, USSR) were carried out during and after the construction period. Observations were made both in the dam foundation and in the reservoir flanks in vertical and horizontal directions. Observation data indicate that the dam foundation experienced uneven settling both over area and in time. The maximum deformations were found to correspond to the maximum loads. These actual data indicate that the construction of a dam and creation of a reservoir cause deformations of the rock mass in an extensive region, and the specific settlement depends upon the strength and density of the rocks composing the foundations and also upon the pressure created by the dam's weight. The geodetic observations are continuing at the Nurek hydroelectric station to monitor the possible movements of the rock blocks and the effects of these movements on the normal operation of individual structures of the hydrostation. (Shieh-IVI)
W85-03580

8F. Concrete

SEALING OF THE HEAVILY JOINTED SANDSTONE STRATA AT BROMBACH-DAM (ABDICHTUNG DES STARK KLUFTIGEN SANDSTEINGEBIRGES AN DER BROMBACHTALSPERRE),
Ruhrverband, Essen (Germany, F.R.).
T. Strobl, and R. Weber.
Wasserwirtschaft, Vol. 74, No. 3, p 158-164, March, 1984. 9 Fig.

Descriptors: *Grouting, *Dam foundations, *Sandstone, *Brombach Dam, *Germany (Federal Republic), Foundation rock, Cut-off walls, Igelsbach Dam.

The 40 m high Brombach Dam (Federal Republic of Germany) is founded on Keuper sand-stone. The high permeability of the foundation rock and the pronounced jointing require unusual efforts for sealing. The paper presents the experience gained with grouting at Igelsbach Dam, an upstream reservoir at Brombach Dam. Based on these results the sandstone foundation below Brombach Dam is sealed by a soil-concrete cut-off wall 60 cm thickness which is executed by use of a special hydraulic trenching machine. (Author's abstract)
W85-03260

RATIONAL SLOPE STABILIZATION BY MEANS OF A NEW TYPE OF CONCRETE PLATE (RATIONELLE BOSCHUNGSBEFESTIGUNGEN DURCH NEUARTIGE BETONPLATTEN),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
E. Lattermann, and H.-J. Schuster.
Wasserwirtschaft - Wassertechnik, Vol. 34, No. 4, p 84-85, May, 1984. 3 Fig, 2 Ref.

Descriptors: *Concrete plates, *Slope stabilization, *Prefabrication, Construction, Reservoirs, Dams, Erosion control, Channels, Storage tanks.

Concrete plates for sealing and reinforcing slopes in hydraulic engineering have had the disadvantages of a labor-intensive joint-sealing process. A new type of plate was developed to alleviate this problem. The new, precast plate, which may be constructed of concrete or reinforced, prestressed, or rolled concrete, is formed with stepped edges on all four sides (it appears as two thin plates, which have been placed on top of one another so that they overlap). The edges are slightly less thick than half the plate thickness, so that the sum of two edges plus the sealant in between equals one plate thickness, thereby ensuring an even surface when the plates are laid. When a plate is laid, sealing tape is applied to the top of the lower step of the edge, then the bottom of the upper step of the next plate is pressed onto the sealant. The use of plates of half length or width allow joints to be arranged discontinuously. The plates were used successfully in the construction of a small reservoir. They can be used both for sealing and as a protective covering. In addition to slope linings for small dams, uses include sealing and erosion prevention for irrigation and drainage channels and inlet and outlet channels at power stations as well as lining for storage tanks for water, wastewater, liquid manure or other liquids. (Gish-IVI)
W85-03453

LOWERING OF THE WATER LEVEL AT WATERTIGHT REINFORCEMENTS (WASSERSPIEGELSENKUNG BEI DICHTEN DECKWERKEN),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 8A.
W85-03521

8G. Materials

RECONSTRUCTION OF BITUMINOUS SLOPE LININGS AT DAMS AND PUMPED-STORAGE RESERVOIRS (REGENERIERUNG VON ASPHALTAUBENDICHTUNGEN BEI STAUDAMMEN UND PUMPSPEICHERBECKEN),
Strabag Bau-A.G., Cologne (Germany, F.R.).
For primary bibliographic entry see Field 8A.
W85-03255

MUTAGENICITY OF COAL TAR PAINTS USED IN DRINKING WATER DISTRIBUTION SYSTEMS,
Perugia Univ. (Italy). Cattedra di Igiene.
M. Silvano, and J. R. Meier.
Science of the Total Environment, Vol. 39, No. 3, p 251-263, November, 1984. 2 Fig, 7 Tab, 29 Ref.

Descriptors: *Mutagenicity, *Coal tar, *Paints, *Tanks, *Pipes, Water storage, Water distribution, Water quality control, Toxicity, Drinking water, Carcinogenicity.

The mutagenicity of coal tar paints used for coating drinking water tanks and pipes was evaluated as a preliminary screening for potential genotoxic hazards associated with leaching of mutagens into drinking water during water storage and distribution. The Salmonella/microsome assay was performed on different fractions of two paints. Fractions were taken using different fractionation procedures for removing the presence of inhibitory components. Both fractionation procedures confirmed an extraordinarily high mutagenicity in both paints, with metabolic activation, much higher than the mutagenicity of the unfractionated paints. The acid-base fractionation was more time-consuming but gave higher mutagenicity recoveries and provided information as to the general nature of the genotoxic constituents, which were concentrated in the neutral fractions. The sequential solvent extraction by sonication was a shorter and simpler method and revealed the presence of direct-acting mutagens. The application of the Salmonella/microsome assay coupled with both fractionation methods may give complementary and confirmatory data on the genotoxic properties these coal based paints, as a screening of the pot tial mutagenic/carcinogenic hazards derived fr these materials used in drinking water distribut systems. (Baker-IVI)
W85-03659

8I. Fisheries Engineering

EFFECT OF CHANNEL ALTERATION FISH HABITAT,
Hokkaido Univ., Sapporo (Japan). Lab. of Eros Control Engineering.
For primary bibliographic entry see Field
W85-03507

FOUR-TANK RECIRCULATION SYST WITH A HYDROCYCLONE PREFILTER A A SINGLE WATER RECONDITIONING UN
Department of Fisheries and Oceans, Winni (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field
W85-03637

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

DEVELOPMENT OF HYDROLOGICAL SEARCH IN FRANCE RELATIVE TO THE FLUENCE OF MAN ON WATER CYCLES A THE FORECASTING OF FLOODS (LE DEV LOPPEMENT DE LA RECHERCHE HYDR LOGIQUE EN FRANCE EN RELATION AV L'INFLUENCE DE L'HOMME SUR LE CYC DE L'EAU ET LA PREVISION DES CRUE
Academie d'Agriculture de France, Paris.
J. Jacquet.
Houille Blanche, No. 5, p 315-321, 1984. 19 R

Descriptors: *Research priorities, *France, *H drology, *Flood forecasting, *Hydrologic cyc Training, Institutions, Monitoring, Foreign search.

Hydrological research in France has gone throu various stages. After a period of intense activity the nineteenth century giving it international mensions, it subsequently suffered from up-a down interest in water problems and a plethora interested bodies. Any consideration of the sit tion in modern times highlights the need for m efficient use of existing teams, whose profession ism is not in dispute, but which are not prope organized and used in the framework of scienti research in France. Three areas of action seem be called for: recognizing hydrology as a separ scientific discipline; establishing an appropri structure for coordinating research in the field; a developing professional training specifically hydrology. Recent initiatives are discussed, p ticularly the setting up of the C.N.R.S. interdis plinary program for environmental research, cluding a section on water. Multidisciplin projects have been initiated on man's influence water cycles, and some of their original aspects outlined. In the more traditional flood-forecasti area, researchers are involved in many questions which no answer has as yet been found and whi are definitely topical. Lastly, there is a remin that the future of hydrological research w depend to a very major extent on the quality a endurance of permanent measurement networ which are a sine qua non for implementing a wa policy which will be able to satisfy public a long-term needs. (Author's abstract)
W85-03585

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

DYNAMIC FLOW RESISTANCE FOR HYDROLOGIC SIMULATIONS,
Agricultural Research Service, Columbia, MO. North Central Region.
For primary bibliographic entry see Field 2J.
W85-03785

LAKE DEVELOPMENT IN THE BOREAL PEATLANDS OF SOUTHEASTERN LABRADOR, CANADA,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 2H.
W85-03842

QUANTITATIVE PRECIPITATION FORECAST TECHNIQUES FOR USE IN HYDROLOGIC FORECASTING,
National Weather Service, Silver Spring, MD. Office of Hydrology.
K. P. Georgakakos, and M. D. Hudlow.
Bulletin of the American Meteorological Society, Vol. 65, No. 11, p 1186-1200, November, 1984. 6 Fig, 1 Tab, 47 Ref.

Descriptors: *Weather forecasting, *Precipitation, *Hydrologic models, Spatial distribution, Temporal distribution, Forecasting.

Current operational rainfall prediction approaches are examined in this paper from the viewpoint of potential use in support of various hydrologic forecasting applications. A relatively new approach, which is designed specifically for use in watershed modeling is presented. This approach is a coupled one, which links a precipitation model with streamflow models. Future directions in the area of more effective use of quantitative precipitation forecast (QPF) information in hydrologic forecasting are discussed. Specifically, avenues are suggested for more effectively integrating or numerically coupling the hydrological and meteorological computer resources, data bases, and model computations. Such linking of systems and procedures is important if we hope to achieve a comprehensive hydrometeorological solution to the hydrologic prediction problem especially for small scale applications such as the identification and prediction of flash floods. Future plans for linking systems should consider the new technology that is available for providing and using rainfall observations from automated in situ sensors and remote sensors. (Baker-IVI)
W85-03864

WATER LEVELS AND WATER-LEVEL CHANGES IN THE PRAIRIE DU CHIEN-JORDAN AND MOUNT SIMON-HINCKLEY AQUIFERS, TWIN CITIES METROPOLITAN AREA, MINNESOTA, 1971-80,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03946

STATISTICAL ANALYSIS OF CROP YIELD-SOIL WATER RELATIONSHIPS IN HETEROGENEOUS SOIL UNDER TRICKLE IRRIGATION,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
D. Russo.
Soil Science Society of America Journal, Vol. 48, No. 6, p 1402-1410, November/December, 1984. 8 Fig, 4 Tab, 18 Ref.

Descriptors: *Crop yield, *Statistical analysis, *Soil water, *Trickle irrigation, Soil water pressure, Saline soils, Kriging, Spatial variability, Soil hydraulic properties.

Conventional statistical analysis and spatial structure analysis are used to investigate the field spatial variability in soil water pressure (P), salinity (EC), and crop yield obtained under trickle irrigation. Also, the dependence of these variables on the inherent spatially-variable soil hydraulic parameters (Ks and alpha) and the dependence of Y on P and EC are analyzed. Multiple regression analysis suggests the variability of Ks and alpha is responsible for about 25% of the variabilities in both P and EC, which in turn, are responsible for $< 25\%$ of the variability in Y, when experimental data from the entire field are considered. Field spatial structure affects the relationships between different properties over distances which were related to the respective ranges of direct variograms of pertinent properties. The direct variograms of properties were used to calculate kriging estimates of pertinent properties, which in turn, were used for two subsequent analyses. In the first analysis, kriging estimates obtained for a square domain moving over the entire field were used to calculate the correlation between different properties at different parts in the field. In some parts of the field variability in Ks and alpha was responsible for about 90% of the variabilities in both P and EC, which in turn, were responsible for about 90% of the variability in Y. In the second analysis, kriging estimates of Y, P and EC obtained for regions in the field which are associated with a constant saturated zone in the vicinity of the trickle emitter (in terms of its radius) were used to analyze the dependence of Y on P and on EC. In regions which were associated with relatively small values of the radius of the saturated zone, the variability in P and EC is responsible for > 0.8 of the variability of Y. In regions which were associated with relatively large values of the radius of the saturated zone and a relatively large leached zone, it was not soil water pressure or salinity but other factors that most influenced yield. (Moore-IVI)
W85-03966

MODELING SUBSURFACE STORMFLOW ON STEEPLY SLOPING FORESTED WATERSHEDS,
Kentucky Fair Tax Coalition, Lovely, KY. Water Research Office.
P. G. Sloan, and I. D. Moore.
Water Resources Research, Vol. 20, No. 12, p 1815-1822, December, 1984. 5 Fig, 1 Tab, 32 Ref. Dept. of the Interior project A-085-KY.

Descriptors: *Storm seepage, *Mathematical models, *Forest watersheds, Slopes, Hydrologic models, Simulation, Finite element models, Kinematic wave models, Storage-discharge models.

Five mathematical models for predicting subsurface flow were compared to discharge measurements made by Hewlett and Hibbert (J. Geophys. Res., 68(4), 1081-1087, 1963) on a uniform sloping soil trough at the Coweeta Hydrologic Laboratory. The models included one- and two-dimensional finite element models based on the Richards equation, a kinematic wave model, and two simple storage-discharge models based on the kinematic wave and Boussinesq assumptions. The simple models simulated the subsurface response and water table positions as well as the more complex models based on the Richards equation and were much more economical to use from the point of view of computational costs. Such models have features that would allow them to be incorporated into more complex watershed models, thus placing hydrologic prediction on a more physically correct and less empirical footing. (Author's abstract)
W85-03987

MODELING PERSISTENCE IN HYDROLOGICAL TIME SERIES USING FRACTIONAL DIFFERENCING,
Institute of Hydrology, Wallingford (England).
J. R. M. Hosking.
Water Resources Research, Vol. 20, No. 12, p 1898-1908, December, 1984. 6 Fig, 4 Tab, 39 Ref.

Descriptors: *Hydrologic models, *Streamflow, Temperature effects, Time series analysis, Mathematical studies, Simulation, Model studies.

Some fundamental properties of fractionally differenced autoregressive integrated moving average (ARIMA) time series model processes are presented. Methods of simulating these processes are described. Estimation of the parameters of fractionally differenced ARIMA models is discussed, and an approximate maximum likelihood method is proposed. The methodology is illustrated by fitting fractionally differenced models to time series of streamflows and annual temperatures. The practical applicability of fractionally differenced ARIMA models is enhanced by the availability of an approximate maximum likelihood method for estimation of the model parameters; the method gives results very close to those of exact maximum likelihood, but with a considerable saving in computation time. Possible extensions of the models include models with nonnormal marginal distributions. Seasonality may be incorporated into ARIMA models by the inclusion of a fractional seasonal difference in operator. Multivariate fractionally differenced ARIMA models may be defined by combining fractional differencing, possibly of different orders, applied to each univariate series, and a multivariate ARMA model to describe the short-term dependence in the fractionally differenced series. (Baker-IVI)
W85-03996

METHOD OF CALCULATING LOCAL HEAT AND MOISTURE TRANSFER IN THE WATER BODY-ATMOSPHERE SYSTEM,
G. N. Panin.
Water Resources, Vol. 10, No. 3, p 315-324, July-August, 1983. 6 Fig, 1 Tab, 28 Ref. Translated from Vodnye Resursy, No. 4, p 3-12, July-August, 1983.

Descriptors: *Heat transfer, *Moisture transfer, *Atmosphere, *Surface waters, Mathematical equations, Evaporation, Vertical transfer.

Heat and moisture transfer between a water body and the atmosphere determines to a considerable extent the dynamic, thermal, and moisture regime of the lower atmosphere and is almost completely responsible for the thermal regime of the water body. Thus, the success of solving problems related both to an investigation of processes within the water body and to management of water resources depends on knowing processes of heat and moisture transfer in the water body-atmosphere system. An important place is occupied by a study of the regularities of transfer and its dependence on determining factors and an investigation of the possibilities of determining the characteristics of transfer between the water body and atmosphere on the basis of using standard hydrometeorological information. A method of calculating the characteristics of heat and moisture transfer between a water body and the atmosphere on the basis of using standard hydrometeorological information for the case of a stratified atmosphere is presented. (Baker-IVI)
W85-04115

CALCULATION OF WATER EXCHANGE BETWEEN BODIES OF WATER WITH SPECIAL REFERENCE TO THE KERCH STRAIT,
A. E. Naumov.
Water Resources, Vol. 10, No. 4, p 324-329, July-August, 1983. 2 Fig, 2 Tab, 9 Ref. Translated from Vodnye Resursy, No. 4, p 13-18, July-August, 1983.

Descriptors: *Water exchange, *Kerch Strait, *Azov Sea, *USSR, Straits, Water resources development, Water management.

A relaible water-management substantiation of the water-resources utilization projects being developed requires a thorough investigation of the interaction of the components of the water balance, which govern the hydrological and hydrochemical regimes of river and sea waters. River inflow, evaporaton, precipitation, and water exchange between water bodies constantly change, but there exists a certain time interval within which the regime of the water body can be considered close to steady-state. An attempt is made to develop a practical method of calculating water exchange in straits, making it possible to investigate the interaction of the main water balance components. A

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special feature of the proposed method is that it makes it possible to relate jointly the freshwater balance of the Azov Sea to the capacity of the Kerch Strait and also to take into account the relationship of the main factors determining exchange during the calculated time interval; in this case the time step is taken equal to one month. Thus the selected value of the calculated interval permits taking into account the dynamics of the process. (Baker-IVI)
W85-04116

LANDSCAPE DIRECTION IN HYDROLOGY,
A. I. Subbotin.
Water Resources, Vol. 10, No. 6, p 525-531, November-December, 1983. 2 Fig, 1 Tab, 13 Ref. Translated from Vodnye Resursy, No. 6, p 41-20, November-December, 1983.

Descriptors: *Runoff, *Drainage basins, *Hydrology, Seasonal variation, Drainage, Erosion, Subsurface drainage, Surface drainage, Forest hydrology, Floodplains, Floods.

Landscape-hydrologic investigations are very important for solving such an urgent problem as the determination of causes and character changes in the hydrologic regime as a result of anthropogenic alterations of the landscape. At the current state of hydrology it is impossible to determine the runoff from any landscape component, since it is impossible to take into account the effect of all landscape components on the runoff. In different landscape-hydrologic regions the relation between spring runoff in field and forest is different. The effect of the forest on the formation of spring maximum discharges is distinctly expressed in the middle part of the forest zone. A somewhat different relation is observed in the north of the forest zone, where comparatively small treeless tracts are usually surrounded by a forest and cloudy weather predominates in the spring. River channels and the floodplains and steep slopes adjacent to them serve as the place of formation of the bulk of the precipitation runoff in the summer-fall period. A large part of the basin surface in this period does not participate in runoff formation, since all precipitation is retained by soils and vegetation. Floodplains have a water-regulating ability. In certain periods much water is accumulated in the drainage system, including on floodplains and in ephemeral streams, and the danger of soil erosion arises. The drainage network plays an especially great role in the formation of not only the rainwater runoff but also the spring flood. (Baker-IVI)
W85-04142

MODERN METHODS OF HYDROLOGIC FORECASTS,
E. G. Popov.
Water Resources, Vol. 10, No. 6, p 532-536, November-December, 1983. 4 Ref. Translated from Vodnye Resursy, No. 6, p 51-56, November-December, 1983.

Descriptors: *Forecasting, *Runoff forecasting, *Ice, *Hydrology, Model studies, Hydrologic models, Computers, Floods, Meltwater, Mathmatical models, Ice formation, Ice breakup.

A hydrologic forecast represents a real-time precalculation of the characteristics of the water or ice regime based on knowledge of the regularities of the development of processes determining a given phenomenon under particular physiographic conditions. The use of electronic computers has greatly expanded the possibilities of mathematical modeling in hydrology. The practical success of developing forecasting methods depends ultimately on the presence of empirical data, their completeness and accuracy. In principle the most favorable conditions for runoff forecasts occur where the snow accumulated during the winter is the main feeding source. Long-range forecasts of the seasonal meltwater runoff of flatland and mountain rivers are based on empirically established relations between runoff and water equivalent and characteristics of the water absorbing capacity of the river basins. A considerably more difficult problem is the long range forecast of the maximum discharges and stages of the spring flood. Quarterly and monthly runoff forecasts in the summer-fall and winter low-streamflow periods are based on the regularities of depletion of water storage in river basins. Long-range ice forecasts are based on the use of the correlations between the time of appearance of ice, freezeup, and breakup of rivers and reservoirs and certain characteristics of meteorological processes. Short-range ice forecasts are based on regularities of heat transfer with the direct use of short-range weather forecasts. (Baker-IVI)
W85-04143

NUMERICAL PROCEDURE FOR OBTAINING THE MEAN SOLUTION AND VARIANCE OF THE TWO-DIMENSIONAL STOCHASTIC CONVECTION EQUATION,
Battelle Pacific Northwest Labs., Richland, WA.
C. A. Oster, and A. G. Gibbs.
Advances in Water Resources, Vol. 6, No. 4, p 240-248, December, 1983. 4 Fig, 4 Tab, 9 Ref. DOE contract DE-AC06-76RLO 1830.

Descriptors: *Stochastic process, *Convection, *Mathematical studies, Hydrological models, Velocity, Flow, Differential equations, Finite difference equations.

The concentration of a substance moving in a stochastic flow field under certain conditions is described by the stochastic convection equation. The true, but unknown, velocity field is assumed to be one member of an ensemble of velocity fields. It is assumed that, through appropriate statistical analysis, an estimate of the mean velocity field is available, as is a measure of the uncertainty of the estimate in the form of a covariance. A numerical method is described for solving the two-dimensional stochastic convection equation. The method consists of replacing the differential equation by a system of finite difference equations whose solution is the mean concentration at discrete points in time and space. The variance of concentration can then be calculated. The model is called SCAT (stochastic approach to transport). An example is given for which an approximate analytical solution and its variance is known; the numerical method is applied to the example and results compared to the approximate analytical solution and variance. The results show no evidence of instability. The technique can be used with finite element methods as long as the stiffness matrix remains relatively sparse. (Moore-IVI)
W85-04159

DIFFUSION-CONVECTION PROBLEMS USING BOUNDARY ELEMENTS,
Southampton Univ. (England). Computational Mechanics Inst.
C. A. Brebbia, and P. Skerget.
Advances in Water Resources, Vol. 7, No. 2, p 50-57, June, 1984. 13 Fig, 9 Ref.

Descriptors: *Boundary conditions, *Diffusion, *Convection, Sediment transport, Solute transport, Flow.

The boundary element technique is applied to solve steady and time dependent transport problems governed by the diffusion-convection equation. The starting integrating equations for the problems are obtained using weighted residual techniques in time and space. A space dependent fundamental solution is applied for steady state problems and a time and space dependt one is used to solve time dependent problems. These fundamental solutions introduce singularities in the problem which can be dealt with using numerical and analytical techniques described. The formulation is implemented for higher order elements, quadratic in space and linear on time. Results are compared against those presented by other studies or against known analytical solutions and their agreement demonstrates the validity of the present approach. The method can be extended to solve a range of nonlinear material problems which can be linearized using the Kirchhoff transform. (Baker-IVI)
W85-04160

UNSTEADY FLOW TO A DITCH FROM A SEMI-CONFINED AND LEAKY AQUIFER,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Water Resources and Environmental Engineering.
S. Mustafa.
Advances in Water Resources, Vol. 7, No. 2, p 81-84, June, 1984. 3 Fig, 5 Ref, 1 Append.

Descriptors: *Unsteady flow, *Mathematical equations, *Leaky aquifers, Confined aquifers, Ditches, Surface-groundwater relations, Leekage, Recharge.

Previous unsteady flow problems involving flow into a ditch have not treated the case of a leakage or recharge situation in the aquifer. An unsteady state solution by Fourier series is presented for flow to a ditch from a semi-confined and finite aquifer with leakage in the form of recharge or evaporation. In the probem studied, an aquifer is bounded by a recharge source at the right side and a ditch at the left end. The lower impervious boundary is horizontal, and the water levels in the source and ditch remain constant. The solution was compared with that obtained by the Laplace method. (Moore-IVI)
W85-04164

EFFECT OF ANISOTROPY AND GROUNDWATER SYSTEM GEOMETRY ON SEEPAGE THROUGH LAKEBEDS; 1. ANALOG AND DIMENSIONAL ANALYSIS,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2F.
W85-04275

EFFECT OF ANISOTROPY AND GROUNDWATER SYSTEM GEOMETRY ON SEEPAGE THROUGH LAKEBEDS; 2. NUMERICAL SIMULATION ANALYSIS,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-04276

DRAINAGE DENSITY IN RELATION TO PRECIPITATION INTENSITY IN THE U.S.A.,
State Univ. of New York at Buffalo. Dept. of Geography.
A. D. Abrahams, and J. J. Ponczynski.
Journal of Hydrology, Vol. 75, No. 1/4, p 383-388, 1984/1985. 3 Fig, 20 Ref.

Descriptors: *Drainage density, *Rainfall intensity, *Precipitation, Runoff, Vegetation, Soil cover, Topography.

Drainage density (D), defined as the total length of channel per unit area, is a useful measure of the topographic texture or linear scale of landforms in fluvially eroded landscapes. As such, it has been widely employed to characterize landscapes and predict runoff properties. An analysis of data from 62 different areas scattered across the nonglaciated conterminous USA indicates that the relationship between drainage density (D) and precipitation intensity (PI) is inverse, at least where PI > 50mm/24 hr. This inverse relationship is consistent with the direct relationship between PI and mean annual precipitation (PM) and the inverse relationship between D and PM. Drainage density varies directly with PI and PM via runoff intensity and inversely with these precipitation variables via the vegetation and soil cover. Previous studies of the relationship between D and PI either held PM constant or adjusted for differences in PM. Because the vegetation and soil cover are closely related to PM, these studies may have inadvertently controlled for differences in the vegetation and soil cover. The effect of PI on D was predominantly through runoff intensity, so that D was found to vary directly with PI. (Moore-IVI)
W85-04285

2B. Precipitation

ESTIMATING PRECIPITATION IN MOUNTAINOUS REGIONS,

Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
H. B. Osborn.
Journal of Hydraulic Engineering, Vol. 110, No. 10, p 1859-1863, December, 1984. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Precipitation, *Mountains, *Arizona, Rainfall distribution, Seasonal variation, Estimating, Weather, Elevation, Mathematical equations, Estimating equations.

There is a need for a coordinated effort to develop more generalized methods of estimating annual and seasonal precipitation in mountainous areas. Data were used to analyze annual and seasonal precipitation-elevation relationships in Arizona. The study indicated a strong linear correlation between precipitation and elevation, and an equally strong indication of excess and deficit stations at similar elevations. The excess stations are all located in central Arizona. The deficit stations are mostly north of the Mogollon Rim, in northeastern Arizona. A breakdown between winter precipitation and summer rainfall indicates that the slopes of the linear regressions for summer rainfall are almost parallel, whereas the linear regressions for winter precipitation diverge. In the summer, strong surges of moist tropical air push into and across Arizona from the Southwest. Tropical moisture can move into Arizona in the winter as well, but most events in the drier northeastern part of the state are the result of frontal systems from the Northwest with relatively dry air. This may explain the parallel slopes in the summer and the divergent slopes in the winter. There is no significant correlation between precipitation and elevation for winter storms at deficit stations. Simple linear regressions for seasonal and annual precipitation-elevation relationships are shown. (Baker-IVI)
W85-03794

SECULAR VARIATIONS IN STREAMFLOW IN THE WESTERN UNITED STATES,
Arizona Univ., Tucson. Lab. of Tree-Ring Research.
For primary bibliographic entry see Field 2E.
W85-03845

QUANTITATIVE ESTIMATES OF THE EFFECT OF LAKE MICHIGAN ON SNOWFALL,
Chicago Univ., IL. Dept. of Geophysical Sciences.
R. R. Braham, Jr, and M. J. Dungey.
Journal of Climate and Applied Meteorology, Vol. 23, No. 6, p 940-949, 1984. 13 Fig, 1 Tab, 11 Ref.

Descriptors: *Snowfall, *Temperature effects, *Lake Michigan, *Wisconsin, *Lake-effect snowfall, Climatology, Meteorology, Snowbelt.

The contribution of lake-effect snow to total snowfall along the lee shore of Lake Michigan has been shown to have increased substantially during the period from about 1930 through 1970s. The most probable cause for this is the decrease in average winter temperatures that occurred during this same time interval. Since December and January are the months of greatest lake-effect snow, the average December-January temperatures at Muskegon, Michigan and Madison, Wisconsin were plotted. Superimposed on the values of temperatures for individual winters is a seven season Gaussian smoothed curve which suppresses some of the year to year variability. The very high correlation coefficient between unsmoothed two-month temperature means at the two stations shows that, on average, larger-scale atmospheric conditions are virtually identical at these two stations during winter months. However, the average December-January temperature at Muskegon is 3-4 C warmer than that at Madison. Most of this difference can be attributed to the presence of Lake Michigan. Since the 1930's both areas have experienced about a 3-4 C drop in winter temperatures. In an effort to relate the amount of snowfall downwind of the lake to the temperatures of air before it crossed the lake, January air temperatures were compared at three stations in Wisconsin with January snowfall at three snowbelt stations in Lower Michigan. There was a strong inverse relation between monthly mean temperatures in the air upwind of Lake Michigan and monthly mean snowfall along the downwind shore. Januaries with colder mean temperatures in Wisconsin are Januaries with heavier snowfall in the Lower Michigan snowbelt. (Baker-IVI)
W85-03846

IDENTIFICATION OF 10- TO 20- YEAR TEMPERATURE AND PRECIPITATION FLUCTUATIONS IN THE CONTIGUOUS UNITED STATES,
National Climatic Center, Asheville, NC.
T. R. Karl, and W. E. Riebsame.
Journal of Climate and Applied Meteorology, Vol. 23, No. 6, p 950-966, 1984. 22 Fig, 5 Tab, 18 Ref. NOAA contract NA82AA-H-00062, DOE contract DE-ACO2-83ER60162.

Descriptors: *Climatology, *United States, *Weather patterns, Temperature effects, Precipitation, Rainfall distribution.

Efforts were made to determine if the recent (1931-1982) United States climate record exhibits fluctuations of sufficient scope and magnitude to be useful in a complement of retrospective, empirical studies of climate impacts. The search for fluctuations was designed specifically to identify areas and periods in which the climate within an epoch was terminated by a rather sharp transition to another epoch with a climate unlike the previous epoch. Climate fluctuations were found to occur during all seasons of the year, but the greatest temperature climate fluctuations have occurred during the summer, followed by lesser fluctuations in winter, and the transitional seasons. Rather sharp transitions of climate fluctuations of opposite sign have been identified. Such would prove important, not only to CLIMPAX (the Climate Impacts, Perception and Adjustment Experiment), but to the practical interpretation of large-scale climate change. One of the more ominous scenarios of a carbon dioxide induced climate change is increased temperature and decreased precipitation in the Great Plains. Examples of this type of climate fluctuation have been identified for the spring and summer for several different areas and times in the Great Plains. Climate fluctuations of 10-20 years duration for temperature, with no significant climate fluctuation for precipitation, and vice versa, have also been identified. (Baker-IVI)
W85-03847

PALMER DROUGHT SEVERITY INDEX: LIMITATIONS AND ASSUMPTIONS,
Geological Survey, Reston, VA.
W. M. Alley.
Journal of Climate and Applied Meteorology, Vol. 23, No. 7, p 1100-1109, July, 1984. 3 Fig, 3 Tab, 30 Ref.

Descriptors: *Drought, *Palmer Drought Severity Index, *Evaluation, Climatology, Data collections.

The structure of the Palmer Drought Severity Index (PDSI) is examined. The PDSI addresses two of the most elusive properties of droughts: their intensity and beginning and ending times. Unfortunately, the index uses rather arbitrary rules in quantifying these properties. In addition, the methodology used to normalize the values of the PDSI is based on very limited comparisons and is only weakly justified on a physical or statistical basis. Under certain conditions, the PDSI values are very sensitive to the criteria for ending an established drought. In addition, precipitation during a month can have a large effect on the PDSI values for several previous months. The conditional distribution of the PDSI given the value for the previous month may often be bimodal. Thus, conventional time series models may be quite limited in their ability to capture the stochastic properties of the index. Published values of the PDSI are widely used, but many of the limitations of the index are noted in this paper. Additonal research into drought indexes is necessary. (Baker-IVI)
W85-03848

SOME STATISTICS OF INSTANTANEOUS PRECIPITATION,
Illinois State Water Survey Div., Champaign.
D. M. A. Jones, and W. M. Wendland.
Journal of Climate and Applied Meteorology, Vol. 23, No. 9, p 1273-1285, September, 1984. 15 Fig, 8 Tab, 10 Ref. USAF grant F19628-82-K-0012.

Descriptors: *Instantaneous precipitation, *Statistical analysis, Precipitation distribution, Rainfall intensity, Precipitation, Rainfall, Climatology.

Data was gathered in an effort to provide an international data base of near-instantaneous precipitation rate measurements in mesonetworks in various climatic regions. Simultaneously, an investigation was made of the correlation between near-instantaneous point precipitation rates at adjacent sites as a function of increasing distance from the reference site. Known sources of data were gathered from southern Germany, east-central Illinois, northeastern Illinois, central Florida, and Hilo, Hawaii. These data were analyzed for line averages of the percent frequency of occurrence of the exceedance of selected threshold precipitation intensities. The decay in correlation coefficients of the precipitation intensity at sites at varying distances from the reference site was found to be a function of climate region and the type of precipitation: showery or continuous. Showery rains are essentially uncorrelated about 12 km from the reference site while continuous rain exhibits no correlation beyond about 50 km. (Baker-IVI)
W85-03850

QUANTITATIVE PRECIPITATION FORECAST TECHNIQUES FOR USE IN HYDROLOGIC FORECASTING,
National Weather Service, Silver Spring, MD. Office of Hydrology.
For primary bibliographic entry see Field 2A.
W85-03864

LOW-FLOW TRANSPORT MODELS FOR CONSERVATIVE AND SORBED SOLUTES - UVAS CREEK STUDIES,
Geological Survey, Menlo Park, CA. Water Resources Div.
A. P. Jackman, R. A. Walters, and V. C. Kennedy.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 84-4041, 1984. 82 p, 11 Fig, 4 Tab, 17 Ref.

Descriptors: *Path of pollutants, *Mathematical models, Strontium, Chloride, *Low flow transport models, *Adsorption, Environmental tracers, Streams, *Solute transport, Model studies, Uvas Creek, Santa Clara County, *California.

Models describing low-flow transport of conservative (nonreactive) and reactive solutes, which adsorb on the streambed, are developed and tested. Temporary storage within the bed plays an important role in solute movement. Three different models of bed-storage processes are developed for conservative solutes. One model assumes the bed is a well-mixed, nondiffusing, nonreacting zone. Solute flux into the bed is then proportional to the difference between stream and bed-solute concentrations. A second model assumes that solute is transported within the bed by a vertical diffusion process. The bed-solute concentration, which matches the stream concentration at the interface, varies with depth in the bed according to Fick's law. A third model assumes convection in the downstream direction occurs in certain parts of the bed, while the mechanism of the first model functions elsewhere. Storage of absorbing species is assumed to occur by equilibrium adsorption within streambed particles. Uptake rate is described by an intraparticle diffusion process. Model equations were solved using finite element numerical methods. Models were calibrated using data from a 24-hour injection of conservative chloride and adsorptive Sr ions at Uvas Creek near Morgan Hill, California. All models predict well except for some overestimation by the adsorption model during dieaway. (USGS)
W85-03948

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NUMERICAL PREDICTION OF THE HEAVY RAINFALL VORTEX OVER EASTERN ASIA MONSOON REGION,
European Centre for Medium Range Weather Forecasts, Reading (England).
S.-J. Chen, and L. Dell'Osso.
Journal of the Meteorological Society of Japan, Vol. 62, No. 5, p 730-747, October, 1984. 17 Fig, 24 Ref.

Descriptors: *Rainfall, *Monsoons, *Weather forecasting, *Asia, Forecasting, Prediction, Tibet Plateau, Weather.

A series of numerical forecasts was carried out to investigate a heavy rainfall event over the monsoon region of Eastern Asia which was caused by a vortex formed over the Tibet Plateau during Summer. The ECMWF global grid point model was able to predict the vortex four days in advance. The importance of the moist processes in the development of the vortex was investigated by comparing the results from a moist and a dry (without latent heat) version of the model. The low level jet associated with the vortex and the upper level easterlies are more active when the latent heat is included in the model. The ECMWF limited area model with resolution 0.5 degrees of latitude and longitude was used in order to obtain a more accurate and detailed forecast. Some intermediate scale disturbances were predicted over the Tibet Plateau and verified with satellite pictures and observations. This result is significant for the problem of numerical weather prediction over the Asian Continent. (Baker-IVI)
W85-04022

MOISTURE BUDGET DURING THE 1978-79 SOUTHERN HEMISPHERE SUMMER MONSOON,
Hawaii Univ., Honolulu. Dept. of Meteorology.
S. M. Lubis, and T. Murakami.
Journal of the Meteorological Society of Japan, Vol. 62, No. 5, Series II, p 748-760, October, 1984. 8 Fig, 9 Ref. NOAA grant ATM-8206350-A01.

Descriptors: *Monsoons, *Moisture, *Southern Hemisphere, Meteorology, Australia, Pacific Ocean, Oceans, Weather.

Using FGGE Level IIIb data, the moisture balance over an extensive region during the 1978-79 Southern Hemisphere summer monsoon was analyzed. Major moisture source regions for the monsoon rainfall are the Indonesian Seas and the subtropical South Pacific off the east coast of Australia. The contribution of the Northern Hemisphere moisture flux is less than these Southern Hemisphere sources. The monsoon activity shifts eastward and southward from pre- to post-onset. During the break period, the monsoon activity shifts still further eastward and poleward. Some of the similarities between the break conditions for the Southern Hemiphere summer monsoon and the Indian monsoon are illustrated by the moisture convergence pattern over Australia. The strong moisture convergence center over northeast Australia during the active period splits into two centers during the break period. A strong interhemispheric moisture exchange exists over the central Pacific between 150 E and the dateline during the break period. During the same period, a strong northerly moisture flux around 150 W transports a large amount of moisture into the mid-latitudes of the South Pacific. (Baker-IVI)
W85-04023

PRECIPITABLE WATER OVER AFRICA AND THE EASTERN CENTRAL ATLANTIC OCEAN DURING THE 1979 SUMMER,
Florida State Univ., Tallahassee. Dept. of Meteorology.
D. L. Cadet, and S. H. Houston.
Journal of the Meteorological Society of Japan, Vol. 62, No. 5, Series II, p 761-774, October, 1984. 16 Fig, 27 Ref. NSF grants ATM-8120575 and NA83AA-D-00053.

Descriptors: *Africa, *Atlantic Ocean, *Monsoons, *Precipitable water, Weather, Meteorology, Humidity, Wind, Water vapor.

TIROS-N moisture data and Level III-b humidity fields from European Center for Medium Range Weather Forecasting (ECMWF) have been analyzed during the 1979 summer to obtain fields of precipitable water (PW) in three layers twice a day over Africa and the eastern and central Atlantic. The most significant changes noted are associated with the northward shift of the monsoon trough in relation with the depth and penetration inland of the low level monsoon flow. Spectral analysis reveals besides the African easterly waves the existence of another important periodicity around 6-9 days. Using the information of PW in the three layers, moisture profiles can be derived. Using these moisture profiles in conjunction with the Level III-b wind data, water vapor transport studies can be performed to investigate the question of moisture origin and transport during the African monsoon. (Baker-IVI)
W85-04024

DESIGN STORMS FOR URBAN DRAINAGE DESIGN,
National Water Research Inst., Burlington (Ontario). Hyrdraulics Research Div.
J. Marsalek, and W. E. Watt.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 574-584, September, 1984. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Design storms, *Drainage, *Urban drainage, Rainfall distribution, Design flow, Peak flow.

The design storm concept is well established in Canadian urban drainage practice, but appropriate use is hindered by an incomplete definition of design storms and their applications. To remedy this situation, it is recommended that design storms be described for various regions and a wide range of durations and return periods; these storms should be based on local Atmospheric Environment Service (AES) rainfall data, given for both the rational method and hydrograph model applications, and supplemented by specifications of the computational procedure and normal antecedent conditions. Such design storms would produce peak flows of approximately the same return period as that of the design flow. None of the existing design storms has all these features but an acceptable set of design storms could be developed using existing Canadian data. (Author's abstract)
W85-04049

OKLAHOMA'S REACH TO THE CLOUDS,
Oklahoma Water Resources Board, Oklahoma City.
For primary bibliographic entry see Field 3B.
W85-04208

DETERMINATION OF WINTERTIME CLOUD SEEDING POTENTIAL IN THE MOGOLLON RIM AREA OF ARIZONA,
Salt River Project, Phoenix, AZ. Watershed Div.
L. C. Beddome, R. W. Shaffer, and J. L Sutherland.
Available from the National Techincal Information Service, Springfield, VA 22161. Bureau of Reclamation Final Report, February, 1983. 165 p, 26 Fig, 49 Tab, 21 Ref. Contract/Grant No. 2-07-81-V0238.

Descriptors: *Cloud seeding, *Precipitation, Weather modification, Cost-benefit analysis, Storms, Salt River, Verde River, *Arizona.

An approach followed on several studies for the determination of cloud seeding potential has been to estimate the potential precipitation increase from the frequency of occurrence of atmospheric conditions falling within certain specifications (seedability criteria). Requirements for this approach include hourly precipitation data and rawinsonde data from within or near the area of interest to determine the portion of precipitation normally occurring when the seedability criteria are met. A percentage increase, based on research results, is assumed for this portion of the precipitation to determine what the total precipitation would have been had the cloud seeding been conducted. This information on potential precipitation increase may then be utilized in economic or hydrologic models to estimate the potential benefits that may be expected from cloud seeding. A benefit/cost analysis may be made by comparing the potential benefits with an estimation of the costs of an operational cloud seeding program. The results of the seeding increment computation indicated a higher increment for the Salt River drainage than for the Verde River drainage. Except for the upper Salt River region, either remotely-controlled, mountaintop seeders or aircraft would be required to increase precipitation from the stable storms. The upper Salt River drainage could be effectively seeded when northwesterly winds occurred. The changes in reservoir routing, groundwater pumping and hydroelectric generation were compared for the baseline forecast and the forecast with weather modification at the 2 demand scenarios. The average benefit/cost varied between 3.4 and 6.0. A potential to increase precipitation exists.
W85-04218

PROBABLE MAXIMUM PRECIPITATION ESTIMATES - UNITED STATES BETWEEN THE CONTINENTAL DIVIDE AND THE 103RD MERIDIAN,
National Weather Service, Silver Spring, MD. Office of Hydrology.
J. F. Miller, E. M. Hansen, D. D. Fenn, L. C. Schreiner, and D. T. Jenson.
NOAA Hydrometeorological Report No. 55, March, 1984. 245 p, 121 Fig, 25 Tab, 40 Ref, 5 Plates.

Descriptors: *Probable maximum precipitation, *Storms, Orographic precipitation, Precipitation, Meteorological data collection, Snowpack.

This study provides all-season general-storm probable maximum precipitation (PMP) estimates for durations from 1 to 72 hours for the region between the Continental Divide and the 103rd meridian. For the nonorographic portions of eastern Montana, Wyoming, North Dakota, Colorado, New Mexico and Western Texas, estimates are available for area sizes from 10 to 20,000 sq mi. For orographic regions of these states east of the Continental Divide estimates are available for area sizes from 10 to 5,000 sq mi. The study also provides estimates of local-storm PMP for the more sheltered portions of the region where PMP amounts for short durations and small areas will not occur as part of a general storm. These estimates cover durations from 15 min to 6 hr and drainage areas between 1 and 500 sq mi. A step-by-step procedure for computing PMP is presented for both the general- and local-storm criteria. An example is provided for the general storm criteria.
W85-04226

INITIAL MODEL OF THE RELATIONSHIP BETWEEN RAINFALL EVENTS AND DAILY RAINFALLS,
Meteorological Service, Wellington (New Zealand).
K. J. A. Revfeim.
Journal of Hydrology, Vol. 75, No. 1/4, p 357-364, 1984/1985. 1 Tab, 14 Ref.

Descriptors: *Rainfall, *Stochastic process, Model studies, Rainfall duration, Rainfall distribution, Statistical studies.

There are two approaches which recognize some of the stochastic properties of the rainfall process. The essential difference between these two approaches is the time scale on which the observations are made. A simplistic model of mutually independent rainfall occurrences, amounts and durations is used to relate the statistical properties of rainfall accumulations over long and short time intervals. The assumption of exponentially distributed amounts and durations leads to a partitioning of rainfall events into a three-component distribution of daily amounts. Properties of this distribution are compared with some characteristics of daily rainfall data used in more complex stochastic models. The model challenges the supposition that daily rainfall models must be more informative simply because there are more data. The model is a

conjecture of some elements of the relationship between monthly rainfall parameters and the characteristics of daily rainfall. There would seem to be some advantages in partitioning events into clock hours since this would remove the problem of more than one event contributing to amounts within one hour. A 2-3 hr dead time in the recurrence process should follow each event. (Moore-IVI)
W85-04283

PH OF THE ATMOSPHERIC PRECIPITATION IN VENICE, RELATED TO BOTH THE DYNAMICS OF PRECIPITATION EVENTS AND THE WEATHERING OF MONUMENTS,
Consiglio Nazionale delle Ricerche, Padova (Italy). Ist. di Chimica e Tecnologia dei Radioelementi.
For primary bibliographic entry see Field 5B.
W85-04362

2C. Snow, Ice, and Frost

WETTING FRONT ADVANCE AND FREEZING OF MELTWATER WITHIN A SNOW COVER; 1. OBSERVATIONS IN THE CANADIAN ARCTIC,
P. Marsh, and M.-K. Woo.
Water Resources Research, Vol. 20, No. 12, p 1853-1864, December, 1984. 8 Fig, 2 Tab, 54 Ref.

Descriptors: *Snowmelt, *Freezing, *Wetting front, *Snow cover, Ice, Latent heat, Runoff, Infiltration, Basal ice layer, Flow fingers, Soil temperature.

In a naturally stratified snow cover the movement of meltwater into dry snow is complicated by the interaction of the wetting front with stratigraphic horizons. Field observations showed that when the wetting front reached premelt stratigraphic horizons, water ponded at the interface and then flow fingers developed and penetrated the lower stratum. The flux in these fingers, which was increased to about twice that of the surface flux, was used to feed water to the impeding horizons where it froze to form ice layers. These ice layers were the major source of latent heat released within the snow cover, and they were responsible for the warming of the snow and the underlying soil. These continuous ice layers grew only at stratigraphic boundaries. Because of this ice layer growth the wetting front advance was retarded, and the arrival of meltwater at the snow cover base was significantly delayed. Owing to a cold substrate the strong heat flux from the snow into the soil delays the warming of the snow cover and limits runoff after the snow is isothermal at 0 C by the refreezing of soil infiltration and the development of a basal ice layer. (Author's abstract)
W85-03991

WETTING FRONT ADVANCE AND FREEZING OF MELTWATER WITHIN A SNOW COVER; 2. A SIMULATION MODEL,
National Hydrology Research Inst., Ottawa (Ontario).
P. Marsh, and M.-K. Woo.
Water Resources Research, Vol. 20, No. 12, p 1865-1874, December, 1984. 12 Fig, 10 Ref.

Descriptors: *Snowmelt, *Wetting front, *Freezing, *Snowcover, *Simulation, Model studies, Flow fingers, Infiltration, Soil temperature, Frozen ground, Snow temperature, Ice, Basal ice layers, Thermal conductivity, Runoff, Soil temperature, Arctic.

A simulation model is developed which incorporates the effect of flow fingers at the leading edge of the wetting front, ice layer growth within and at the base of the snow cover, and meltwater infiltration into the underlying frozen soils. The model results demonstrated that ice layers grow rapidly over a 24- to 36-hr period due to the conduction of heat into the snow and underlying soil. Sufficient water is frozen as ice layers to slow the finger wetting front and to account for the rapid snow and soil warming. Wetting front advance and ice layer growth were found to be sensitive to snow temperature, thermal conductivity, volume of flow in the fingers, and irreducible water saturation. Simulation of a warm snow cover showed that with reduced ice layer growth the flow fingers were able to transmit rapidly water to the snow cover base before the entire snow cover was wet. In the arctic situation the soil was sufficiently cold to ensure basal ice growth throughout the melt period. Basal ice growth was found to be sensitive to soil infiltration, length of the growing period, and the snowmelt rate. As a result of the negative soil heat flux, all meltwater is not available for runoff until both the liquid and thermal requirements of the snow and soil have been satisfied. (Author's abstract)
W85-03992

OBSERVATION OF ICE PELLETS,
National Research Center for Disaster Prevention, Nagoka (Japan). Inst. of Snow and Ice Studies.
T. Kimura, and M. Kajikawa.
Journal of the Meteorological Society of Japan, Vol. 62, No. 5, Series II, p 802-808, October, 1984. 10 Fig, 16 Ref.

Descriptors: *Ice pellets, *Precipitation, *Japan, *Nagaoka, Freezing, Snow, Ice.

Ice pellets were observed at Nagaoka, Central Japan on February 2, 1983. The ice pellets were transparent, mostly globular grains of ice, with a diameter range of 0.22 to 2.6 mm. Thin sections revealed that the polycrystalline structure several large air bubbles. The average grain diameter range (0.2 to 0.6 mm) was roughly constant, regardless of the size of the ice pellets, but the grain number increased with increasing size of the ice pellets. The size distribution of the ice pellets was similar to that of snowflakes, but they were less frequent in the size range of less than about 1 mm at a precipitation intensity of 0.49 mm/hr. The formation of these ice pellets was proved to be a local meteorological phenomenon on the basis of a synoptic analysis. The ice pellets were produced by the refreezing of largely melted snowflakes when they fell through a below-freezing layer of air near the ground. (Baker-IVI)
W85-04025

ANALYSIS OF WINTER HEAT FLOW IN AN ICE-COVERED ARCTIC STREAM,
National Hydrology Research Inst., Ottawa (Ontario).
A. Wankiewicz.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 430-443, September, 1984. 13 Fig, 2 Tab, 24 Ref.

Descriptors: *Heat flow, *Streams, *Ice cover, *Caribou Creek, *Northwest Territories, Thermal properties, Streamflow, Ice formation, Arctic zones, Freezing, Conduit flow.

The growth of river ice during the winter of 1977-1978 is modeled for Caribou Creek, an Arctic stream near Inuvik, Northwest Territories. Heat flow from unfrozen ground beneath the channel decreased over winter from 12 W/sq m on October 2 to 0.8 W/sq m on May 1, based on observed ground temperature profiles. Heat loss from ice cover in late November is calculated to be over an order of magnitude larger than heat transfer from full-width channel flow. The establishment in late December of narrow conduit flow beneath the ice at shallow sections is shown to check ice growth above the conduits. The observed air-temperature threshold for expansion of flow width, about -20 C, corresponded to that calculated for melt enlargement on an ice conduit of 2 m width by 0.2 m thickness. An implication of conduit flow during late December and early January in 1977 is that streamflow would be air-temperature dependent during that period. Icing activity observed below lakes and tributaries is probably a result of source flow exceeding channel conduit capacity. Differences in conduit dimensions between shallow sections should result in excess pressure or icing activity at various locations along the channel, at times which are probably air-temperature dependent. Wide spread river icing activity was noted from time to time during the conduit flow period, always during moderate spells in the weather. In mid-January, destruction of snow cover by icing activity and its substitution by an icing deposit is estimated to have reduced the ice cover's thermal resistance by a factor of 4. The channel was frozen solid at shallow sections shortly afterwards. (Baker-IVI)
W85-04042

ANALYSIS OF BREAKUP AND ICE JAMS ON THE ATHABASCA RIVER AT FORT MCMURRAY, ALBERTA,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
D. D. Andres, and P. F. Doyle.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 444-458, September, 1984. 14 Fig, 4 Tab, 19 Ref.

Descriptors: *Athabasca River, *Fort McMurray, *Alberta, *Ice jams, *Ice breakup, Flooding, Hydraulics, Ice, Flood frequency, Velocity.

During breakup, severe ice jams form at Fort McMurray, Alberta due to the dramatic change in the character of the Athabasca River at that point. Instantaneous velocities observed during breakup in this reach have been estimated at 5.5 m/sec with the maximum height of an ice run jam measured at 11.5 m above the bed. Water level profiles have been established along the stable jams at Fort McMurray in each of the three years of observations. It was possible to analyze these jams using the theory for floating jams formed by internal collapse. Calculated jam thicknesses ranged between 2.8 and 5.3 m and the value of mu varied from 0.8 to 2.7, with an average value of 1.6. Regardless of the range of computed values of mu it is evident that Fort McMurray can suffer from flooding at discharges less than the 1 in 2 year flood if an ice jam forms. Further extension of the analysis toward producing an ice jam stage frequency curve is difficult. More field documentation of ice jams is needed to gain a further insight into the actual relationships between thickness and roughness. (Baker-IVI)
W85-04043

CONCEPTUAL MODEL OF RIVER ICE BREAKUP,
National Water Research Inst., Burlington (Ontario). Environmental Hydraulics Section.
S. Beltaos.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 516-529, September, 1984. 18 Fig, 1 Tab, 24 Ref.

Descriptors: *Ice breakup, *River ice, *Model studies, Ice jams, Flooding, Ice thickness, Channels.

The present capability for engineering predictions relating to river ice breakup and jamming problems is very limited. Only crude estimates of jam stage are possible and only where it can be assumed that a floating equilibrium jam has formed nearby. A conceptual model of ice breakup was formulated and used to analyze and compare data from four Canadian river gauge sites. Emphasis is on the development of generalized short-term forecasting methods, which to date have been site specific. A major factor facilitating the onset and progress of breakup has been identified as the available water surface width in relation to the size of separate ice sheets that form by transverse cracking of the ice cover. Thus it is possible to study the effects of parameters such as ice cover dimensions and channel geometry. Bending on planes parallel to the water surface, caused by stream curvature, could account for the observed crack spacing but more data are needed for positive conclusions. The breakup initiation stage increases with increasing freeze-up stage, ice thickness, and strength, and with decreasing channel width and slope. The flooding potential of breakup is largely governed by discharge, which dictates the potenial stage of any ice jams that might occur. The present model suggests that there should be an ice-clearing discharge such that larger discharges will be associated with unstable, if any, jams. This

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places additional limitation on the flooding potential of breakup depending on freeze-up stage, ice thickness, and channel width and slope. The present model does not apply in cases of 'overmature' breakup, proximity of stage controls, and river planforms different from the single meandering channel type. (Collier-IVI)
W85-04046

ROLE OF HEAT AND WATER TRANSPORT IN FROST HEAVING OF FINE-GRAINED POROUS MEDIA UNDER NEGLIGIBLE OVERBURDEN PRESSURE,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano, and K. Horiguchi.
Advances in Water Resources, Vol. 7, No. 2, p 93-102, June, 1984. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Frost heaving, *Porous media, *Heat transport, *Water transport, Mathematical equations, Heat removal, Phase equilibrium.

The phenomenon of frost heave may be considered to consist of four major rate processes: heat transport; water transport; ice growth; and soil deformation. The rate of frost heave is determined mainly by the rate of heat removal and the rate of water intake. The mass and heat balance equations for frozen soils in terms of a material coordinate that follows mineral particles are derived by applying the mixture theory. Using these balance equations, an equation is obtained that accurately describes the rate of frost heave. When the phase equilibrium holds in the system, the relation between the rate of heat removal and the rate of water intake depends mainly on the phase composition data of a given medium. Analysis of reported experimental data indicates that the phase equilibrium may hold until the rate of heat removal reaches a certain critical value. When the rate of heat removal exceeds this critical value, the phase equilibrium may possibly be disrupted for some media. (Moore-IVI)
W85-04167

WINTERTIME OROGRAPHIC STORMS OVER THE SIERRA, PART II, THE PRECIPITATION PROCESS,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W85-04216

2D. Evaporation and Transpiration

DEWFALL AND EVAPOTRANSPIRATION DETERMINATION DURING DAY- AND NIGHTTIME ON AN IRRIGATED LAWN,
Istituto di Fisica dell'Atmosfera, Rome (Italy).
M. Severini, M. L. Moriconi, G. Tonna, and B. Olivieri.
Journal of Climate and Applied Meteorology, Vol. 23, No. 8, p 1241-1246, August, 1984. 2 Fig, 2 Tab, 19 Ref.

Descriptors: *Evapotranspiration, *Dewfall, *Irrigation, *Kazanskiy-Monin nomograph, Diurnal variation, Dew, Evaporation, Water loss.

The use of the Kazanskiy-Monin nomograph in conjunction with the energy-balance method using a simple set of instruments and a proper data analysis had lead to a determination of values of actual evapotranspiration and dewfall that are generally in good agreement with direct measurements. The possibility of evaluating the two processes with the same methodology is demonstrated; both dew deposition and evapotranspiration can be derived through the same parameter, the latent heat flux, by measuring the same micrometerological field parameters during day and night. The measurement apparatus consists of just two thermometers, one anemometer, one net radiometer, two soil heat flux plates and a data logger. Hygrometers, wet thermometers and dew-point sensors are not included in this set of instruments. This assures relatively low cost and good accuracy. The proposed method can be very useful in places where a lysimeter is not available. Its applications are in the areas of hydrology, plant disease control and agricultural meteorology. The main limitation of the illustrated method is that it can be applied only on horizontally homogeneous and flat surfaces. In order to improve the accuracy, further work on the advective effects and on soil heat propagation is in progress. (Baker-IVI)
W85-03849

RECENT OBSERVATIONS AND NEW DEVELOPMENTS IN THE CALIBRATION OF OPEN CHANNEL WASTEWATER MONITORS,
Washington Suburban Sanitary Commission, Hyattsville, MD. Infiltration and Inflow Evaluation and Control Div.
For primary bibliographic entry see Field 7B.
W85-03871

EVAPOTRANSPIRATION OF A DECIDUOUS FOREST: SIMULATION USING ROUTINE METEOROLOGICAL DATA,
Institut National de la Recherche Agronomique, Versailles (France). Station de Bioclimatologie.
S. Halldin, B. Saugier, and J. Y. Pontailler.
Journal of Hydrology, Vol. 75, No. 1/4, p 323-341, 1984/1985. 10 Fig, 4 Tab, 26 Ref.

Descriptors: *Evapotranspiration, *Forests, *Simulation, *Fontanbleau, *France, Water stress, Soil water, Throughfall, Interception, Precipitation, Surface resistance, Mathematical models.

Prediction of forest water balance for estimation of, e.g. stress periods, is always subjected to the conflict between data availability and the desire to approach physical reality. The model described in this paper was conceived to work with routine meteorological data while still retaining the basic physics. Values of all its nine parameters were estimated independently for a 120 yr.-old oak stand in Fontainebleau forest near Paris, France. Weekly measurements of soil-water content and throughfall served as validation for the wet 1981 and the dry 1982. Model sensitivity was assessed to changes in the values of the surface and aerodynamic resistances, the interception capacity, the field capacity and the soil-water content at onset of soil-water stress. A comparison of different formulae to predict potential transpiration/evaporation clearly demonstrated the necessity to include a surface resistance term in a forest transpiration formula. The aerodynamic resistance was less important and the simple threshold formulation for interception did not always work well. The overall behavior of the model was primarily limited by the availability of precipitation data very near the study site. (Author's abstract)
W85-04281

2E. Streamflow and Runoff

HYDRAULICS OF HIGH-GRADIENT STREAMS,
Geological Survey, Lakewood, CO.
R. D. Jarrett.
Journal of Hydraulic Engineering, Vol. 110, No. 11, p 1519-1539, November, 1984. 7 Fig, 3 Tab, 33 Ref.

Descriptors: *Streamflow, *Fluid mechanics, *Hydraulic properties, Slope, Streams, Mannings equation, Friction, Hydraulic roughness, Hydraulic radius, Mountain streams.

On site surveys and 75 measurements of discharge were made on 21 high gradient streams for the purpose of computing the Manning roughness coefficient, n, and to provide data on the hydraulics of these streams. The data indicate that Manning's roughness coefficient decreases markedly with depth and increases with friction slope. Multiple-regression techniques were used to develop a method for predicting Manning's roughness coefficient from the easily measured friction slope and hydraulic radius. The average standard error of the prediction equation is 28%. The data indicate that Froude numbers for flow in high gradient, natural mountain streams are generally less than unity. There is no tendency for Froude numbers to increase with slope. Alpha, the velocity head coefficient, was computed from discharge measurements and was found to range from 1.0 to 2.0 in these high gradient streams. Alpha showed a slight tendency to increase with an increase in Manning's roughness coefficient, but this was not always the case. Streambed particle-size data were obtained and presented but not used directly in the analysis of flow resistance. (Baker-IVI)
W85-03774

RESPONSE OF CHANNEL FLOW TO ROUGHNESS HETEROGENEITY,
Center for Technological Education, Holon (Israel).
D. Naot.
Journal of Hydraulic Engineering, Vol. 110, No. 11, p 1568-1587, November, 1984. 13 Fig, 28 Ref.

Descriptors: *Channel flow, *Hydraulic roughness, *Hydrodynamics, Sediment transport, Fluid mechanics, Vorticity, Turbulent flow, Turbidity currents, Simulation.

With the advance of computing methods in fluids, it became possible to obtain at a reasonable cost, numerical calculations for three-dimensional turbulent flow with secondary currents driven by the interaction of the turbulent eddies with the open surface, the geometry of the channel, and the roughness heterogeneity along the wetted perimeter. Roughness induced secondary currents were numerically simulated in the presence of the vortex induced by the free surface, and the two vortices induced by the channel corner. The relative importance of these sources for lateral motion was examined. Turbulence was modeled by the energy dissipation model, combined with an algebraic stress model. The three dimensional flow was solved using a parabolic pressure correlation algorithm. The dominant presence of the strong vortex, which is induced by the free surface, restricts the effects of the roughness heterogeneity to the lower part of the channel. Major differences in the structure of turbulence near the channel bed are shown. Research aimed at studying the transport of sediments and the propagation and growth of organic material may use properly designed calculations to learn how to account for the influence of surface heterogeneity on the flow, thus introducing a feedback mechanism into the models that account for the influence of the flow on the transport and propagation of these features. (Baker-IVI)
W85-03777

UNIFIED STREAMFLOW ROUTING BY FINITE ELEMENTS,
F. I. L. Nawogazie, and A. K. Tyagi.
Journal of Hydraulic Engineering, Vol. 110, No. 11, p 1595-1611, November, 1984. 6 Fig, 36 Ref.

Descriptors: *Streamflow routing, *Finite element method, *Mathematical models, *Illinois River, *Oklahoma, Model studies, Mathematical equations, Flow, Streamflow, Routing, Flow discharge, Hydrographs, Flood routing.

In a model developed for streamflow routing, the simultaneous solution of the continuity and momentum equations results in a complete model that uses the Galerkin finite element technique and a dimensionless time-weighting factor. The weighted-implicit unified finite element model results in an accurate and unconditionally stable solution for a time-weighted factor in a range of 0.55-1.00. Application of the model to the Illinois River in Oklahoma, for a flood observed on April 10, 1979, produced discharge hydrographs that are in close agreement with the observed flows. A time step of 1,800 sec and a time-weighting factor of 0.55 was used in simulation runs at the Tahlequah station. When an average value of Manning's coefficient is used in the model, the observed and computed values of the peak stage are the same but the computed peak occurs 13 hrs prior to the observed peak. The stage hydrograph is converted into the discharge hydrograph. Predicted value of the peak is about 15% higher than the observed peak. When the variable value of Manning's coefficient is inserted in the model, the computed peak stage is

about 5% less than the observed peak stage. Both peak stages occur at the same time. The predicted peak discharge is about 22% less than the observed peak discharge. The model is sensitive to the variations of the Manning's coefficient, lateral inflow, and large time and distance steps. The model using an average value of Manning's coefficient is simpler than the one using the variable value. The former is also conservative from the standpoint of flood warning and evaluation of areas expected to be flooded. For predicting an accurate time of arrival of the flood wave, however, the latter model is preferred, but it involves more detailed computations and calibration. (Baker-IVI)
W85-03779

VARIATION OF FLOW RESISTANCE THROUGH CURVED CHANNELS,
San Diego State Univ., CA. Dept. of Civil Engineering.
H. H. Chang.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1772-1782, December, 1984. 3 Fig, 1 Tab, 17 Ref, 1 Append. NSF grant CEE-8209029.

Descriptors: *Channel flow, *Flow resistance, *Flow characteristics, Channels, Model studies, Sediment transport, River morphology, Meanders.

Spatial variations of flow resistance and other flow characteristics through curved channels have been analyzed and a mathematical model for computing such variations has been developed. The excess flow resistance due to transverse circulation is directly related to the circulation strength which varies along a curved channel. In the process of circulation growth and decay, the transverse velocity profile is assumed to remain similar. The growth and decay of transverse circulation is under the interaction of centrifugal force and internal turbulent shear. In a long curve, transverse circulation will become fully developed. But in a short curve, this circulation and its associated resistance reach the maximum at the curve exit and they persist at higher values for a considerable distance in the downstream tangent. The rate of circulation decay is directly related to internal turbulent shear (for channel roughness) and inversely related to flow depth. The computed results, substantiated with measurements, demonstrate that flow resistance produced by transverse flow can be very significant even for mild curves without flow separation. However, backwater effect caused by such curves is usually small. Because of the important effects of transverse flow, analytical methods developed in this model provide useful techniques for studies of river morphology and sediment transport in meandering streams. (Baker-IVI)
W85-03788

PARAMETER OPTIMIZATION IN FLOOD ROUTING,
Queen Mary Coll., London (England). Dept. of Civil Engineering.
P. R. Wormleaton, and M. Karmegam.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1799-1814, December, 1984. 5 Fig, 4 Tab, 11 Ref, 1 Append.

Descriptors: *Optimization, *Flood routing, *River Wye, *England, *Floods, Flood control, Saint Venant equations, Mathematical equations, Systems analysis.

The use of optimization methods to evaluate those geometric and hydraulic river data which are required when routing floods using the complete Saint-Venant equations is demonstrated. The methods were successfully applied to five in-bank floods on the River Wye in Great Britain. The optimization process involves minimizing the errors in depth and discharge of the downstream routed hydrograph. Two objective function criteria, namely minimix and least squares, were investigated. Four optimization parameters are used, two representing channel geometry and two its hydraulic properties. Comparison of the two optimization methods used confirmed that, for all five flood events, the least squares gradient method was more robust and distinctly faster than the linear influence coefficient algorithm. The five floods analyzed fell naturally into two groups, three occurring in winter and two in spring. The agreement between the optimized conveyance values for the winter floods was very close. However the two spring floods showed variations which, while needing close study, might well be due to the higher peak discharge of these floods or imperfect modeling of the lateral inflow, or both. (Baker-IVI)
W85-03790

WATER SURFACE PROFILE OF STREAM WITH SIDE OVERFLOW,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
T. Ishikawa.
Journal of Hydraulic Engineering, Vol. 11, No. 12, p 1830-1840, December, 1984. 11 Fig, 1 Tab, 3 Ref, 1 Append.

Descriptors: *Stream flow, *Overflow, *Levees, Embankments, Dams, Earthworks, Mathematical equations, Froude number.

Overflow depth on a levee crown was studied using one dimensional analysis of a stream with side overflow. There are two typical water surface profiles which depend only on channel properties and not on flow rate, Type I and Type II. The Type II, which is caused by an obstacle like bridge piers or weirs, may give a large overflow depth on a levee crown. An overflow depth of Type I is not so great becaue the water stage is controlled by a small flow rate in the downstream reach. A mathematical equation was developed which gives a good approximation for a flow profile with gradual overtopping. Results of analysis suggest that the overflow depth becomes larger as the river bed slope is steeper. Applicability of these theoretical results were verified with experimental flume data. The relationship between overflow depth and channel properties was calculated using a one dimensional momentum equation. Two important parameters concerned with a bankfull flow include the Froude number and channel width x slope/ channel depth. (Baker-IVI)
W85-03792

FLASH FLOOD IN TANQUE VERDE CREEK, TUCSON, ARIZONA,
Geological Survey, Tucson, AZ.
H. W. Hjalmarson.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1841-1852, December, 1984. 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Flash floods, *Tanque Verde Creek, *Tucson, *Arizona, *Floods, Flooding, Flood routing, Rainfall, Storms.

Flash floods are common in the arid Southwest and are frequently an unrecognized potential hazard to people and property. The principal factors of streams which present potential flood hazards to people are: maximum instantaneous rate of flow; depth of flow; rate of increase of flow; and velocity of flow. The discharge hydrographs show that all these factors need not be present to have a serious hazard. The killer flood of July 26 was much smaller and shallower than other floods had been, but the rate of increase of flow may have been 1,450 cfs (41.1 cubic m/sec) in 1 min near Tanque Verde Falls. The estimated average velocity of the floodwaters was 1.5 m/s, but the velocity may have been 3 m/s near the falls. Thus the suddenness and high velocity of the floodwaters were major contributing factors to the tragedy, and the peak rate of flow and depth of water were only minor contributing factors. Flash floods often occur during the summer thunderstorm season, and walls of water can travel for many miles in rough or sandy stream channels at rates of rise and speeds faster than people can escape. Flash floods can occur many miles from the storm area. In only a few hours after the killer flood of July 26, the waters had disappeared as water infiltrated into the ground or reentered the atmosphere by evaporation. (Baker-IVI)
W85-03793

EXAMINATION OF RECENT FIELD DATA ON STREAM REAERATION,
Wright-McLaughlin Engineers, Denver, CO.
P. Frexes, G. H. Jirka, and W. Brutsaert.
Journal of Environmental Engineering, Vol. 110, No. 6, p 1179-1188, December, 1984. 3 Tab, 13 Ref. NSF grant CEE-8004621.

Descriptors: *Streams, *Aeration, *Wind velocity, *Turbulence, Dissolved oxygen, Turbidity, Mathematical equations, Air-water interface.

The atmospheric reaeration of streams and rivers results from the transfer of oxygen across the air-water interface. An extensive review of field experimental techniques for the transfer coefficient has been given elsewhere. The coefficients resulting from field data are examined and compared in the context of some of the predictive equations from other works. The turbulence and mixing caused by wind can have a strong effect on the rate of gas transfer across water surfaces. However, most equations for stream reaeration currently used in environmental engineering do not take the effect of wind into account. In this note, data are first analyzed apart from the wind effect and in later sections the effect of wind velocity is considered. (Baker-IVI)
W85-03808

RECORDS OF FLOODING PERIODS IN A RIVER MOUTH. EXAMPLE OF THE RIO PARAIBA DO SUL (BRAZIL). PALEOCLIMATIC IMPLICATIONS (ENREGISTREMENT DES PERIODES DE FORTES ET FAIBLES ENERGIES A L'EMBOUCHURE D'UN FLEUVE. LE CAS DU RIO PARAIBA DO SUL (BRESIL). IMPLICATIONS CLIMATIQUES),
Observatorio Nacional, Rio de Janeiro (Brazil).
L. Martin, J.-M. Flexor, and K. Suguio.
Comptes Rendus Hebdomadaires des Seances, Academy des Sciences, Paris, Vol. 299, No. 10, p 661-664, October, 1984. 2 Fig, 3 Ref.

Descriptors: *Paleoclimate, *Floods, *Paraiba do Sul, *Brazil, Sediments, River flow, Rainfall, Sand.

The degrees of roundness of sands from the terraces on both sides of the Paraiba do Sul river mouth, shows that the river-carried sediments are deposited periodically along the northern part. The deposit corresponds to river flooding periods and thus to rainy epochs. By comparison with C-14 dates already obtained, it becomes possible to propose a chronology to these rainy periods during the last 5,000 years. (Author's abstract)
W85-03810

V-SHAPED SHORT-CRESTED WEIR WITH SEMICIRCULAR CROSS SECTION,
Waterloopkundig Lab. te Delft, Wageningen (Netherlands). Wageningen Branch.
For primary bibliographic entry see Field 7B.
W85-03815

METHOD FOR MEASURING STREAM FLOWS IN RIVERS,
Fisheries Research Services, Grand Chenier, LA.
For primary bibliographic entry see Field 7B.
W85-03833

RELATIVE BIAS OF SEVERAL FISHERIES INSTREAM FLOW METHODS,
Wyoming Game and Fish Dept., Cheyenne.
T. C. Annear, and A. L. Conder.
North American Journal of Fisheries Management, Vol. 4, No. 4B, p 531-539, Fall, 1984. 6 Tab, 15 Ref.

Descriptors: *Fish management, *Measuring instruments, *Streamflow, Flow, Streams, Tennant method, Wetted perimeter curves, Habitat retention models, Model studies, Physical habitat simulation, Habitats.

Four general categories of instream flow methods were evaluated to determine their biases relative to each other. The categories include the Tennant method, wetted perimeter curves, habitat retention

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models, and physical habitat simulation (PHASBSIM) models. The Tennant method was one of the least biased methods, but it did not include biological data and is not capable of identifying trade-offs. No settled perimeter methods were significantly unbiased, and methods relying on subjective identification of inflection points were biased upwards. Two habitat retention methods were significantly unbiased. These methods include the mean recommendation of all riffles in a study reach where all three criteria were met, and the recommendation for the single most critical riffle in a study reach where two of the three criteria are met. No PHASIM models were unbiased. The IFG-4 model was biased upwards for small streams and low for large streams. Any method used to define an instream flow for fisheries should be based on biological data, defensible, and capable of quantifying trade-offs to some degree. While cost and time should not be the most important factors in the selection of an appropriate method, they are important considerations. A combination of methods could be used to best identify seasonal flow needs. (Baker-IVI)
W85-03835

SECULAR VARIATIONS IN STREAMFLOW IN THE WESTERN UNITED STATES,
Arizona Univ., Tucson. Lab. of Tree-Ring Research.
D. M. Meko, and C. W. Stockton.
Journal of Climate and Applied Meteorology, Vol. 23, No. 6, p 889-897, June, 1984. 7 Fig, 3 Tab, 22 Ref.

Descriptors: *Streamflow, *Climate, *Meteorology, *Western United States, *Rainfall, Precipitation, Temperature effects, Variation coefficient.

Carefully selected streamflow records can provide useful information on climatic variations, especially in mountainous areas where high-elevation weather stations are sparse. Examination of annual streamflow series in the West indicates that significant hydrologic changes related to climate have taken place in the past century. In general, major low-frequency variations in streamflow have tracked variations in precipitation and temperature; minima in the low-frequency component of streamflow have generally been associated with periods of both low precipitation and high temperature. Secular trends in streamflow in various parts of the West have sometimes paralleled one another and at other times have diverged. This behavior seems related to major shifts in regimes of the general circulation. Correlation analysis for 1932-1980 indicates that in terms of regional sums of annual streamflow, water supply of the Pacific Northwest is uncorrelated with water supply of the Upper Colorado region, and significantly negatively correlated with streamflow in Arizona and Texas. (Baker-IVI)
W85-03845

TIME OF TRAVEL AND DISPERSION STUDY IN THE ANDROSCOGGIN RIVER BASIN, MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
G. W. Parker, G. S. Westerman, G. S. Hunt, and G. L. Morrill.
Available from the OFSS, USGS, Box, 25425, Fed. Ctr. Denver, CO 80225. USGS Water Resources Investigations Report 83-4232, 1983. 135 p, 108 Fig, 9 Tab, 9 Ref.

Descriptors: *Dye releases, Rivers, Reservoir, *Mixing, *Marking techniques, Parametric hydrology, Streamflow, Tracers, Stratifications, Stratified flow, Unsteady flow, Fluorometry, *Maine, *Time-of-travel, *Longitudinal dispersion, Androscoggin River, Gulf Island Pond.

In a series of dye tracer studies at discharge ranging from 45 to 212 cubic meters per second, time of travel and dispersion characteristics were determined at 12 sampling sites along 123 kilometers of the Androscoggin River (Rumford to Prejepscot Dam). Dye-cloud centroid traveltimes ranged from approximately 120 hours at high discharge to 410 hours at flows approaching 95 percentile duration. Longitudinal dispersion coeficients ranged from 21.3 to 76.7 square meters per second. In the 37.2 kilometer unsteady flow reach from Gulf Island Dam to Prejepscot Dam, the concept of mass flow versus time was applied to relate centroid traveltime to average discharge at five sites. This information was used to develop traveltime versus discharge relationships, traveltime versus distance relationships, and longitudinal dispersion coefficients. In Gulf Island Pond, a 70.4 million cubic meter impoundment, three complete dye clouds were traced. The range of observed centroid traveltime through the pound was 110 hours at a mean discharge of 84 cubic meters per second to 260 hours at 59 cubic meters per second. Traveltimes are dependent upon reservoir stratification and mixing as well as discharge. During 1981, inflowing dye-tagged water at 19.0 and 19.5 degrees Celsius was observed to seek its own temperature density level during movement along the thalweg. (USGS)
W85-03911

WATER RESOURCES OF SLEEPING BEAR DUNES NATIONAL LAKESHORE, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
A. H. Handy, and J. R. Stark.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4253, 1984. 39 p, 16 Fig, 7 Tab, 13 Ref.

Descriptors: *Water resources, Surface water, Groundwater, Water quality, Hydrogeology, *National Lakeshores, *Michigan, Benzie County, Leelanaw County.

Sleeping Bear Dunes National Lakeshore in a water-rich area. It borders Lake Michigan and several small streams flow through the park to the lake. Small lakes are numerous within the park and near its boundaries. Ground water is available at most places in the park and wells yield as much as 100 gallons per minute. Water from streams, lakes, wells, and springs is of good quality. Dissolved solids range from 35 to 180 mg/L in lakes, from 145 to 214 mg/L in streams, and from 136 to 468 mg/L in groundwater. Analyses of samples for pesticides and trace metals indicate that no pesticides are present in the water, and that concentrations of trace metals do not exceed recommended drinking-water standards. Surface and ground water are available in sufficient quantity in most areas of the park for the development of water supplies for visitor's centers, campgrounds, picnic areas, and other park facilities. (USGS)
W85-03917

ANALYSIS AND CHARACTERISTICS OF SIMULATED FLOWS FROM SMALL SURFACE-MINED AND UNDISTURBED APPALACHIAN WATERSHEDS IN THE TUG FORK BASIN OF KENTUCKY, VIRGINIA, AND WEST VIRGINIA,
Geological Survey, Reston, VA. Water Resources Div.
A. G. Scott.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4151, 1984. 169 p, 24 Fig, 8 Tab, 10 Ref.

Descriptors: *Simulation analysis, *Virginia, *West Virginia, *Kentucky, *Coal mines, *Streamflow forecasting, Model studies, Mathematical models, Flood frequency.

Hydrologic and climatologic data were collected at 10 small, mined and unmined watersheds in the Tug Fork basin of Kentucky, Virginia, and West Virginia. These data included continuous records of discharge, precipitation, and air temperature. Daily records of sediment concentrations and sediment discharges were also obtained and periodic observations of water-quality data taken. A compilation of all these data is presented. The observed climatic and hydrologic data from these basins were used to calibrate the U.S. Geological Survey Precipitation-Runoff Modeling System for each watershed. The calibrated models of each basin were then used with a set of nearby, long-term climatic data to simulate a long record of streamflow. A 68-year record of daily streamflow and 57 years of annual peaks were simulated for each site. These simulated records were analyzed to obtain flood-frequency curves, flow-duration curves, mean-annual discharges, and the 7-day, 10-year low flow for each site. The flow characteristics computed from the simulated records of discharge were analyzed graphically and statistically by regression analysis to investigate the degree of relationship and to define the relationship between mining and runoff. For this sample of small basins, peak flows, discharges for 10- and 50-percent flow durations, and mean-annual flows are directly related to percent of drainage area disturbed (measured from aerial photos) and drainage area. Percent of drainage area disturbed is generally a more statistically significant estimator of discharge than drainage area, particularly for peak flows of higher recurrence intervals. (USGS)
W85-03918

OKLAHOMA: SUMMARY OF ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, OKLAHOMA DISTRICT, 1983,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 10C.
W85-03922

FLOW-DURATION HYDROGRAPHS FOR SELECTED STREAMFLOW STATIONS ON SOUTH DAKOTA STREAMS,
Geological Survey, Huron, SD. Water Resources Div.
J. R. Little.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Open-File Report 84-432, 1984. 129 p, 10 Fig, 9 Tab, 2 Ref.

Descriptors: Surface water, Flow, *Flow duration, *Hydrographs, *Streamflow, *South Dakota.

Duration hydrographs showing the percent of time which specified discharges were equaled or exceeded on nine South Dakota streams are presented. Accompanying tables list the values plotted on the hydrographs and the 10, 30, 70, and 90 percent exceedence values for the streams. (USGS)
W85-03923

HYDROLOGIC CONDITION OF THE CHICOD CREEK BASIN, NORTH CAROLINA, BEFORE AND DURING CHANNEL MODIFICATIONS, 1975-81,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 4A.
W85-03928

WATER RESOURCES OF THE PALAU ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
O. Van der Brug.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4140, 1984. 223 p, 50 Fig, 83, Tab, 33 Ref.

Descriptors: *Hydrologic data, *Weather data, Geology, Water resources development, Pacific Islands, *Palau Islands.

The Palau Islands are a group of 350 islands, ranging in size from a few hundred square feet to the 153-square-mile island of Babelthuap. Babelthuap is the second largest island in the Western Pacific and comprises more than 80 percent of the total land area of the Palau Islands. Most of the islands are uninhabited limestone ridges covered with dense vegetation. These islands have no freshwater resources and are not included in this report. The island of Koror with an area of 3.6 square miles is the administrative, commercial, and population center of Palau and has an annual average rainfall of 148 inches. Short-term rainfall records at

other locations in the islands indicate little variation in annual rainfall throughout the Palau Islands. Runoff-to-rainfall ratios for streams on Babelthuap show that about 70 percent of the rain falling on the island runs off to the ocean. The uniformity of rainfall and basin characteristics is shown by the excellent correlation between mean annual rainfall on Koror and streamflow on Babelthuap and by the close correlations between discharge at gaging stations and partial-record sites. Surface water quality is generally very good as shown by 55 chemical analyses of water from 18 sources. The dissolved solids concentration of water samples did not exceed 66 milligrams per liter. This report summarizes in one volume hydrologic data collection in a 14-year period of study and provides interpretations of the data than can be used by planners and public works officials as a basis for making decisions on the development and management of the islands' water resources.
W85-03935

WATER RESOURCES OF KOSRAE, CAROLINE ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
O. Van der Brug.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4161, 1984. 143 p, 26 Fig, 53 Tab, 20 Ref.

Descriptors: *Hydrologic data, *Weather data, Water resources development, *Pacific Islands, Caroline Islands, *Kosrae Island.

Kosrae is a high volcanic island about 42 square miles in area and the easternmost of the Caroline Islands. Mount Finkol (Mt. Crozer), at 2,065 feet, is the highest point on the island. Mountainous ridges descend sharply to narrow coastal strips which support a population of 5,500 people. Many streams, some quite large relative to the size of the island, drain radially from the interior. The average annual discharge of surface water amounts to almost 7 million gallons per square mile per day. Annual rainfall for coastal areas on Kosrae averages about 200 inches, and is similar to the rainfall for coastal areas on the island of Ponape, about 340 statute miles to the northwest. Rainfall in the interior was estimated at 225 inches per year of which about two thirds runs off as streamflow. Surface-water quality is very good as shown by 42 chemical analyses of water from 12 streams. This report summarizes in one volume the hydrologic data collected and provides interpretations that can be used by planning and public works officials as a basis for making decisions on the development and management of their water resources. (USGS)
W85-03936

WATER RESOURCES OF PONAPE, CAROLINE ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
O. Van der Brug.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4139, 1984. 171 p, 32 Fig, 62 Tab, 31 Ref.

Descriptors: *Hydrologic data, *Weather data, Water resources development, *Pacific Island, *Ponape Island, Caroline Islands.

Ponape is the third largest island in the western Pacific, with a land area of 129 square miles. The island is volcanic, nearly circular in shape, and covered with lush tropical vegetation. The mountainous interior has the highest peaks in the western Pacific. Annual rainfall at Kolonia and other coastal areas is 191 inches. Inland at higher elevations, the rainfall is considerably higher. The upper Nanpil River basin averages about 340 inches annually. Runoff-to-rainfall ratios for Ponapean streams show that about two thirds of the rain falling on the island runs off. Flow-duration curves show the similarity of the geology, vegetation, and rainfall of the drainage basins and indicate little ground-water contribution to surface runoff. Surface-water quality is excellent as shown by 53 chemical anlyses of water from 19 streams. Water of the Nanpil River, the source of water for the central water system, is especially low in dissolved elements and solids. This report summarizes in one volume all the hydrologic data collected and provides analyses that may be used by planning and public works officials as a basis for making decisions on the development and management of their water resources. (USGS)
W85-03937

BASE FLOW OF STREAMS IN THE OUTCROP AREA OF SOUTHEASTERN SAND AQUIFER: SOUTH CAROLINA, GEORGIA, ALABAMA, AND MISSISSIPPI,
Geological Survey, Atlanta, GA. Water Resources Div.
V. A. Stricker.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4106, October, 1983. 17 p, 10 Fig, 3 Tab, 16 Ref.

Descriptors: *Surface-groundwater relations, *Base flow, *Groundwater recession, *Sand aquifer, *Hydrograph analysis, Recession curve, Groundwater flow, *Southeastern sand aquifer, Hydraulic diffusivity, Hydrograph separation, South Carolina, Georgia, Alabama, Mississippi.

The base flow component of streamflow was separated from hydrographs for unregulated streams in the Cretaceous and Tertiary clastic outcrop area of South Carolina, Georgia, Alabama, and Mississippi. The base flow values are used in estimating recharge to the sand aquifer. Relations developed between mean annual base flow and stream discharge at the 60- and 65-percent streamflow duration point can be used to approximate mean annual base flow in lieu of hydrograph separation methods for base flows above 10 cu ft/s. Base flow recession curves were used to derive estimates of hydraulic diffusivity of the aquifer which was converted to transmissivity using estimated specific yield. These base-flow-derived transmissivities are in general agreement with transmissivities derived from well data. The shape of flow duration curves of streams is affected by the lithology of the Coastal Plain sediments. Steep flow duration curves appear to be associated with basins underlain by clay or chalk where a low percentage of the discharge is base flow while flatter curves appear to be associated with basins underlain by sand and gravel where a high percentage of the discharge is base flow. (USGS)
W85-03940

DIGITAL MODEL FOR STREAMFLOW ROUTING BY CONVOLUTION METHODS,
Geological Survey, Bay Saint Louis, MS. Water Resources Div.
W. H. Doyle, Jr., J. O. Shearman, G. J. Stiltner, and W. R. Krug.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 83-4160. 130 p, 18 Fig, 20 Tab, 15 Ref.

Descriptors: *Streamflow routing, Attenuation, *Computer model, Discharge, Dispersion, *Flood routing, Flow system, *Hydrograph, Low flow, *Mathematical models, Streamflow, *Convoluting techniques, Diffusion analogy, Multiple linearization, Single linearization, Storage continuity.

U.S. Geological Survey computer model, CONROUT, for routing streamflow by unit-response convolution flow-routing techniques from an upstream channel location to a downstream channel location has been developed and documented. Calibration and verification of the flow-routing model and subsequent use of the model for simulation is also documented. Three hypothetical examples and two field applications are presented to illustrate basic flow-routing concepts. Most of the discussion is limited to daily flow routing since, to date, all completed and current studies of this nature involve daily flow routing. However, the model is programmed to accept hourly flow-routing data. (USGS)
W85-03942

LOW-FLOW TRANSPORT MODELS FOR CONSERVATIVE AND SORBED SOLUTES - UVAS CREEK STUDIES,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2B.
W85-03948

REPORT OF THE ANNUAL YIELD OF THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS-OKLAHOMA, 1983 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
M. A. Moore, and T. E. Lamb.
USGS Open-File Report 84-598, 1984. 24 p, 1 Fig, 3 Tab, 2 Ref.

Descriptors: *Interstate compacts, *Stream discharge, *Reservoir storage, *Arkansas, *Oklahoma, Annual yield, Arkansas River basin compact.

The computed annual yield and deficiency of the subbasins as defined in the Arkansas River Compact, Arkansas-Oklahoma, are given in tables. Actual runoff from the subbasins and depletion caused by major reservoirs in the compact area are also given in tabular form. Monthly, maximum, minimum, and mean discharges are shown for the 14 streamflow stations used in computing annual yield. (USGS)
W85-03951

ENHANCED JOB CONTROL LANGUAGE PROCEDURES FOR THE SIMSYS2D TWO-DIMENSIONAL WATER-QUALITY SIMULATION SYSTEM,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W85-03953

REGIONAL FLOOD RELATIONS FOR UNREGULATED LAKES IN WEST CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
M. A. Lopez, and R. D. Hayes.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4015, 1984. 60 p, 5 Fig, 9 Tab, 27 Ref.

Descriptors: *Flood stages, *Flood recurrence interval, *Regional analysis, *Lake classification, *Florida, Lakes, Average lake altitude regionalization, Frequency analysis.

Regional lake flood altitude in the Southwest Florida Water Management District for 2- to 500-year recurrence intervals was estimated by multiple linear-regression analysis. The average lake altitude was used as a reference above which flood volumes are related to lake geometry, watershed characteristics, and rainfall. Average altitude at surface-outflow lakes is related to the altitude of the lake surface shown on topographic maps, lake-outlet altitude, and annual rainfall. Average altitude at closed-basin lakes is related to the altitude of the lake surface shown on topographic maps. Flood volume above average altitude for surface-outflow lakes is related to lake geometry, watershed characteristics, and rainfall. The average standard error of estimate for regional relations of surface-outflow lakes ranges from 29 to 54 percent in the Central Lake District and from 50 to 58 percent in the Ocala Uplift District. The average standard error of estimate for regional relations of closed-basin lakes ranges from 22 to 40 percent. Regional relations for average altitude and flood volume above average altitude are used to weight station flood-altitude data. Tables comparing station, regional, and weighted lake flood altitudes are shown for 47 lakes used in the analysis. (USGS)
W85-03960

AVAILABILITY OF HYDROLOGIC DATA IN SAN JUAN COUNTY, NEW MEXICO,

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Geological Survey, Albuquerque, NM. Water Resources Div.
R. L. Klausing, and G. E. Welder.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Open-File Report 84-608, 1984. 142 p, 2 Fig, 3 Tab, 14 Ref, 1 Map.

Descriptors: Surface water, Groundwater, Well data, San Juan County, *New Mexico, San Juan River, Animas River, La Plata River, *Hydrologic data, Data collections.

San Juan County, in the northwestern corner of New Mexico, uses surface water from the San Juan, Animas, and La Plata Rivers as a principal source of water for the county, but the water in these streams is fully appropriated. Ground water is present in San Juan County in several bedrock formations and in the alluvium of the river valleys. This report describes the hydrologic data that have been collected in San Juan County, presents examples of the data, shows the locations of the data-collection sites, and indicates where more complete records may be obtained. This data base should be helpful in assessing the quantity, quality, and availability of the county's water resources. Information collected at 1,877 water wells, 39 streamflow-gaging stations, and 172 springs is presented. The collection sites and geology are shown on a base map with a scale of 1 inch = 2 miles. (USGS).
W85-03961

DEVELOPMENT OF TRIBUTARIES OF DIFFERENT SIZES ALONG WINDING STREAMS AND VALLEYS,
State Univ. of New York at Buffalo. Dept. of Geography.
A. D. Abrahams.
Water Resources Research, Vol. 20, No. 12, p 1791-1796, December, 1984. 5 Fig, 4 Tab, 12 Ref.

Descriptors: *Tributaries, *Valley sinuosity, *Streams, Bend migration, Meandering, Topography, Headwaters.

An analysis of 40 winding streams and valleys reveals that higher proportion of large tributaries than small ones occurs on the concave (out) side of bends. The principal reason for this is that large tributaries experience greater difficulty than small ones forming in the limited amount of space on the convex (in) side of bends. The proportions of small and large tributaries on the concave side of bends are determined largely by the spatial requirements of tributaries, valley sinuosity, mean valley bend length, and mean rate of bend migration. In addition, the proportion of large tributaries on the concave side of bends is affected by junction angle adjustments that deflect a main stream toward a large tributary, thereby creating a bend with the large tributary on its concave side. These adjustments increase the proportion of large tributaries on the concave side of bends, especially along low-sinuosity headwater streams. (Author's abstract)
W85-03984

MODEL OF FLOOD WAVE SPEED-DISCHARGE CHARACTERISTICS OF RIVERS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
T. H. F. Wong, and E. M. Laurenson.
Water Resources Research, Vol. 20, No. 12, p 1883-1890, December, 1984. 8 Fig, 2 Tab, 13 Ref.

Descriptors: *Wave velocity, *Flood waves, *Model studies, *Australia, Flood routing, Flood forecasting, Mathematical models, River flow, Flow discharge, Floodplains, Bankfull stage.

A constant general form of relation between wave speed and discharge has been demonstrated for six reaches of three rivers of southeast Australia. This form is similar to that previously proposed for British rivers. A mathematical model of the relation has been developed that fits the data and is consistent with a physical interpretation of the factors determining the relation. Physical bases for determination of two of the model's parameters have not been proposed, so further testing and development are needed to determine the potential of the model for rivers other than those for which it was developed. The model involves estimating in-bank and flood plain components of the flow and weighting of their individually estimated wave speeds to give the overall wave speed. Five parameters must be estimated to define the model. These are power function parameters ai and af, retardance coefficient at bankfull discharge, threshold discharge/bankfull discharge ratio, and bankfull discharge. The retardance of high flows is greatly affected by channel and flood plain storage and boundary roughness alone cannot account for the flow retardance effects. Those nonboundary roughness effects become important well before the flow reaches bankfull. (Baker-IVI)
W85-03994

UNCERTAINTY ANALYSIS OF A DELINEATED FLOODPLAIN,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. McBean, J. Penel, and K.-L. Sui.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 387-395, September, 1984. 4 Fig, 4 Tab, 13 Ref.

Descriptors: *Floodplains, *Data interpretation, *Uncertainty analysis, Computers, Water depth, Water surface profiles, Mathematical equations.

The delineation of floodplains involves, in most circumstances, solving the one-dimensional energy equation. Uncertainties in the identified floodplain arise from both computational and data uncertainties. Data uncertainties are concluded to be generally more significant than computational uncertainties. A method is developed to calculate the uncertainty in floodplain delineation arising from data uncertainties. The proposed method requires only HEC-2 computer output and a small computer program. Application of the method to two case studies and comparison with another uncertainty method suggest that the proposed uncertainty theory is appliable to practical situations within the given constraints. First order uncertainty analysis provides an easily applied mathematical equation for the characterization of uncertainty in water depth and foodplain width. The uncertainty in water depth is a function of the coefficients of variation of parameters such as Q and n and not a function of their absolute magnitude. The uncertainty in floodplain width is dependent on the geometry of the channel and floodplain, and not simply on the percentage increased in water depth. The magnitudes of uncertainty in water depth and foodplain width as obtained from a typical case study may be substantial which strongly argues that uncertainties should be considered in floodplain delineation. (Baker-IVI)
W85-04041

CONCEPTUAL MODEL OF RIVER ICE BREAKUP,
National Water Research Inst., Burlington (Ontario). Environmental Hydraulics Section.
For primary bibliographic entry see Field 2C.
W85-04046

DESIGN STORMS FOR URBAN DRAINAGE DESIGN,
National Water Research Inst., Burlington (Ontario). Hyrdraulics Research Div.
For primary bibliographic entry see Field 2B.
W85-04049

RIVER MIXING - A STATE-OF-THE-ART REPORT,
Minnesota Legislature Science and Technology Research Office, St. Paul.
For primary bibliographic entry see Field 5B.
W85-04050

RELIABILITY OF SUSPENDED LOAD ESTIMATES IN CHALK STREAMS,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2J.
W85-04054

MEANDERING CHANNEL RESPONSE TO ALTERED FLOW REGIME: MILK RIVER, ALBERTA AND MONTANA,
Calgary Univ. (Alberta). Dept. of Geography.
C. Bradley, and D. G. Smith.
Water Resources Research, Vol. 20, No. 12, p 1913-1920, December, 1984. 5 Fig, 3 Tab, 36 Ref.

Descriptors: *Milk River, *Alberta, *Montana, *Dam effects, *Meanders, *Diversion, Channel width, Reservoir storage, Flow regime, Flow discharge, Bed degradation.

Mean and peak flows, channel width, and rates of meander migration are examined for two sandy meandering reaches of the Milk River in south Alberta and north Montana. One reach, upstream of the international boundary near Onefour, Alberta, is affected by the St. Mary diversion. The other reach near Havre, Montana is below the Fresno Dam and reservoir. Comparisons are possible because of the ample and long-term availability of maps, air photos, and hydrometric records preceding and succeeding the two altered flows for both reaches. Understanding the natural river regime and effects of diversion and dam storage are critical for predicting channel responses to a proposed additional dam on the Milk River. Results indicate that increased discharge due to a diversion has increased channel width 5.5 m and increased the rate of meander migration by 0.85 m/year. Downriver, reservoir storage has decreased channel width 16.8 m and the rate of meander migration by 1.3 m/year and caused channel bed degradation up to 1.5 m near the dam. (Author's abstract)
W85-04078

REGIONALIZATION OF CONTINENTS ACCORDING TO THE CHARACTER OF THE ANNUAL DISTRIBUTION OF RIVER RUNOFF,
Moscow State Univ. (USSR).
V. A. Zhuk, K. F. Reteyum, and L. P. Chutkina.
Water Resources, Vol. 10, No. 2, p 131-145, March-April, 1983. 7 Fig, 7 Tab, 12 Ref. Translated from Vodnye Resursy, No. 2, p 53-71, March-April, 1983.

Descriptors: *Runoff, *Rivers, *Regional analysis, Frequency analysis, Algorithms, Mathematical studies, Computers.

A complete automated algorithm for classifying the correlation matrix is created and the matrix is applied to regionalization of continents according to the character of their annual distribution of runoff. The classification algorithm is used by a computer for regionalizing a territory according to the character of annual variability of hydrometerological quantities and the character of their long-term variations and also for classifying objects represented by a set of indices. The proposed algorithm makes it possible to distinguish world-wide regions and groups of rivers having an annual runoff distribution of the same type. An analysis of series of classification variants made it possible to trace the dynamics of unification of observation series and to select the optimal variant with an initial value of the coefficients characterizing the degree of intraregional correlation of the series; the true similarity within the regions is substantially higher than the initial, which indicates a high stability of the results obtained. (Baker-IVI)
W85-04091

CONTRIBUTION TO THE THEORY OF STEADY FLOWS IN RIVER MOUTHS,
S. A. Arsen'ev.
Water Resources, Vol. 10, No. 3, p 301-309, May-June, 1983. 5 Fig, 15 Ref. Translated from Vodnye Resursy, No. 3, p 144-1523, May-June, 1983.

Descriptors: *River mouth, *Steady flow, Flow velocity, Model studies, River flow, Gravity, Velocity.

The possibilities of modeling flows by means of the method of total flows being used when investigating sea and ocean currents at river mouths is discussed. The method of total flows in the present form permits removing various restrictions of the

past. The method is generalized to the case of taking into account the longitudinal component of the gravity, which will permit examining flows in the mouth region of a river. Several exact solutions are obtained to the problem for river mouths bounded by shores having the form of straight lines and a constant depth. These solutions will permit analyzing certain characteristics of flows in river mouths, finding the asymptotic behavior of the flow velocities at great distances from the mouth, and also determining the distance of seaward spreading of river waters. (Baker-IVI)
W85-04112

INVESTIGATION OF WATER CIRCULATION IN THE NORTHWESTERN BLACK SEA AND ITS RELATION TO HUMAN IMPACT ON RIVER RUNOFF,
Akademiya Nauk SSSR, Moscow. Vychislitelnyi Tsentr.
A. S. Blatov, M. A. Rasulov, and I. I. Chechel'.
Water Resources, Vol. 10, No. 4, p 340-347, July-August, 1983. 4 Fig, 1 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 30-37, July-August, 1983.

Descriptors: *River runoff, *Black Sea, *Water circulation, Wind, Bottom currents, Topography.

Results of numerical calculations of the integral circulation of waters in the northwestern Black Sea, the problem of the role of the nonuniform wind fields, bottom topography, and shoreline configuration in the formation and transformation of the field of currents, and the effect of the human impact on water circulation in this area are presented. As a result of numerical experiments it is demonstrated that depending on the wind situation the transient period of water circulation in the northwestern Black Sea is 7-10 days and more. The current schemes and the estimates of water exchange and seasonal variation of the level of this part of the sea with open regions obtained correspond well to the observation data, which attests to the possibility of using the scheme for calculating currents in shallow water bodies. (Baker-IVI)
W85-04118

NUMERICAL METHODS OF SOLVING ONE-DIMENSIONAL PROBLEMS OF HYDRAULICS,
For primary bibliographic entry see Field 8B.
W85-04119

METHOD OF CALCULATING THE SPRING FLOOD HYDROGRAPH,
I. A. Zheleznyak.
Water Resources, Vol. 10, No. 6, p 586-593, November-December, 1983. 3 Fig, 4 Tab, 19 Ref. Translated from Vodnye Resursy, No. 6, p 119-127, November-December, 1983.

Descriptors: *Hydrographs, *Floods, Forecasting, Flood hydrographs, Mathematical equations, Runoff.

Methods of calculating maximum runoff from data on water discharges are laborious, and a determination of the shape of the hydrograph from the recorded hydrograph does not preclude the possibility of errors in calculations of the discharge of the flood runoff, especially in small drainage basin areas where it is governed by the water yield. A method of calculating the ordinates of the hydrograph of a flood is presented with a given probability on the basis of a refined genetic formula of the runoff. Modeling of the process of formation of the flood runoff and determination of the unit hydrograph makes it possible to determine the parameters and coefficients of equations for calculating the maximum discharge and to establish the reduction of the rates of maximum runoff, coefficients taking into account the influence of forests, wetlands, and reservoirs in river basins on the basis of a detailed quantitative assessment of the changes which these factors introduce into the process of formation of the flood runoff. (Baker-IVI)
W85-04150

RIVER RUNOFF MAPS OF SOME HIGH-MOUNTAIN REGIONS OF THE WORLD,
G. Ya. Karasik, G. M. Nikolaeva, and I. D. Tsigel'naya.
Water Resources, Vol. 10, No. 6, p 594-600, November-December, 1983. 7 Fig, 14 Ref. Translated from Vodnye Resursy, No. 6, p 135-142, November-December, 1983.

Descriptors: *Runoff, *Mountains, *Hydrologic maps, *Asia, *South America, Irrigation water, Hydroelectric power, Distribution, Water supply, Rivers.

Hydrologic maps are presented which give an idea about the general regularities of the formation and territorial distribution of resources of river runoff and its genetic components, their applied value being determined by the degree of generalization of the components being mapped, which is governed by the extent of hydrologic knowledge of the mountain regions. An extremely important feature of many mountain regions rich in water resources is their location among arid territories, deserts. Mountains are important not only as a source of irrigation water but also of hydroelectric power. Hydrologic maps for latitudinal mountain systems located in the center of the Asian continent are presented, including Tien Shan, Pamir, Hindu Kush, and Karakoram, and meritional mountains such as the South American Andes. All maps were constructed on a single methodological basis with consideration of general regularities of formation of river runoff in mountains and used with certain modifications depending on the degree of knowledge and character of the investigated territory. (Baker-IVI)
W85-04151

SENSITIVITY ANALYSIS OF THE SWMM RUNOFF-TRANSPORT PARAMETERS AND THE EFFECTS OF CATCHMENT DISCRETISATION,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
N. A. Zaghloul.
Advances in Water Resources, Vol. 6, No. 4, p 214-223, December, 1983. 17 Fig, 8 Ref.

Descriptors: *Sensitivity analysis, *Storm runoff, *Runoff-transport, *Urban runoff, *Discretization, Catchment area, Simulation, Hydrographs, Storm Water Management Model, Calibration, Urban watersheds.

The use of the SWMM (Storm Water Management Model) model to simulate the Runoff-Transport phenomenon necessitates the proper calibration of the different parameters involved in the process and the effect of these parameters on the routed hydrograph. A detailed sensitivity analysis is conducted on the main parameters of the Runoff-Transport Blocks to establish which are the most sensitive parameters affecting the Runoff-Transport simulation. The result of the study indicates a relative influence of the major parameters used in both the Runoff and Transport Blocks. Hence, the SWMM default values can be used adequately. The costs of setting up and running a SWMM simulation are largely determined by the level of discretization used for a particular catchment. The purpose of this part of the study is to investigate the level of discretization needed to adequately represent an urban watershed and to illustrate the effects of reducing the number of subcatchments on the accuracy of runoff simulation. A methodology is defined to achieve a representative equivalent catchment from theoretical considerations. Verification of the procedures involved a series of applications on both hypothetical and real areas. (Author's abstract)
W85-04157

REGIME OF OSCILLATORY FLOW,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
S. Vongvisessomjai.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 111, No. 1, p 96-110, January, 1985. 7 Fig, 4 Tab, 19 Ref, 1 Append.

Descriptors: *Oscillatory flow, *Regime of flow, Laminar flow, Turbulent flow, Bed roughness, Bed load, Hydraulic roughness, Reynolds number, Flow.

A regime of flow is defined as the transition from laminar to turbulent flow which is an inception of turbulence in the flow field. Knowledge of flow regime provides useful information for quantitative description of flow and its analysis. It also serves as the lower limit of sediment transport. Earlier regimes of flow are very complicated because of their various types of flow and bed roughness. In this study an analysis is made of regime of flow using known published data tested in oscillating beds, wave flumes and water tunnels over loose sediment beds and rigid ripple beds, as well as wave flume data tested by the author. The approach is based on a dimensional consideration and a derivation of theoretical regimes of flow. It is found that the theoretical regimes of flow which are expressed in terms of flow Reynolds number and relative smoothness of the bed can be used for loose sediment beds but cannot be used for ripple beds of larger roughness. A unique regime of flow which is expressed in terms of sediment Froude number and relative bed smoothness is obtained from its proper fitting to the experimental data from all types of flow and bed roughness. The appropiate dimensionless parameter 'the relative bed smoothness' reveals automatically the condition of its roughness. (Author's abstract)
W85-04247

CONVOLUTION AND THE KINEMATIC WAVE EQUATIONS,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Center.
A. T. Hjelmfelt, Jr.
Journal of Hydrology, Vol. 75, No. 1/4, p 301-309, 1984/1985. 5 Fig, 12 Ref.

Descriptors: *Rainfall-runoff relationships, *Kinematic wave theory, *Convolution, *Unit hydrographs, Equations, Model studies, Watersheds, Runoff, Histograms.

Two general approaches are used to describe runoff from rainfall: non-linear approaches, of which kinematic wave models are an example; and linear approaches, of which unit hydrograph methods are an example. Both approaches exhibit problems in some cases. It would be desirable to be able to use concepts from one of the approaches to enhance the usability of the other. Kinematic wave equations for a simple watershed model were cast in the form of a convolution integral. This indicated that nonlineariity is expressed in variabe lag time in the convolution process. A linear kinematic wave analysis resulted in convolution of a time-area histogram with the rainfall excess. This result led to the hypothesis that the Clark hydrograph method is a describing function approach to approximating a nonlinear runoff process. Two special cases, flow across a plane rectangular surface and flow with a linear stage-discharge relation, are developed in detail. These solutions are used to show the relationship between the kinematic wave methods and the Clark unit hydrograph, and to explore the source of non-linearity in convolution approaches to rainfall-runoff modeling. The Clark hydrograph parameters are descriptive of the approximation process instead of the watershed. They can be expected to change with each storm; thus, the difficulty in quantifying concepts such as time-of-concentration, lag-time and reservoir constants. (Moore-IVI)
W85-04279

MEANDERING OF UNDERFIT STREAMS,
San Diego State Univ., CA. Dept. of Civil Engineering.
H. H. Chang.
Journal of Hydrology, Vol. 75, No. 1/4, p 311-322, 1984/1985. 4 Fig, 1 Tab, 14 Ref. NSF grant CEE-8209029.

Descriptors: *Meandering, *Underfit streams, Slope, Bed load, Flow discharge, Particle size, *Mathematical equations, Tributaries, Sediments.

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The regime slope adjustment from an alluvial river to an underfit stream with markedly decreased discharge is analyzed. Underfit streams in ample river valleys are usually characterized by a distinct meandering pattern. Such a feature is explained by the development of a stream slope flatter than the river valley slope in response to the discharge reduction. A regime equation which relates channel slope to the discharge, bedload and bed sediment size is developed. From this equation, the bedload/discharge ratio (or bedload content) for an alluvial channel reach of constant slope and sediment size varies as a direct function of the discharge. The bedload/discharge ratio decreases more rapidly as the discharge decreases toward the threshold for bedload movement. A channel reach is usually supplied by tributaries of smaller discharges. Following a marked decrease in discharge, the bedload/discharge ratio in the water-sediment mixture supplied to the reach usually decreases faster than that required to maintain the constant slope. In response to the deficiency in bedload content, the underfit stream eventually develops a flatter slope, i.e. a meandering pattern, in addition to the other adjustments. (Author's abstract)
W85-04280

DEPENDENCE OF STORM FLOWS ON RAINFALL INTENSITY AND VEGETAL COVER IN SOUTH AFRICA,
Georgia Univ., Athens. School of Forest Resources.
J. D. Hewlett, and J. M. Bosch.
Journal of Hydrology, Vol. 75, No. 1/4, p 365-381, 1984/1985. 1 Fig, 7 Tab, 20 Ref.

Descriptors: *South Africa, *Rainfall intensity, *Vegetation, *Storm runoff, Overland flow, Rainfall-runoff relationships, Flood peak, Reforestation, Pine trees, Fire, Grasses.

Analysis of 1546 storm flows from eight small basins in South Africa provides new evidence that hourly rainfall intensity, and consequently overland flow, play a minor role in flood production in many source areas. Regressed against gross storm rainfall and maximum hourly rainfall intensities, storm-flow volumes showed: (1) decreasing sensitivity to rain intensity on high response basins; and (2) decreasing sensitivity as rainstorm size increases on the same basin. In other words, small channel-source storm flows respond to hourly intensity, but large storm flows from expanded source areas do not. Afforestation of a 195-ha basin with Pinus patula produced a detectable but unimportant decrease in storm flows and peak flows while periodic burning of grass veld (Themeda grasses) showed no detectable change in storm flows or peak flows. Results are consistent with previous analyses of actual data from a number of drainage basins large enough to contain perennial streams. (Author's abstract)
W85-04284

DETERMINING STREAMFLOW CHARACTERISTICS BASED ON CHANNEL CROSS-SECTION PROPERTIES,
K. L. Wahl.
Transportation Research Record 922, p 1-10, 1984. 4 Fig, 4 Tab, 49 Ref.

Descriptors: *Streamflow, *Channels, Flow discharge, River flow, Flow characteristics, Hydraulics.

The evolution of relations between dimensions of river channels and discharge characteristics are examined. The regional relations that have been developed are summarized and the sources of error are examined. The focus is on attempts to use these relations as tools in estimating flow characteristics of rivers with primary attention given to flood characteristics rather than to the use of the information in channel design. The principal differences between the channel-geometry approach and conventional approaches that use basin characteristics are that the ungaged site must be visited to measure the channel size before an estimate can be made and some field training is required before an individual can identify the channel reference level. Variability among channel measurements by trained individuals effectively increases the error of the estimate over the standard error of the estimate defined during calibration. The increase is dependent on the variability in channel type but extremely variable conditions could increase a calibration error of 42% to an application error of 55%. (Baker-IVI)
W85-04327

TREE-RING DATA: VALUABLE TOOL FOR RECONSTRUCTING ANNUAL AND SEASONAL STREAMFLOW AND DETERMINING LONG-TERM TRENDS,
C. W. Stockton, and W. R. Boggess.
Transportation Research Record, Vol. 922, p 10-17, 1984. 5 Fig, 3 Tab, 24 Ref.

Descriptors: *Streamflow, *Tree ring analysis, Forecasting, Seasonal variation, Rainfall.

In the absence of gaged records, proxy data sources such as tree rings can be used to reconstruct hydrologic events back in time. Among the several sources of proxy data, tree rings can be used to reconstruct hydrologic events back in time. Tree rings are the most widely used and have the advantage of precise dating, site replication, and the preservation of both high- and low-frequency information. The chief disadvantages is that tree ring reconstructions rarely extend back more than 500 yr. Tree-ring reconstructions are particularly useful in determining whether a know period of record truly represents the infinite number of events that have occurred in the past. Planning models based on anomalously wet or dry periods are likely to produce erroneous results. Climatically sensitive tree-ring series can be used to reconstruct annual and, in some instances, seasonal flows. Periods of above- or below-normal flows as well as long-term trends are quite evident in reconstructed hydrologic series. Because an individual tree ring integrates climatic and site factors for an entire year or more, peak flows cannot be reconstructed. In general, ring widths reflect dry conditions better than wet ones. In a wet season, moisture in excess of that held in the soil profile is not translated into growth. This point is important in hydrologic reconstructions and also explains why narrow rings are better for diagnositc and crossdating purposes than wide rings. Hydrologic information derived from tree rings has had limited use in water resources planning. In lieu of gaged records, there is at present no better source of information on both short- and long-term climatic variations. The development of an expanded, worldwide tree-ring data base could provide a valuable planning tool for hydrologists, This is especially true for parts of the world where gaged records are essentially nonexistent. (Baker-IVI)
W85-04328

PALEOFLOOD HYDROLOGIC TECHNIQUES FOR THE EXTENSION OF STREAMFLOW RECORDS,
V. R. Baker.
Transportation Research Record 922, p 18-23, 1984. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Streamflow, *Paleofloods, *Floods, *Hydrology, Slack-water deposits, Sedimentation, Sediment transport, Flood frequency, Flood stages.

Paleoflood hydrology includes geomorphic-botanic studies of the effects of ancient floods on the landscape and the study of ancient slack-water deposits. Slack water deposits consist of sand and silt that accumulated relatively rapidly from suspension during major floods. Despite the special locations necessary for the accumulation and long-term preservations of slack-water deposits, numerous regions have been found to preserve these records of past floods. Useful slack-water sediment accumulations occur along bedrock canyons at the mouths of tributaries and at other protected localities. Where individual flood-sedimentation units can be recognized, various dating techniques are used to assign ages to the responsible flood events. Problems with incomplete flood records at any one slack-water site, the relating of deposit heights to paleoflood stages, and the age relationships of dated materials to flood ages require the analysis and correlation of numerous sites and flood layers along a given river reach. Paleostage determinations and flood ages can be converted to discharge and recurrence interval estimates for the large, rare floods recorded in a slack-water sequence. Flood-frequency curves can then be constructed by combining the paleo-flood data with shorter-term stream-gage data. Flood slack-water deposits in areas of minimal aggradation or degradation will always provide minimum paleostage estimates unless corrected for depths of flood water above deposits. (Baker-IVI)
W85-04329

STORM-CELL PROPERTIES INFLUENCING RUNOFF FROM SMALL WATERSHEDS,
H. B. Osborn.
Transportation Research Record 922, p 24-32, 1984. 16 Fig, 11 Tab, 11 Ref.

Descriptors: *Storm runoff, *Small watersheds, Runoff, Model studies, Distribution, Spatial distribution, Temporal distribution, Thunderstorms, Rainfall-runoff relationships.

A kinematic-cascade model (KINEROS) was adapted for use on a small (560-acre) rangeland subwatershed to investigate the influence of thunderstorm rainfall variability in time and space on peak discharge and runoff volume. The model parameters were developed with existing rainfall and runoff data, and hydrographs were generated from simulated rainfall distributions. The influence of temporal and spatial variability was examined through comparison of the generated peak discharges and runoff volumes. The results of the study indicated that for a small semiarid rangeland water shed, the spatial and temporal distribution of thunderstorm rainfall exert an approximately equal influence on peak discharge from the watershed and that the influences tend to be additive. (Baker-IVI)
W85-04330

CONCEPTUAL AND EMPIRICAL COMPARISON OF METHODS FOR PREDICTING PEAK-RUNOFF RATES,
R. H. McCuen.
Transportation Research Record 922, p 32-39, 1984. 1 Tab, 14 Ref.

Descriptors: *Runoff rates, *Prediction, *Flood peak, Forecasting, Storm runoff, Runoff, Urban watersheds, Rainfall, Drainage area, Channels, Hydrographs.

Despite empirical studies comparing peak-discharge methods, the debate continues over which method should be used in design. A comparison is made of various methods by using the data from 40 small urban watersheds. Methods are compared on the basis of their input requirements and the means by which channel systems are accounted for. Although the comparison studies have suggested that calibrated equations are relatively unbiased and have the smallest error variation, all of the studies have avoided defining what represents a significant difference. When the peak-discharge methods are compared on the basis of their input requirements, there is little difference; drainage area is usually the most important input variable; a rainfall characteristic and a time characteristic are other common, important input variables. The methods also differ little in structure. The greatest difference between the methods is their conceptual framework. The calibrated equations emphasize channel characteristics, whereas the uncalibrated equations emphasize surface-runoff characteristics. The input variables for the calibrated methods are often similar to those for the uncalibrated equations, but the fitting coefficients provide a conceptual mechanism for incorporating channel charcteristics into the estimated peak discharges. The uncalibrated methods also differ conceptually among themselves. Although both the graphical and the rational methods are based on unit hydrograph concepts, the rational method assumes a much larger portion of flow within the rising limb of the hydrograph than the graphical methods. In formulating policy ade-

quate consideration should be given to the agreement between the conceptual framework of the design method and the characteristics of the design problem for which the policy is intended. (Baker-IVI)
W85-04331

LDA MEASUREMENTS IN OPEN CHANNEL,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-04399

BED SHEAR FROM VELOCITY PROFILES: A NEW APPROACH,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-04400

SUBMERGED WEIRS,
For primary bibliographic entry see Field 8A.
W85-04402

2F. Groundwater

USE OF RESISTIVITY AND GAMMA LOGGING IN LITHOSTRATIGRAPHICAL STUDIES OF THE CHALK IN LINCOLNSHIRE AND SOUTH HUMBERSIDE,
Birmingham Univ. (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 7B.
W85-03772

RELIABILITY OF PACKER TESTS FOR ESTIMATING THE HYDRAULIC CONDUCTIVITY OF AQUIFERS,
Birmingham Univ. (England). Dept. of Civil Engineering.
J. C. Bliss, and K. R. Rushton.
Quarterly Journal of Engineering Geology, London, Vol. 17, No. 1, p 81-91, 1984. 7 Fig, 4 Tab, 10 Ref.

Descriptors: *Permeability coefficient, *Aquifer characteristics, *Packer tests, Tests, Groundwater flow, Groundwater, Water quality control, Depth.

The suitability of the double packer testing technique when it is used to estimate how the hydraulic conductivity of an aquifer varies with depth is investigated. The steady state packer test provides a reliable means of estimating the detailed transmissivity distribution in the vicinity of boreholes. It is particularly valuable for aquifers which exhibit significant variations in hydraulic conductivity. The approximate methods of analysis are suitable for estimating the hydraulic conductivities. If there is a major fissure, Barker's formula should be used but if there are minor fissures or bands of different hydraulic conductivity, Hvorslev's anisotropic formula is preferred Packer tests only disturb the flow for a distance of about 10 m from the borehole. Consequently an equilibrium condition is achieved within a few minutes, though for regions having very low hydraulic conductivities equilibrium may not be reached for an hour. Another useful result deduced from this investigation is that fissures collect most of their inflow from the first 10 m. Therefore there is little difference between the inflow from a fissure which is only 10 m long and one that extends for 3 km. Results from packer test studies have been particularly useful for a detailed groundwater study in the Lower Mersey Area. The identification of the zones of high transmissivity indicate the mechanism whereby water flows through the aquifer. Test sections with a transmissivity below average also provide useful information since they provide a restriction to the upcoming of saline water. Additional uses of the packer test technique include the chemical sampling of water withdrawn from a clearly defined section of the borehole and the measurement of undisturbed groundwater heads at different depths within the aquifer. (Baker-IVI)
W85-03773

GROUND-WATER CONTAMINATION DUE TO TRANSIENT SOURCES OF POLLUTION,
Dames and Moore, Golden, CO.
For primary bibliographic entry see Field 5B.
W85-03781

ANALYTICAL TREATMENT OF UNSTEADY HORIZONTAL SEEPAGE,
Thessaloniki Univ., Salonika (Greece). Lab. of Hydraulics and Hydraulic Works.
E. Sidiropoulos, C. Tzimopoulos, and P. Tolikas.
Journal of Hydraulic Engineering, Vol. 110, No. 11, p 1659-1670, November, 1984. 2 Fig, 5 Tab, 12 Ref.

Descriptors: *Groundwater movement, *Stream flow, *Seepage, Aquifers, Differential equations, Unconfined aquifers.

Flow from a stream into an adjacent aquifer is considered as a result of abrupt lowering or raising of the stream level. The governing nonlinear partial differential equation, known as the Boussinesq equation, is reduced to an ordinary one through a Boltzmann transformation. An analytical approximation is obtained by splitting the equation into two parts, of which the nonlinear one is treated as a source. The source item in each iteration step is evaluated in terms of the solution obtained at the previous step. A finite element solution is employed, combined with a Newton-Raphson procedure. From comparisons, it is shown that the analytical approach is valid for an increase of the stream depth in the range from 1-10 times its initial value. The analytical results are presented in the form of a simple nomogram. A simple algebraic formula is provided for stored volume calculations. (Baker-IVI)
W85-03782

INSTANTANEOUS EQUILIBRIUM APPROXIMATION ANALYSIS,
Notre Dame Univ., IN. Dept. of Civil Engineering.
A. A. Jennings, and D. J. Kirkner.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1700-1717, December, 1984. 11 Fig, 19 Ref. DOE contract DE-AC02-79EV10253.

Descriptors: *Groundwater pollution, *Chemical reactions, Water quality, Model studies, Fate of pollutants, Path of pollutants.

The issue of how fast reversible chemical reactions must be before instantaneous equilibrium may be assumed in ground water contamination problems was investigated. Example multicomponent transport problems were posed using either solution phase complexation, ion exchange, or surface complexation as the interaction mechanism. A series of solutions was then generated for each mechanism representing various degrees of kinetic limitation and instantaneous equilibrium. Kinetically limited solutions were compared to the appropriate instantaneous equilibrium cases to determine when the reactions had become sufficiently fast. For all the mechanisms and degrees of reaction tested, the instantaneous equilibrium assumption may be justified when the limiting Damkohler numbers exceed 100. Reasonably good approximations can be achieved when the system's Damkohler numbers exceed 10. The results presented here are for the specific interaction mechanisms, stoichiometry, and source strength ratios considered. Each mechanism that leads to a distinct kind of transport model nonlinearity must be considered separately. Varying mechanism stoichiometry often alters the order of the nonlinear terms produced. (Baker-IVI)
W85-03784

GROUNDWATER YIELDS FROM BOREHOLES IN THE MIDLANDS,
British Geological Survey, Wallingford (England). Hydrogeology Research Group.
R. A. Monkhouse.
Water Sources, Vol. 88, No. 1065, p 465-467, November, 1984. 3 Fig, 2 Tab, 5 Ref.

Descriptors: *Boreholes, *Water supply development, *Midlands, *England, *Mercia Mudstone Group, *Aquifers, Water supply, Water yield, Groundwater management.

The boreholes in this study are located upon the outcrop of the Mercia Mudstone Group. The strata of the Mercia Mudstone Group consist mainly of red, and less commonly of purple, green and grey, mudstones and subordinate siltstones. The maximum proven thickness in the area exceeds 500 m. The groundwater potential of the mercia Mudstone Group depends on the presence of skerries. Boreholes constructed in the outcrop of the Mercia Mudstone generally stand without support, and sand screens are rarely used. Lengths of plain lining tubes are always installed at the top. A typical borehole in the Mercia Mudstone would be of 150 mm diameter and penetrate borehole in the potentiometric surface. While the possibility exists of obtaining no yield, a completed dry borehole in the Mercia Mudstone would be most unusual. The results of the study show the distribution of specific capacity to be log-normal and the specific capacity can be usefully plotted on log probability paper. From such plots, the probability of yield from a borehole of given dimensions may be estimated. The mean expected yields from a typical borehole in the Mercia Mudstone Group vary from 1.18 liter/sec in the north to 0.41 liters/sec in the western, central and southern areas. The probability of obtaining a yield of less than 0.10 liters/sec from a typical boreole varies from less than 1% in the north to about 12% in the western, central and southern areas. (Baker-IVI)
W85-03800

NEW APPROACH FOR ANALYSIS OF AQUIFER-TEST DATA,
Punjab Engineering Coll., Chandigarh (India).
S. K. Goyal.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 4, p 388-392, December, 1984. 2 Fig, 1 Tab, 9 Ref, 1 Append.

Descriptors: *Aquifer characteristics, *Confined aquifers, *Transmissivity, *Storage coefficient, *Data interpretation, Oude Korendijk, Netherlands, Curve matching, Mathematical analysis, Graphical methods.

The quantitative evaluation of an aquifer depends largely on the correct determination of its two inherent characteristics: its ability to store water and its ability to transmit water. Conventional curve-matching techniques for analysis of aquifer test data involve considerable subjective judgement on the part of the analyst and the solution becomes practically indeterminate if the observed data points exibit a flat curvature. An implicit function theorem was used to estimate the transmissivity and storage coefficients of an aquifer from intersecting graphs, which are drawn for different drawdown observations. The proposed method eliminates the subjectivity involved in the conventional curve-matching techniques and can work even with a small number of observations. The method has been successfully applied to actual aquifer test data from a confined nonleaky aquifer at Oude Korendijk (The Netherlands). (Collier-IVI)
W85-03820

AVAILABILITY OF GROUND WATER FROM THE ALLUVIAL AQUIFER ON THE NISQUALLY INDIAN RESERVATION, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
W. E. Lum, II.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4185, 1984. 42 p, 17 Fig, 4 Tab, 12 Ref.

Descriptors: *Computer model, Groundwater availability, *Groundwater, Borehole geophysics, *Piezometers, Unconfined aquifer, *Permeability coefficient, Well yield, Water resources development, Streamflow depletion, Surface-groundwater relationships, Potential water supply, *Washington, Nisqually River, Nisqually Reservation, Puget Sound Lowland, Alluvial aquifer.

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A digital model using finite-difference techniques was constructed to simulate ground-water flow in an alluvial aquifer on the Nisqually Indian Reservation. The maximum long-term rate of pumping from individual wells, based on available data, is about 0.75 cubic feet per second (340 gallons per minute). Data on the extent, hydraulic conductivity, saturated thickness of the alluvial aquifer, and quality of the ground water was obtained primarily from the more than 22 test holes drilled for this project. The test holes ranged in depth from about 10 to 100 feet. The saturated thickness of the alluvium was found to range generally from about 10 to 60 feet in the area investigated. The water table is usually less than 10 feet below land surface. The hydraulic conductivity of the aquifer was determined to range from 8.5 to 170 feet per day. The leakage coefficient of the river bed material was determined to be about 0.06 foot per day. Rainfall recharge to the aquifer is about 10 inches per year. A U.S. Geological Survey two-dimensional digital computer model was calibrated to simulate ground-water flow in the alluvial aquifer (area investigated is about 1.1 square miles). The calibrated model simulated measured water levels in the alluvial aquifer to within about 1 foot at 13 of 17 test well locations throughout the model area and within 2 feet at 16 of 17 test well locations. When pumping from the alluvial aquifer was simulated with the computer model it was found that 90 to 100 percent of the water pumped from wells was derived from induced recharge from the Nisqually River into the aquifer and (or) reduced discharge from the aquifer to the Nisqually River. Wells drilled for a large demand use such as a fish hatchery supply will achieve the highest yield if they are placed close to the Nisqually River and in the areas of greatest saturated thickness and highest permeability of the aquifer. (USGS)
W85-03891

RECONNAISSANCE OF THE SHALLOW-UNCONFINED AQUIFER IN SALT LAKE VALLEY, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. L. Seiler, and K. M. Waddell.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4272, 1984. 34 p, 6 Fig, 4 Tab, 12 Ref.

Descriptors: *Utah, *Heavy metals, *Organic compounds, *Hydrologic data, Groundwater, Water quality, Landfills, *Unconfined aquifers, Salt Lake (Jordan) Valley, Reconnaissance investigation, Shallow aquifers.

The shallow-unconfined aquifer in Salt Lake (Jordan) Valley, Utah, seldom is used for domestic or industrial purposes because it yields water slowly and is readily contaminated. The water in the aquifer, however, can flood basements and is a potential source of contamination to other water supplies. In about one-half of the valley, water in the shallow-unconfined aquifer is less than 10 feet below land surface. The general direction of flow in the shallow aquifer is toward the Jordan River. Water levels in the north part of the valley and along the Jordan River are highest in March or April and in the south part of the valley are highest in late summer. The smallest concentrations of dissolved solids in water from wells along the east side of the valley, and the greatest concentrations are in the northwest part of the valley near the Great Salt Lake. Large dissolved-solids concentrations are found near some landfills and tailings areas. Nitrate-nitrogen concentrations ranged from less than 0.1 to 86 milligrams per liter and nitrate-nitrogen concentrations from less than 0.02 to 0.85 milligram per liter. Some of the largest nitrate-nitrogen concentrations were found in water wells near animal pens. The greatest concentrations of trace elements generally came from wells near landfills and tailings area. The greatest measured concentration of cadmium was 200 microgram per liter, of mercury 0.1 microgram per liter, of lead 46 micrograms per liter, of iron 37,000 micrograms per liter and of arsenic 360 micrograms per liter. Synthetic organic chemicals were found in water from several wells. The greatest measured concentration of benzene was 400 micrograms per liter, of phenol 660 micrograms per liter, of 1,1 dichloroethane 20 micrograms per liter, of tichloroethylene 8 micrograms per liter, and of chloroethylene, 11 micrograms per liter. The greatest concentrations were in water from wells near landfills. (USGS)
W85-03892

TWO-DIMENSIONAL, STEADY-STATE MODEL OF GROUND-WATER FLOW, NEVADA TEST SITE AND VICINITY, NEVADA-CALIFORNIA,
Geological Survey, Denver, CO. Water Resources Div.
R. K. Waddell.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver CO 80225. USGS Water-Resources Investigations Report 82-4085, 1982. 72 p, 6 Fig, 7 Tab, 49 Ref.

Descriptors: *Radioactive waste disposal, *Computer models, Groundwater movement, *Nevada Test Site, *Nevada, *California.

A two-dimensional, steady-state model of groundwater flow beneath the Nevada Test Site and vicinity has been developed using inverse techniques. The area is underlain by clastic and carbonate rocks of Precambrian and Paleozoic age and by volcanic rocks and alluvium of Tertiary and Quaternary age that have been juxtaposed by normal and strike-slip faulting. Aquifers are composed of carbonate and volcanic rocks and alluvium. Characteristics of the flow system are determined by distribution of low-conductivity rocks (barriers); by recharge originating in the Spring Mountains, Pahranagat, Timpahute, and Sheep Ranges, and in Pahute Mesa; and by underflow beneath Pahute Mesa from Gold Flat and Kawich Valley. Discharge areas (Ash Meadows, Oasis Valley, Alkali Flat, and Furnace Creek Ranch) are upgradient from barriers. Sensitivities of simulated hydraulic heads and fluxes to variations in model parameters were calculated to guide field studies and to help estimate errors in predictions from transport modeling. Hydraulic heads and fluxes are very sensitive to variations in the greater magnitude recharge/discharge terms. Transmissivity at a location may not be the most important transmissivity for determining flux there. Transmissivities and geometries of large barriers that impede flow from Pahute Mesa have major effects on fluxes elsewhere; as their transmissivities are decreased, flux beneath western Jackass Flats and Yucca Mountains is increased as water is diverted around the barriers. Fortymile Canyon is underlain by highly transmissive rocks that cause potentiometric contours to vee upgradient; increasing their transmissivity increases flow through them, and decreases it beneath Yucca Mountain. (USGS)
W85-03893

STRATIFIED-DRIFT AQUIFERS IN THE SUSQUEHANNA RIVER BASIN, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
R. D. MacNish, and A. D. Randall.
New York Department of Environmental Conservation, Albany, Bulletin 75, 1982. 68 p, 17 Fig, 4 Tab, 28 Ref.

Descriptors: *Groundwater recharge, *Glacial aquifers, Induced infiltration, *New York, Outwash, Storage capacity, Surface-groundwater relationships, Underground storage, Susquehanna River Basin, Water yield.

Broad valleys, which occupy about 15 percent of the Susquehanna River Basin, are covered by stratified drift 70 to 500 feet thick. In most localities, productive aquifers of sand and gravel occur within the drift; the estimated extent, depth, and water-storage capacity of 550 such aquifers are shown on maps and tables. A method is presented for estimating the yield of these aquifers by considering the principal factors that control aquifer recharge. These factors include precipitation on surficial aquifers and adjacent hillsides, infiltration from small tributary streams crossing surficial aquifers, storage available in each aquifer, induced infiltration through the beds of major streams, and rates of flow in streams. The recharge rates and aquifer dimensions needed to estimate the yield of each aquifer are supplied, and the aquifers in one locality are evaluated as an example. Yields estimated by this method are appropriate for reconnaissance or preliminary planning. The method could be applied to stratified-drift aquifers in other basins. (USGS)
W85-03896

GEOHYDROLOGY, AQUEOUS GEOCHEMISTRY, AND THERMAL REGIME OF THE SODA LAKES AND UPSAL HOGBACK GEOTHERMAL SYSTEMS, CHURCHILL COUNTY, NEVADA,
Geological Survey, Menlo Park, CA. Water Resources Div.
F. H. Olmsted, A. H. Welch, A. S. VanDenburgh, and S. E. Ingebritsen.
Available from the OFSS, USGS, Box 25425, Fed, Ctr. Denver, CO 80225. USGS Water Resources Investigations Report 84-4054, 1984. 166 p, 31 Fig, 17 Tab, 64 Ref.

Descriptors: *Geohydrology, *Geochemistry, *Temperature, *Geothermal resources, Hydrology, Aquifers, Water quality, Heat flow, Thermal require, *Nevada, Carson Desert, Churchill County.

The Soda Lake and Upsal Hogback geothermal areas in the west-central Carson Desert are the discharge parts of hydrothermal-convection systems in which rising thermal fluid is swept in the direction of lateral ground-water flow within the uppermost 250 meters of nonmarine basin-fill sediments and, at Upsal Hogback, interbedded basalt flows. Estimated dimensions of the Soda Lakes system are: Total area, 370-640 square kilometers; depth of thermal-fluid circulation, 3-7 kilometers; total volume, 1,100-3,800 cubic kilometers; and volume above a depth of 3 kilometers having temperatures equal to or greater than 150 C, 81 + 24 cubic kilometers, of which 3.4 + 1.2 cubic kilometers represents effective pore space. Upflow of thermal water is roughly 1 million cubic meters per year, which represents a heat discharge of 5.3 megacalories per second. The Upsal Hogback system occupies a total area of 140-230 square kilometers, and thermal water circulates at a depth of 245 meters beneath the hottest part of the near-surface thermal anomaly. Upflow of 80 C water to this depth is about 830,000 cubic meters per year, which represents a heat discharge of 1.7 megacalories per second. Radiocarbon age of this water is about 25,000-35,000 years. (USGS)
W85-03898

NUMERICAL SIMULATION OF THE HIGH PLAINS REGIONAL AQUIFER, NORTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. S. Havens, and S. C. Christenson.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water Resources Investigations Report 83-4269, 1984. 27 p, 10 Fig, 3 Tab, 57 Ref.

Descriptors: *Alluvial aquifers, *Computer models, Model studies, *Simulation, *High Plains regional aquifer, *Oklahoma, Digital models.

The High Plains aquifer consists of the Tertiary Ogallala Formation and overlying Quaternary alluvium and terrace deposits together with parts of underlying rocks. Before extensive irrigation in the 1960's, recharge from precipitation was balanced by natural discharge. Baseflow was estimated as approximately 118 cubic feet per second in 1980. A finite-difference digital model simulated flow in the aquifer. Recharge was adjusted so that 1980 baseflow was 118 cubic feet per second. Recharge in the eastern half of the modeled area was 0.45 inch per year and one-half this value in the western half. Three hydraulic conductivity zones were used: 19.3 feet per day in the east; 16.2 feet per day in the center; and 8.28 feet per day in the west. A specific yield of 14.7 percent was used. The calibrated model gave a mean difference between predevelopment modeled and measured heads of -0.044

foot. Using 1980 pumping rates, the model was used to predict 1993 and 2020 water in storage and saturated thickness. The calculated water in storage, in million acre-feet, in 1941 (predevelopment) was 135.2; in 1980, 121.9; in 1993, 112.7; and in 2020, 96.2. (USGS)
W85-03899

GEOHYDROLOGIC AND DRILL-HOLE DATA FOR TEST WELL USW H-3, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
W. Thordarson, F. E. Rush, R. W. Spengler, and S. J. Waddell.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Open-File Report 84-149, 1984. 28 p, 14 Fig, 9 Tab, 1 Ref.

Descriptors: *Aquifer tests, Drawdown curves, Recovery curves, *Geophysical logging, *Nevada, *Data collections, Crater Flat Tuff, Yucca Mountain, Nevada Test Site, Nye County.

Test well USW H-3 is one of a series of test wells drilled in and near the southwestern part of the Nevada Test Site for hydraulic testing, hydrologic monitoring, and geophysical logging. The work was performed in cooperation with the U.S. Department of Energy as part of the Nevada Nuclear Waste Storage investigations. The well penetrated volcanic tuffs of Tertiary age to a depth of 1,219 meters. This report presents data collected to determine the hydraulic characteristics of rocks penetrated. Data on drilling operations, lithology, borehole geophysics, hydrologic monitoring, pumping, swabbing, and injection tests for the well are contained in this report. (USGS)
W85-03901

GROUND-WATER RESOURCES OF THE WHITE RIVER BASIN, RANDOLPH COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
W. W. Lapham, and L. D. Arihood.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4267, 1984. 86 p, 43 Fig, 6 Tab, 19 Ref.

Descriptors: *Aquifers, Aquifer characteristics, *Glacial drift, Groundwater movement, Groundwater resources, *Indiana, Model studies, *Observation wells, *Seepage, Surface-groundwater relationships, Water level fluctuation, Pumping, *Groundwater model, Groundwater withdrawal, Randolph County, Stream depletion, White River, Simulation analysis.

The two major aquifer systems in Randolph County, Indiana are sand and gravel and bedrock (limestone, dolomite, and shale of Silurian to Odovician age). The average thickness of the sands and gravels is 15 ft, and the aquifers are areally discontinuous. The bedrock aquifer underlies the entire study area and is estimated to be 150 ft in thickness. Six pumping plans simulated in the two systems by a five-layer, digital, ground-water-flow model provide data for an assessment of the water-yielding potential of the systems. The model indicates that as much as 2.5 million gallons per day can be pumped from the aquifers at some locations. This and similar rates of pumping may cause drawndown greater than 5 feet in 10 to 50 percent of the study area. About half the stream reaches were reduced in flow by more than 10 percent by the simulated pumping. However, reaches where discharge exceeded more than 2 cubic feet per second were not affected to this degree. (USGS)
W85-03902

GROUND-WATER RESOURCES OF ST. JOHNS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Spechler, and P. S. Hampson.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4187, 1984. 49 p, 16 Fig, 8 Tab, 59 Ref.

Descriptors: Water quality, *Geohydrology, *Groundwater, Aquifers, Potentiometric level, Aquifer characteristics, *Florida aquifer, *Surficial aquifer, *Florida, St, Johns County.

The primary sources of water in St. Johns County are the surficial and Floridan aquifers. The surficial aquifer is the principal source of public and rural water supplies in most of the county. The Floridan aquifer serves as the major source of water for irrigation. In much of the county, water from the Floridan aquifer does not meet secondary drinking water standards established by the U.S. Environmental Protection Agency. The surficial aquifer is comprised of deposits of clay, sand, shell, and coquina that extended to a maximum depth of about 120 feet below land surface. Yields to 2-inch wells tapping the aquifer range from 1 to 40 gallons per minute and water generally meets drinking water standards. The Floridan aquifer consists of limestone and dolomite of Eocene age. In St. Johns County, the top of the aquifer ranges from about 89 to more than 360 feet below sea level. Yields from 4-inch wells range from 100 to several thousand gallons per minute. The presence of ancient seawater and the dissolution of gypsum and anhydrite are the primary factors governing water quality in the aquifer. In the southwest part of the county, intensive pumpage for irrigation has resulted in substantial increases in chloride concentration. (USGS)
W85-03903

HYDROGEOLOGY OF THE VERNA WELL-FIELD AREA AND MANAGEMENT ALTERNATIVES FOR IMPROVING YIELD AND QUALITY OF WATER, SARASOTA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
C. B. Hutchinson.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water Resources Investigations Report 84-4006, 1984. 53 p, 24 Fig, 2 Tab, 40 Ref.

Descriptors: Hydrologic systems, Groundwater movement, Water management, *Pumping, Water-supply development, City of Sarasota, Sarasota County, *Florida.

About 8 million gallons of water are pumped daily from the 3-square-mile Verna well field to supply the city of Sarasota. Pumping has resulted in water-level declines and changes in water quality. Drawdowns of at least 30 feet have occurred in the producing zone at the well-field boundaries. Sulfate concentrations in the pumped water have increased from about 200 milligrams per liter in 1966 to about 400 milligrams per liter in 1982 in the western part of the well field. In the eastern part, sulfate concentrations have increased from about 300 to 350 milligrams per liter during this period. The increases roughly coincide with increases in pumping rates. (USGS)
W85-03904

HYDROGEOLOGY OF PARTS OF THE CENTRAL PLATTE AND LOWER LOUP NATURAL RESOURCES DISTRICTS, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
J. M. Peckenpaugh, and J. T. Dugan.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4219, 1983. 100 p, 38 Fig, 22 Tab, 35 Ref.

Descriptors: *Water levels, Streamflow, Irrigation, *Hydrogeological systems, *Nebraska, Platte River, Groundwater flow model, Surface-groundwater relationships.

Water-level declines of at least 15 feet have occurred in this heavily irrigated area of central Nebraska since the 1930's, and potential for additional declines is high. To test the effects of additional irrigation development on water levels and streamflow, computer programs were developed that represent the surface-water system, soil zone, and saturated zone. A two-dimensional, finite-difference ground-water flow model of the 3,374 square-mile study area was developed and calibrated using steady-state and transient conditions. Three management alternatives were examined. First, 125,000 acre-feet of water would be diverted annually from the Platte River. During a water year in which flows are similar to those in 1957, months of zero streamflow at Grand Island increased from the historical 2, to 7. After 5 years of such low flows, in 36 nodes (997.4 acres per node) water levels declined more than 5 feet, with a maximum decline of 10.7 feet. A second alternative would allow no new ground-water development after 1980. The third alternative would allow irrigable but unirrigated land to be developed at an annual rate of 2, 5, and 8 percent and to apply irrigation water at 80, 100, and 120 percent of consumptive irrigation requirements. The maximum projected declines by 2020 are 119 and 139 feet, respectively, for the second and third alternatives. (USGS)
W85-03905

RECONNAISSANCE OF THE WATER RESOURCES OF THE SHOALWATER BAY INDIAN RESERVATION AND ADJACENT AREAS, PACIFIC COUNTY, WASHINGTON, 1978-79,
Geological Survey, Tacoma, WA. Water Resources Div.
W. E. Lum, II.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4165, 1984. 34 p, 9 Fig, 8 Tab, 15 Ref.

Descriptors: Groundwater, *Groundwater availability, Groundwater level, *Water quality, Surface water availability, Shoalwater Bay Indian Reservation, Pacific County, *Washington, Pesticides.

A 1978-79 reconnaissance of the quantity and quality of water in the Shoalwater Bay Indian Reservation yielded information needed by the Shoalwater Bay Indian Tribe to plan future use of these resources. Ground water from the local artesian aquifer is suitable for most uses and it is estimated that yield can be as much as 100 to 500 gallons per minute. Long-term yields cannot be calculated from available data. Data from 1968-80 show no measurable declines in water levels or rates of flow due to pumping from the aquifer. Analysis of ground-water samples indicated no seawater intrusion into the aquifer. Mean monthly flows of two streams in the study area ranged from 0.53 to 3.28 cubic feet per second in February 1979. Estimated average 7-day low flows with a recurrance interval of 2 years ranged from 0.3 to 3.0 cubic feet per second. Analyses of surface-water samples indicated concentrations of Aldrin, DDD, DDT, Dieldrin, Diazinon, and Ethyl Parathion that exceeded EPA limits for protection of marine life. Samples of the stream-bottom material in one stream had high concentrations of Aldrin, DDD, DDE, DDT, Dichlobenil, and Dieldrin. Tribally owned tidelands into which these streams flow may be contaminated by these toxic chemicals. (USGS)
W85-03906

GROUND-WATER MODELS AS A MANAGEMENT TOOL IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 6A.
W85-03913

HYDROLOGIC ANALYSIS OF THE HIGH PLAINS AQUIFER SYSTEM IN BOX BUTTE COUNTY, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
R. A. Pettijohn, and H. H. Chen.
Available from the OFSS, USGS, Box, 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4046, March, 1984. 54 p, 22 Fig, 5 Tab, 31 Ref.

Descriptors: Geohydrology, Digital modeling, *Aquifer characteristics, *Model studies, Simula-

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tion, Recharge, Irrigation pumpage, Tertiary Period, Box Butte County, *Nebraska, *High Plains aquifer system.

During the past 40 years, pumpage of ground water for irrigation from the High Plains aquifer system underlying Box Butte County, Nebraska, has resulted in a steady decline of water levels. Consequently, a digital model of the aquifer system was constructed to evaluate various water-management alternatives. The hydraulic conductivity of the aquifer system ranges from 6 to 60 feet per day; the specific yield ranges from 12 to 21 percent; and natural recharge ranges from 0.06 to 4.33 inches annually. Predevelopment saturated thickness (1938) ranged from 190 to 510 feet. Water pumped in 1980 was estimated at 104,000 acre-feet from an estimated recoverable volume of 34.4 million acre-feet in the aquifer system. Results from model simulation predict that the area of water-level declines of 10 feet or more will increase from 336 square miles (1981) to 630 square miles by 1991 if pumpage is increased at the maximum annual rate experienced for the period 1972-81. Maximum water-level declines would increase from 50 feet (1981) to 79 feet (1991). However, pumpage rates held at the 1981 level (no further development) would limit the decline area of 10 feet or more to 530 square miles by 1991 and the maximum decline to 63 feet. (USGS)
W85-03915

WATER RESOURCES OF SLEEPING BEAR DUNES NATIONAL LAKESHORE, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03917

GEOHYDROLOGY AND WATER RESOURCES OF THE PAPAGO FARMS-GREAT PLAIN AREA, ARIZONA, PAPAGO INDIAN RESERVATION ARIZONA, AND THE UPPER RIO SONOYTA, SONORA, MEXICO,
Geological Survey, Tucson, AZ. Water Resources Div.
K. J. Hollett.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Open-File Report 83-774, December, 1983. 76 p, 21 Fig, 4 Tab, 46 Ref.

Descriptors: *Water quality, Streamflow, *Groundwater, *Computer models, *Basin geology, Irrigation, Structure, *Geohydrology, Papago Indian Reservation, Sonora, *Mexico, *Arizona.

The Papago Farms-Great Plain and upper Rio Sonoyta study area includes about 490 square miles in south-central Arizona and north-central Sonora, Mexico. In the study area 23,700 acre-feet of ground water from the basin-fill deposits was used to irrigate more than 5,000 acres in 1981. Surface water is not a reliable source for irrigation or public supply. Ground water enters the area as underflow from the north and east and as recharge from the montains, moves through basin-margin sediments, around the basin-center clays, and exits the area to the west beneath the Rio Sonoyta. Ground-water withdrawals in the upper Rio Sonoyta area do not appear to have an effect on water levels in the Papago Farms-Great Plain area. Depth to water ranges from 500 feet near the southern boundary to 150 feet in the center of study area. About 10 million acre-feet of recoverable ground water is stored in the upper 400 feet of the aquifer. Storage is being depleted at a rate of 19,000 acre-feet per year. The ground water is a sodium and bicarbonate type and has an anomalously high content of arsenic and fluoride. (USGS)
W85-03920

DEPTH AND THICKNESS OF SELECTED UNITS IN UPPER PERMIAN, UPPER JURASSIC, AND LOWER CRETACEOUS ROCKS IN SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
J. J. Kume, and J. M. Spinazola.
USGS Water-Resources Investigations Report 83-4095, 1983. 7 Maps, 7 Fig, 7 Ref.

Descriptors: *Geologic units, *Sandstones, *Aquifers, Geology, Subsurface mapping, *Maps, *Kansas, *Groundwater, Geohydrology.

As ground-water reserves decline in the Ogallala aquifer in an area of about 17,400 square miles in 26 counties of southwestern Kansas, sandstone aquifers in underlying Upper Jurassic and Lower and Upper Cretaceous rocks may be developed to supplement or replace the Ogallala as a source of water for some uses. Maps show that depths from land surface to Upper Permian rocks range from 0 at the outcrop to over 2,100 feet, depths to Upper Jurassic rocks ran from 0 at the outcrop to about 2,000 feet, depths to the Cheyenne Sandstone range from about 150 to about 1,950 feet, and depths to the Dakota Formation range from 0 at the outcrop to about 1,650 feet. Additional maps show that the thickness of Upper Jurassic rocks, where present, ranges from less than 50 feet to about 250 feet, the thickness of the Cheyenne Sandstone, where present, ranges from about 20 feet to about 250 feet, and the thickness of the Dakota Formation, where present, ranges from about 60 feet to about 460 feet. (USGS)
W85-03921

OKLAHOMA: SUMMARY OF ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, OKLAHOMA DISTRICT, 1983,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 10C.
W85-03922

GROUND-WATER MODELS AS A MANAGEMENT TOOL IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
C. B. Hutchinson.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4016, 1984. 26 p, 5 Fig, 2 Tab, 49 Ref.

Descriptors: *Computer models, *Groundwater movement, *Hydrogeology, Water management, *Model studies, *Simulation, *Florida.

Highly sophisticated computer models provide powerful tools for analyzing historic data and for simulating future water levels, water movement, and water chemistry under stressed conditions throughout the ground-water system in Florida. Models that simulate the movement of heat and subsidence of land in response to aquifer pumping also have potential for application to hydrologic problems in the State. Florida, with 20 groundwater modeling studies reported since 1972, has applied computer modeling techniques to a variety of water-resources problems. Models in Florida generally have been used to provide insight to problems of water supply, contamination, and impact on the environment. The model applications range from site-specific studies, such as estimating contamination by wastewater injection at St. Petersburg, to a regional model of the entire State that may be used to assess broad-scale environmental impact of water-resources development. Recently, ground-water models have been used as management tools by the State regulatory authority to permit or deny development of water resources. As modeling precision, knowledge, and confidence increase, the use of ground-water models will shift more and more toward regulation of development and enforcement of environmental laws. (USGS)
W85-03924

GEOCHEMISTRY OF GROUND WATER IN THE SACRAMENTO VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W85-03926

PRECONSTRUCTION AND SIMULATED POSTCONSTRUCTION GROUND-WATER LEVELS AT URBAN CENTERS IN THE RED RIVER NAVIGATON PROJECT AREA, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
J. E. Rogers.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water Resources Investigations Report 83-4154, 1983. 33 p, 30 Fig, 2 Tab, 18 Ref.

Descriptors: *Surface-groundwater relations, *Water levels, *Hydrographs, *Potentiometric level, Model studies, Alluvial aquifer, *Red River, Red River Valley, *Louisiana.

The Red River Valley in Louisiana is 3 to 10 miles wide and is underlain by the Red River alluvial aquifer. This aquifer is in hydraulic connection with the Red River. Precipitation infiltrates the aquifer and water discharges from the aquifer at the Red River and major tributaries. Construction of locks and dams along the Red River will cause new, higher minimum stages for the river for each of the pools. Water levels will rise and outflow from the alluvial aquifer to the river after construction of the locks and dams will be at higher elevations because of the new river stages. Mathematical models of the stream-aquifer system simulate the effects of the lock and dam system for plan B-3, modified. Water-level changes in the aquifer in response to the changes imposed by the system are greatest near the river and are progressively smaller away from the river. The saturated zone in the fine-grained material overlying the aquifer provides the principal potential impact on structures and vegetation in urban areas. As water levels in the aquifer rise, the saturated zone above the aquifer will decrease the thickness. The soil zone in low areas in some communities will be waterlogged. (USGS)
W85-03929

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACES OF THE MAGOTHY AQUIFER OF SEPTEMBER 1975 DIFFERED FROM THE POTENTIOMETRIC SURFACE OF SEPTEMBER 1981 IN SOUTHERN MARYLAND,
Geological Survey, Annapolis, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, and S. E. Curtin.
Available from the OFSS, USGS, Box, 25425, Fed. Ctr. Denver, CO 80225, Price: $1.00 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-339. 1 Map.

Descriptors: *Groundwater level, *Potentiometric level, *Artesian aquifer, *Coastal Plain, *Maryland, Wells, Maryland Coastal Plain, Anne Arundel County, Prince Georges County, Calvert County, Charles County, Cone of depression, Magothy aquifer.

A map has been prepared that shows the net differences between two sets of water-level measurements made in 67 observations wells over a six-year period. One set of measurements was made in 1975, a relatively wet year, and the other set of measurements was made in 1981, a relatively dry year. The map shows that, except for a small area near the Annapolis well field where Magothy production wells were temporarily shut down, the potentiometric surface of 1981, compared with the potentiometric surface 1975, was: lower throughout the entire area; lower by at least 10 feet in the southwestern third of the area; lower by 30 to 40 feet in parts of northern Charles County, where pumping rates increased from an average of one million gallons per day (Mgal/d) in 1975 to 2.5 Mgal/d in 1981. (USGS)
W85-03931

EVALUATION OF THE POTENTIAL FOR ARTIFICIAL GROUND-WATER RECHARGE IN EASTERN SAN JOAQUIN COUNTY, CALIFORNIA--PHASE 2,
Geological Survey, Sacramento, CA. Water Resources Div.
R. L. Ireland.

Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4207, 1984. 28 p, 15 Fig, 3 Tab, 8 Ref.

Descriptors: *Groundwater, *Groundwater recharge, *Artificial recharge, *California, San Joaquin County.

In response to the increasing demand on water supplies and declining water levels in eastern San Joaquin County, the U.S. Geological Survey, in cooperation with the San Joaquin County Flood Control and Water Conservation District, is evaluating the potential for artificially recharging the aquifer system in eastern San Joaquin County, Calif. Phase 1 of this study evaluated the geologic and hydrological conditions in the area and selected 20 drill sites in three areas of high potential for artificial recharge of the aquifer system. In phase 2, test holes were drilled. This report is on phase 2, and summarizes the data collected during the drilling and evaluates the suitability of the drilled areas for their potential for artificial recharge. Two areas seem to have a fair potential for artificial recharge of the aquifer system using the basin-spreading method: (1) The flood plain area along the Mokelumne River north of Lockeford, and (2) an area northeast of Linden along the Calaveras River. (USGS)
W85-03933

WATER RESOURCES OF THE PALAU ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03935

WATER RESOURCES OF KOSRAE, CAROLINE ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03936

WATER RESOURCES OF PONAPE, CAROLINE ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03937

CHANGES ON THE SHALLOW GROUNDWATER RESOURCES OF THE YELLOWSTONE RIVER VALLEY NEAR BILLINGS, MONTANA, AUGUST 1968-1978,
Geological Survey, Helena, MT. Water Resources Div.
R. D. Hutchinson.
Montana Bureau of Mines and Geology, College of Mineral Sciences and Technology, Butte, Hydrogeologic Map Series Number 6, 1983. 6 Maps, 7 Fig, 1 Tab, 3 Ref.

Descriptors: *Groundwater reservoirs, Water supply, Water quality, Urbanization, *Water table, Wetlands, Water demand, Land use, *Maps, Yellowstone River valley, *Montana, Billings.

A study of ground-water resources in the Yellowstone River valley near Billings, Montana, indicates that the water table averaged about 2 feet higher in August 1978 than August 1968, despite steady urban growth in the area. Much of the increase in ground-water storage is attributed to greater-than-normal precipitation during the 4-month period prior to the 1978 data collection. The 1968 data were collected after 4 months of near normal precipitation. As indicated by specific conductance measurements, the water in general was less mineralized in 1978 than in 1968. U.S. Geological Survey Hydrologic Investigations Atlas HA-454 described shallow ground-water conditions in the Yellowstone River valley between Park City and Billings, Montana. The present study not only re-evaluates conditions in that area but includes baseline ground-water information for the Huntley area, northeast of Billings. (USGS)
W85-03938

GROUND-WATER RECONNAISSANCE OF THE CENTRAL WEBER RIVER AREA, MORGAN AND SUMMIT COUNTIES, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
J. S. Gates, J. I. Steiger, and R. T. Green.
Utah Dept. of Natural Resources, Salt Lake City, Utah, Technical Publication No. 77, 1984. 70 p, 10 Fig, 8 Tab, 23 Ref.

Descriptors: *Groundwater, *Surface-ground water relationships, Base flow, Streamflow, Water quality, *Recharge, *Discharge, *Computer models, Morgan Valley, Weber River, *Utah, Morgan County, Summit County.

A reconnaissance of ground water in the central Weber River area, Utah (Morgan Valley to Coalville) obtained data to help the State decide on future applications for ground-water use. Ground water occurs in unconsolidated alluvium and older rocks and is used to a much lesser extent than water from the Weber River and its tributaries. About 170,000 acre-feet of ground water, mostly fresh, is stored in the alluvium in Morgan Valley and lower East Canyon Creek. Ground water throughout the area discharged to streams. Average gain in base flow through the area for October 25-31, 1931-60 (including base flow of tributaries wholly within the area) is 109 cubic feet per second. Estimated minimum ground-water recharge is about 84,000 acre-feet per year. Discharge from wells (average of about 2,800 acre-feet per year during 1979-80) probably has been balanced by increases in recharge or decreases in other forms of discharge. Withdrawals from future wells not returned to the ground-water system ultimately will be balanced by increasing in recharge or decreases in seepage to streams or evapotranspiration. Most of these changes probably will decrease streamflow; however, withdrawal that is balanced by decreases in evapotranspiration from nonirrigated phreatophytes will not affect surface-water flow. Simulations with a simplified digital model of Morgan Valley along the downstream reach of East Canyon Creek indicated that additional withdrawals from wells will be balanced mostly by decreases in seepage to streams and to a lesser extent by decreases in evapotranspiration. (USGS)
W85-03939

BASE FLOW OF STREAMS IN THE OUTCROP AREA OF SOUTHEASTERN SAND AQUIFER: SOUTH CAROLINA, GEORGIA, ALABAMA, AND MISSISSIPPI,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03940

SHALLOW GROUND WATER IN THE BOULDER-FORT COLLINS-GREELEY AREA, FRONT RANGE URBAN CORRIDOR, COLORADO, 1975-1977,
Geological Survey, Lakewood, CO. Water Resources Div.
P. A. Schneider, Jr.
USGS Water-Resources Investigations Report 83-4058, 1983. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Groundwater level, *Shallow water table, *Water-table fluctuations, *Underflow, Saturated thickness, *Colorado, Boulder County, Larimer County, Weld County, South Platte River, Cache la Poudre River, Big Thompson River, St. Vrain Creek, Lone Tree Creek, Boulder, Beebe Seep.

Shallow ground water may limit the location of construction and excavation projects in parts of the Front Range Urban Corridor. A shallow water table occurs from 0 to 50 feet below the land surface principally in the alluvial deposits along the streams and rivers in the Boulder-Fort Collins-Greeley area. This shallow water table underlies approximately 400 square miles and is maintained by natural recharge within the South Platte River basin and by the infiltration of irrigation water that is diverted into the basin from streams and reservoirs in the Colorado and the Laramie River basins. Return flow from irrigation, which is mostly ground water, helps maintain the flow of the South Platte River and its tributaries. The report includes a map from which depth to water table and the direction of ground-water movement can be determined. The map, compiled on a topographic base, shows the areal extent of the saturated materials and the altitude and configuration of the ground-water surface. The water-table contour map was prepared using data from approximately 400 wells. Monitoring of shallow ground-water within the study area shows depths to water have changed only slightly over the last 20 years, except for some seasonal and drought-related fluctuations. Gradients, computed from ground-water measurements, range from 27.7 feet per mile in Lone Tree-Spring Creek valley to 10.3 feet per mile in the South Platte River valley. The shallow groundwater underflow from the major tributaries in the basin is about 29,000 acre-feet per year, and underflow calculated at a cross section near Kersey is about 12,000 acre-feet per year. (USGS)
W85-03941

POTENTIOMETRIC MAP OF THE GORDO AQUIFER IN NORTHEASTERN MISSISSIPPI, NOVEMBER AND DECEMBER 1982,
Geological Survey, Jackson, MS. Water Resources Div.
D. Darden.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 83-4243, 1984. 1 Sheet Map, 3 Fig, 5 Ref.

Descriptors: *Potentiometric map, *Water level, *Groundwater, *Aquifer, *Mississippi, Gordo aquifer, Tuscaloosa.

This potentiometric map is the second map of the Gordo aquifer in a series of maps prepared by the U.S. Geological Survey in cooperation with the Mississippi Department of Natural Resources, Bureau of Land and Water Resources, delineating the potentiometric surfaces of the major aquifers in Mississippi. The potentiometric surface of the Gordo aquifer slopes generally to the west away from the outcrop area and it is marked by large ground-water cones of depression in the Tupelo and Columbus areas. Water levels in or near the outcrop of the Gordo aquifer show little long-term change. Heavy withdrawals in the downdip area have caused water-level declines of about 2 feet per year since 1978 in much of the confined part of the aquifer. The water-level decline in the Tupelo area has averaged about 5 feet per year since 1966; however, there has been water-level rise at the center of the cone of depression as a result of a change in the distribution of pumping. (USGS)
W85-03943

HYDROLOGY OF THE WIBAUX-BEACH LIGNITE DEPOSIT AREA, EASTERN MONTANA AND WESTERN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2K.
W85-03945

WATER LEVELS AND WATER-LEVEL CHANGES IN THE PRAIRIE DU CHIEN-JORDAN AND MOUNT SIMON-HINCKLEY AQUIFERS, TWIN CITIES METROPOLITAN AREA, MINNESOTA, 1971-80,
Geological Survey, St. Paul, MN. Water Resources Div.
M. E. Schoenberg.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 83-4237, 1984. 23 p, 12 Fig, 2 Tab, 9 Ref.

Descriptors: *Groundwater, *Groundwater level, *Minnesota, Twin Cities metropolitan area, Prairie du Chien-Jordan aquifer, Mount Simon-Hinckley

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aquifer, Sandstone aquifer, Dolomitic limestone aquifer, Minneapolis, St. Paul, Water-level measurement strategy.

The Mississippi, Minnesota, and St. Croix Rivers greatly influence flow patterns in the Prairie du Chien-Jordan aquifer. Water generally flows toward these streams from surrounding water-level highs. Heavy pumping has caused only localized cones of depression. In contrast, pumping in Minneapolis and St. Paul has greatly influenced ground-water flow in the Mount Simon-Hinckley aquifer, resulting in a large cone of depression. Between 1971 and 1980 average water levels in the Prairie du Chien-Jordan aquifer changed less than 5 feet in most of the study area, while average water levels in the Mount Simon-Hinckley aquifer rose as much as 60 feet in the center of the cone of depression. Water-level data suggest that (1) little variation of annual pumpage between 1971 and 1980 from the Prairie du Chien-Jordan aquifer produced generally stable water levels in that aquifer, (2) decreased annual pumpage from 1971 to 1980 from the Mount Simon-Hinckley aquifer caused rising water levels in that aquifer, and (3) a greater seasonal component of pumpage for the Mount Simon-Hinckley aquifer than for the Prairie du Chien-Jordan produced larger and more widespread seasonal water-level declines in the Mount Simon-Hinckley than in the Prairie du Chien-Jordan, particularly during dry years. (USGS)
W85-03946

HYDROGEOLOGIC DATA FOR SELECTED TEST WELLS DRILLED IN THE FORT UNION COAL REGION, EASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
W. A. Wood.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Open-File Report 84-464, 1984. 63 p, 13 Fig, 12 Tab, 16 Ref.

Descriptors: *Test wells, Coal, *Hydrologic data, *Fort Union coal region, *Montana, Data collections.

Hydrologic and geologic data have been collected as part of energy-related projects conducted by the U.S. Geological Survey in 11 counties of eastern Montana. Records of 408 test wells are tabulated in this report. The data include well location, type of well, date drilled, well depth, type and diameter of casing, depth cased, interval open to well, principal aquifer, depth to water level, water-level-record dates, water-quality-sampling record, and type of logs available. Location of the wells is shown by county on maps at a scale of 1:500,000.
W85-03952

GROUND WATER IN THE FRESNO AREA, CALIFORNIA--A PROGRESS REPORT,
Geological Survey, Sacramento, CA. Water Resources Div.
H. T. Mitten.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 83-4246, 1984. 15 p, 5 Fig, 25 Ref.

Descriptors: *Groundwater, *Model studies, *Alluvial aquifers, *California, San Joaquin Valley, Fresno.

The U.S. Geological Survey, in cooperation with Fresno County, is developing a computer model of the unconfined aquifer system in the Fresno area. In the area, consolidated rocks are overlain by unconsolidated deposits. The unconsolidated deposits are divided into a lower fine-grained unit and an overlying coarse-grained unit. The system is assumed to be a single unconfined unit. The top of the system is the water table and the bottom is the base of the coarse-grained deposits. The northeastern boundary is the only natural lateral hydrologic boundary. The other lateral boundaries are placed so that errors along them will not affect heads in the area of interest. Initial heads for 1943, hydraulic conductivity, and bottom elevations were used in a steady-state model that generated net flux values. It is anticipated that most of the remaining effort will center on model calibration. (USGS)
W85-03954

MAP OF THE CARPINTERIA AREA AND VICINITY, SANTA BARBARA COUNTY, CALIFORNIA, SHOWING WATER-LEVEL CONTOURS FOR MARCH 1982,
Geological Survey, Sacramento, CA. Water Resources Div.
D. Maltby.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 83-4273, 1984. 1 p, 1 Fig, 1 Ref.

Descriptors: *Water level, *Wells, *Well hydrographs, Contours, *California, Carpinteria, Sandyland, Santa Barbara, Rincon Creek, Rincon thrust fault.

A water-level contour map of the Carpinteria area, California, has been completed by the U.S. Geological Survey using 34 water-level measurements made by the Carpinteria County Water District in March 1982. Also shown are 5 hydrographs that show water-level fluctuations in each well between 1977 and 1982. (USGS)
W85-03955

MAP OF THE CARPINTERIA AREA AND VICINITY, SANTA BARBARA COUNTY, CALIFORNIA, SHOWING WATER-LEVEL CONTOURS FOR MARCH 1983, AND NET CHANGE IN WATER LEVEL BETWEEN MARCH 1982 AND MARCH 1983,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W85-03956

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1982 TO SPRING 1983.
Geological Survey, Tucson, AZ. Water Resources Div.
USGS Open-File Report 84-428, 1984. 2 Sheets, 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Water levels, *Water level fluctuations, *Pumpage, Irrigation, *Maps, *Arizona, Basin and Range lowlands province, Central highlands province, Plateau uplands province.

The withdrawal of ground water was slightly less than 4.2 million acre-feet in Arizona in 1982, which is about 1.2 million acre-feet less than the amount withdrawn in 1981. Most of the decrease in 1982 was in the amount of ground water used for irrigation in the Basin and Range lowlands province. Through 1982, slightly more than 193 million acre-feet of ground water had been withdrawn from the ground-water reservoirs in Arizona. The report contains three small-scale maps that show groundwater pumpage by areas, the status of the groundwater inventory and observation-well program, and the ground-water quality sampling program. The main map, which is at a scale of 1:500,000, shows potential well production, depth to water in selected wells in spring 1983, and change in water level in selected wells from 1978 to 1983. A brief text summarizes the current ground-water conditions in the State. (USGS)
W85-03958

GEOHYDROLOGIC RECONNAISSANCE OF DRAINAGE WELLS IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. O. Kimrey, and L. D. Fayard.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4021, 1984. 67 p, 15 Fig, 7 Tab, 51 Ref.

Descriptors: *Drainage wells, *Injection wells, *Artificial recharge, *Groundwater pollution, Underground storage, Carbonate aquifers, *Florida, Geohydrologic reconnaissance, Underground waste disposal.

Drainage wells are used to inject surface waters directly into an aquifer, or shallow ground waters directly into a deeper aquifer, primarily by gravity. Such wells in Florida may be grouped into two broad types: (1) surface-water injection wells, and (2) interaquifer connector wells. Drainage wells of the first type are further categorized as either Floridan aquifer drainage wells or Biscayne aquifer drainage wells. Floridan aquifer drainage wells are commonly used to supplement drainage for urban areas in karst terranes of central and north Florida. Data are available for 25 wells in the Ocala, Live Oak, and Orlando areas that allow comparison of the quality of water samples from these Floridan aquifer drainage wells with allowable contaminant levels. Comparison indicates that maximum contaminant levels for turbidity, color, and iron, manganese, and lead concentrations are equaled or exceeded in some drainage-well samples, and relatively high counts for coliform bacteria are present in most wells. Biscayne aquifer drainage wells are used locally to dispose of stormwater runoff and other surplus water in southeast Florida, where large numbers of these wells have been permitted in Dade and Broward Counties. The majority of these wells are used to dispose of water from swimming pools or to dispose of heated water from air-conditioning units. The use of Biscayne aquifer drainage wells may have minimal effect on aquifer potability so long as injection of runoff and industrial wates is restricted to zones where chloride concentrations exceed 1,500 milligrams per liter. Interaquifer connector wells are used in the phosphate mining areas of Polk and Hillsborough Counties, to drain mines and recharge the Floridan aquifer. Water-quality data available from 13 connector wells indicate that samples from most of these wells exceed standards values for iron concentration and turbidity. One well yielded a highly mineralized water, and samples from 6 of the other 12 wells exceed standards values for gross alpha concentrations. (USGS)
W85-03959

AVAILABILITY OF HYDROLOGIC DATA IN SAN JUAN COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03961

SURVEY OF A COASTAL KARSTIC AQUIFER BY ANALYSIS OF THE EFFECT OF THE SEA-TIDE: EXAMPLE OF THE KRAS OF SLOVENIA, YUGOSLAVIA,
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
C. Drogue, M. Razack, and P. Krivic.
Environmental Geology and Water Science, Vol. 6, No. 2, p 103-109, 1984. 7 Fig, 2 Tab, 22 Ref.

Descriptors: *Karst hydrology, *Aquifers, *Tidal effects, *Kras, *Yugoslavia, Bay of Trst, Geological fractures, Water table, Hydrogeology, Hydrodynamics.

A hydrodynamic study of a coastal karstic aquifer is attempted by analyzing the effect of sea-tide on its water table. Under certain conditions, this approach, which involves quite easy data processing, may yield the hydrodynamic parameters of the aquifers, diffusivity, in particular. The aquifer involved here is the Kras of Slovenia, Yugoslavia, which is bounded on one side by the Adriatic Sea (Bay of Trst). Kras is the Slovenian word from which the word karst originates. The Kras aquifer is located in a thick carbonate sequence (Cretaceous) with an anticline structure. This sequence outcrops and is affected by opened vertical fractures. The geological setting could suggest a free groundwater with negligible piezometric variations with respect to the thickness of the carbonate sequence. The study was carried out by the identification of observed data (fluctuations of the water table) and computed data under various assumptions (confined, semi-confined, free groundwater). The best fit is obtained when considering a groundwater with semi-confined behavior, which, of course, does not agree with the geological setting of the Kras. However, this behavior can be justified by the fact that an important karstification

occurred below the existing sea-level during the Quaternary and Tertiary marine recessions, creating diffusive zones in lower parts of the saturated karst. It should be noted that similar situations must prevail in all the peri-Mediterranean karsts as they too were affected by the Quaternary and Tertiary recessions. (Author's abstract)
W85-03980

APPROACH TO MODELLING RADIONUCLIDE MIGRATION IN A MEDIUM WITH STRONGLY VARYING VELOCITY AND BLOCK SIZES ALONG THE FLOW PATH,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W85-03988

EXTENDED IDENTIFIABILITY IN AQUIFER PARAMETER IDENTIFICATION AND OPTIMAL PUMPING TEST DESIGN,
California Univ., Los Angeles. Dept. of Civil Engineering.
W. W.-G. Yeh, and N.-Z. Sun.
Water Resources Research, Vol. 20, No. 12, p 1837-1847, December, 1984. 8 Fig, 7 Tab, 29 Ref. NSF grants CEE-81-13500 and CEE-83-01230.

Descriptors: *Identifiability, *Aquifers, *Pumping tests, *Parameter identification, Model studies, Groundwater management, Optimization, Experimental design, Nonlinear programming.

An extended identifiability, called 'delta identifiability', is developed for groundwater modeling and management. Some fundamental concepts are developed for establishing a criterion in connection with the problem of optimal experimental design, such as the design of an optimum pumping test to assist aquifer parameter identification. In practice, the quantity and quality of data prohibits a unique solution of the inverse problem of parameter identification. The proposed 'delta identifiability' is based upon the concept of weak uniqueness. The determination of the admissibility of a given design is formulated as a nonlinear programming problem. The original constrained problem is transformed into solving a sequence of unconstrained problems by a penalty function method. Numerical experiments are conducted to illustrate the proposed concept and algorithm. (Author's abstract)
W85-03989

ANALYSIS OF THE RELIABILITY AND STABILITY OF THE PERIODS OF OSCILLATIONS OF THE GROUNDWATER LEVEL,
Yu. B. Chelidze.
Water Resources, Vol. 10, No. 2, p 146-151, March-April, 1983. 1 Tab, 9 Ref. Translated from Vodnye Resursy, No. 2, p 80-85, March-April, 1983.

Descriptors: *Cyclicity, *Groundwater level, *Oscillations, Mathematical analysis, Harmonic analysis, Autocorrelation, Geophysics, Solar activity cycles.

It is important to determine the reliability of detected cycles both in the groundwater level (GWL) regime and in heliogeophysical factors, the stability of the detected cycles, and the most representative combination of methods for a reliable assessment of cyclicity. The cyclic component of time series was assessed by means of harmonic analysis, autocorrelation function, and visually. Cyclicity is actually characteristic for the GWL series. Strictly speaking, it is not quite correct to assert the presence of a stable cyclicity of the GWL. Characteristic periods were found, or more clearly, periods of characterisic duration. A substantial variation is characteristic for the amplitude of oscillations of the GWL within one period. It appears to be improper to compare cyclicity detected in solar activity with that in the GWL regime if cyclicity is analyzed on the basis of series of different lengths. (Baker-IVI)
W85-04092

USE OF GROUNDWATER ISOTOPIC PARAMETERS FOR CLASSIFYING STRUCTURAL AND HYDROGEOLOGICAL STAGES OF THE PLATFORM AREA OF DAGESTAN,
Moscow State Univ. (USSR).
M. K. Kurbanov, O. V. Mamaev, and V. A. Filonov.
Water Resources, Vol. 10, No. 2, p 165-169, March-April, 1983. 1 Fig, 3 Tab, 5 Ref. Translated from Vodnye Resursy, No. 2, p 103-107, March-April, 1983.

Descriptors: *Groundwater, *Isotope studies, *Dagestan, *USSR, Hydrogeology, Hydrogeochemistry, Radioisotopes, Uranium radioisotopes, Hydrodynamics.

The possibility of using radioactive and stable isotopes as indicators for solving problems of scientific applied hydrogeochemistry was established in earlier investigations. The results of using isotopic parameters for classifying by type vertical hydrogeological and hydrogeochemical zonation of aquifer systems of the sedimentary cover of the platform part of Dagestan are presented. The isotopic parameters included data on the content of radioactive elements in groundwaters. Statistical processing of the limited amount of data on the isotopic ratios of uranium and also on the total content of radioactive elements in groundwaters of the sedimentary cover of the platform part of Dagestan confirmed the presence of vertical hydrogeological zonation by stages. Such processing of analytical data provides a high reliabiliy of the combined use of iosotopic parameters as a criterion in structural-genetic, hydrodynamic, and hydrogeological forecasts. (Baker-IVI)
W85-04094

INVESTIGATION OF THE POSSIBILITIES OF URANIUM ISOTOPIC MODELING OF PROCESSES OF GROUNDWATER FORMATION AND CIRCULATION UNDER CONDITIONS OF THE DEVELOPMENT OF SURFACE STREAMS AND SHORT TRANSIT ZONE,
Akademiya Nauk Kirgizskoi SSR, Frunze. Inst. Fiziki i Matematiki.
P. I. Chalov, and A. I. Tikhonov.
Water Resources, Vol. 10, No. 2, p 169-175, March-April, 1983. 6 Fig, 1 Tab, 10 Ref. Translated from Vodnye Resursy, No. 2, p 108-116, March-April, 1983.

Descriptors: *Groundwater movement, *Isotope studies, *Uranium radioisotopes, *Cholpon-Ata, *USSR, Model studies, Transition zone, Geochemistry, Hydrogeology.

The Cholpon-Ata resort zone is located in the middle part of the northern limb of the large intermontane Issyk-Kul artesian basin. Intrusive, extrusive, and metamorphic Paleozoic rocks composing the high-mountain Kungei-Alatoo Range have exceptional develoment in its northern part. An areal survey was performed to study waters of the investigated zone by uranium isotopic methods. Water samples were taken from 90 points, including 62 operating wells, 12 springs in the piedmont zone, 1 pit and 15 rivers, and analyzed for the content and isotopic composition of uranium. The uranium content in waters varied from 1.35 to 24.5 relative units, but its distribution has certain regularities. There were no geochemical barriers for uranium deposition and the Quaternary deposits through which the waters seep are rather well flushed. The uranium isotopic model of the formation and circulation of groundwaters of the Quaternary deposits of the Cholpon-Ata resort zone were found in the main to correspond to the hydrogeological notions about the general direction of movement and character of sources feeding the investigated groundwaters. This confirms the possibility of using uranium disequilibrium for modeling the indicated processes under conditions of development of surface streams and short length of the transient zone of groundwaters. The uranium isotopic model made it possible to obtain new information about groundwaters of the investigated region, which could not otherwise be obtained. The information and model can be used when determining the optimal pumping rates at existing wells, when planning the drilling of new wells, and when monitoring groundwater pollution. The earlier proposed method of calculating discharges of groundwater supply sources gave results agreeing with the hydrogeological notions, which indicates the possibility of using it when solving scientific and practical problems of hydrogeology. (Baker-IVI)
W85-04095

HYDROGEN AND OXYGEN ISOTOPES IN REVEALING THE NATURE OF HYDROCHEMICAL INVERSION OF DEEP GROUNDWATERS,
Yu. B. Seletskii.
Water Resources, Vol. 10, No. 2, p 176-182, March-April, 1983. 1 Fig, 4 Tab, 24 Ref. Translated from Vodnye Resursy, No. 2, p 117-123, March-April, 1983.

Descriptors: *Groundwater availability, *Isotope studies, *Hydrochemical inversion, Bicarbonates, Brines, Artesian basins, Groundwater flow, Oxygen isotopes, Deuterium.

Data which has been gathered on deep groundwaters suggests that relatively low-mineralized waters of the sodium bicarbonate type seem often to be observed below the zone of development of brines. The existence of such waters gives rise to the presence of an inverted hydrochemical zonation in the section of artesian basins. Hydrochemical inversion and the presence of low-mineralized waters in the section of artesian basins is not a rare phenomenon and is one which requires explanation from the standpoint of genesis. In using data on deuterium concentrations for this purpose, each organic substance contains less deuterium than the initial material that served as its hydrogen source. Therefore waters of an organo-degradation genesis will have relatively low deuterium concentrations. Waters formed as a result of metamorphism of liquid and solid hydrocarbons will apparently be distinguished by especially low concentrations. As regards the degradation of permafrost as a cause of occurrence of low-mineralized waters, as a result of this process waters that formed in a harsh climate will enter the beds. The process of collapse of natural-gas hydrate pools in permafrost regions will apparently be accompanied by an analogous effect. Radiolysis can be one of the mechanisms of formation of low-mineralized waters. As a result of this process, strongly bound water passes from the rocks into the water. The scale of this process is small. From the standpont of the isotopic composition of hydrogen and oxygen the existing hypotheses of the origin of deep low-mineralized waters can be roughly divided into three groups. When the waters are genetically related to waters in a molecular form they are on the whole analogous to them in isotopic composition and the deuterium concentrations do not contrast with the oxygen-18 concentrations. In the case of the origin of freshened waters from natural objects in which water is absent in a molecular form there is either a contrast of the deuterium and oxygen-18 concentrations which is greater, the greater the corresponding fractionation factors, or anomalously low deuterium concentrations. (Baker-IVI)
W85-04096

ALTITUDINAL HYDROCHEMICAL ZONATION OF GROUNDWATERS,
G. V. Shipovalov.
Water Resources, Vol. 10, No. 3, p 261-265, May-June, 1983. 6 Tab, 9 Ref. Translated from Vodnye Resursy, No. 3, p 94-96, May-June, 1983.

Descriptors: *Hydrochemical zonation, *Groundwaters, *Altitude, Distribution, Water supply development, Hydrogeology.

The distribution of groundwaters with different mineralization and chemical composition by altitude can be used in a preliminary assessment of the possibility of discovering groundwaters in poorly investigated and uninvestigated parts of intermontane depressions. In an example for the active water-exchange zone of a closed intermontane depression, the following aspects can be distinguished: a belt of bicarbonate fresh groundwaters (absolute heights of more than 2,600 m, height above base level more than 1,800 m); a belt of chloride, primarily mineralized groundwaters (ab-

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solute heights less than 1,400 m, height above base level up to 600 m); a belt of groundwaters of various mineralization and chemical composition with a predominance of sulfate waters (absolute heights 1,400-2,400 m, height above base level 600-1800 m). With further establishment of the characteristics of altitudinal zonation it will apparently be possible to obtain a more fractional division of the transition (sulfate) altitudinal belt. Thus the existence of altitudinal hydrochemical zonation of groundwaters, differing from the known horizontal (latitudinal, geographical) and vertical hydrochemical zonations, was established. Its consideration and the possibility of a quantitative evaluation will permit increasing the efficiency of hydrogeological investigations. (Baker-IVI)
W85-04106

DETERMINATION OF THE PARAMETERS OF INTERCONNECTED CONFINED AND UNCONFINED AQUIFERS ON A COMPUTER,
O. A. Dul'kite.
Water Resources, Vol. 10, No. 3, p 266-273, May-June, 1983. Translated from Vodnye Resursy, No. 3, p 100-108, May-June, 1983.

Descriptors: *Aquifers, *Parametric hydrology, *Computers, Confined aquifers, Leaky aquifers, Head, Unsteady flow, Boundary conditions.

When determining the main parameters of two-layer aquifers, Boulton's solution and the methods of standard curves of type A and B are used most often. The use of Boulton's solution requires much computer time, since the indefinite integrals contained in the Bessel function converge rather slowly when calculating the derivatives with respect to the parameters. The process of minimization of the functional also converges slowly or not at all. In a qualitative analysis of the calculation results, maximum attention should be given to the values of the parameters obtained by the combined method, since the decline of head depends not only on time but also on the location of the wells relative to the boundaries of the bed in plan and source. The values of the parameters obtained by the temporal and areal processing methods should serve for substantiating the reliability of the selected calculation scheme or for establishing additional boundaries of the aquifer which were not included in the calculation scheme. For the case of steady flow, the bank of schemes is supplemented by the following hydrodynamic schemes, a semiconfined aquifer having incomplete connection with the river; an aquifer-strip with the same conditions on the boundaries as for unsteady flow; a leaky aquifer with a constant head in the adjacent stratus. (Baker-IVI)
W85-04107

USE OF ISOTOPE METHODS IN HYDROGEOLOGY,
Bierman (Sheldon L.) and Associates, Washington, DC.
J. Jordon, K. Frohlich, and D. Herbert.
Water Resources, Vol. 10, No. 3, p 279-284, May-June, 1983. 5 Fig, 2 Tab, 5 Ref. Translated from Vodnye Resursy, No. 3, p 116-122, May-June, 1983.

Descriptors: *Isotope studies, *Hydrogeology, Hydrologic cycle, Groundwaters, Precipitation, Hydrologic cycle, Residence time, Aquifers.

Isotope hydrogeology is based on the use mainly of natural isotopes present in the environment for obtaining additional information of the global and regional hydrologic cycle. This information is related primarily to the age of water, hydraulic interconnection of aquifers, and the degree of protection of groundwaters from pollution. The entry of isotopes into the recharge area and their concentration in the discharge area or in investigated wells are the main prerequisites for determining the residence time of groundwaters, dispersion, flow rate of groundwaters, dynamics of pollutants, genesis of water, and hydraulic interconnections between aquifers and between surface and subsurface waters of various origin. In the past two decades sufficiently sensitive and accurate methods of measuring natural isotopes have been developed. Examples of using natural isotopes for solving various hydrogeological problems are examined. (Baker-IVI)
W85-04109

USE OF A HELIUM SURVEY FOR EVALUATING THE STATE OF GROUNDWATERS,
Kiev Waterworks and Sewage Administration (USSR).
S. A. Brind, G. I. Burshtein, and V. S. Krylov.
Water Resources, Vol. 10, No. 3, p 285-288, May-June, 1983. 3 Fig, 1 Tab, 4 Ref. Translated from Vodnye Resursy, No. 3, p 123-126, May-June, 1983.

Descriptors: *Helium, *Groundwater, Aquifers, Wells, Water resources development, Percolation, Groundwater level, Leakage.

The main form of movement of helium in sedimentary strata is percolation with a phase-carrier, water. Helium, moving along deformations from the depths of the earth, is mixed in water-bearing layers with helium formed during decay of radioactive substances of the sedimentary strata, and in most cases its contribution to the helium content of the investigated waters is negligible. The distribution of helium content both for the Cenomanian and Jurassic aquifer did not contradict the lognormal law. The changes in the helium concentration along the profiles can be explained by a combination of a number of geological factors, presence of deformations, and marked drop of the groundwater level. For the Cenomanian aquifer, anomalous and high helium concentrations were recorded in certain wells of the Lybid' River valley. The long operation of these wells has caused a considerable drawdown, as a result of which the high-head waters occurring lower have become an additional supply source of the Cenomanian aquifer. A high helium content was observed in wells which tapped the Cenomanian and Jurassic aquifers. Descending leakage into a producing aquifer leads to a decrease of the helium content in it. The gradient of the helium concentration between adjacent aquifers increases with depth, and therefore the concentration anomalies in the case of downward leakage are less distinct than in the case of upward leakage of water. The most significant inflow of water from below is clearly recorded by the change in the helium concentration. (Baker-IVI)
W85-04110

IDENTIFICATION OF HYDROGEOLOGICAL SYSTEMS FROM DATA OF ISOTOPE TRACER INVESTIGATIONS,
V. T. Dubinchuk, and V. A. Polyakov.
Water Resources, Vol. 10, No. 4, p 376-384, July-August, 1983. 2 Fig, 17 Ref. Translated from Vodnye Resursy, No. 4, p 96-104, July-August, 1983.

Descriptors: *Groundwater, *Isotope studies, *Hydrogeology, Natural waters, Tracers, Recharge, Mixing, Boundary conditions, Groundwater movement.

The diversity of the conditions of formation and introduction of natural isotopes into groundwaters, conditions and regimes of artificial injection of isotope and nonisotope tracers into flows of natural waters, and also of the physicochemical properties of tracers offers wide possibilities for specialists studying natural waters - their genesis, age, and dynamics, structure of flows, and kinetics of natural physicochemical and hydrogeochemical processes. Regardless of the diversity of the purposes of studying hydrogeological objects, practically all problems of hydrogeology are problems of identifying the investigated real object, determining its structure and regime of functioning, and estimating its parameters as a system. For the most complete hydrogeological processing and interpretation of isotope tracer data physicomathematical models of the functioning of hydrogeological systems are constructed which should take into account the structure; the hydrodynamic regime; the condition of recharge, discharge, crossflow, and mixing of waters; and certain initial and boundary conditions. When determining the space-time distribution of the content of natural or artificially injected isotope tracers in groundwater it is possible to formulate and solve a number of important identification problems. (Baker-IVI)
W85-04122

MODEL OF TRITIUM INFILTRATION IN AQUIFERS USING A LOGNORMAL FUNCTION,
B. V. Karasev.
Water Resources, Vol. 10, No. 4, p 384-389, July-August, 1983. 2 Fig, 1 Tab, 18 Ref. Translated from Vodnye Resursy, No. 4, p 112-117, July-August, 1983.

Descriptors: *Aquifers, *Model studies, *Tritium, Isotope studies, Seepage, Groundwater movement, Infiltration.

The short-lived isotope tritium is often found in aquifers in which the water, according to radiocarbon deteminations, has an age in the hundreds and thousands of years. The presence of tritium in such aquifers requires the construction of specific models of rapid migration of part of the modern waters to considerable distances from the recharge areas. The problem of the most suitable type of probability distribution for describing any physical process can be solved on the basis of observation data. On the basis of limited data only a judgement about the consistency of a particular probability distribution law with the observation is possible. The presence of tritium in groundwaters of considerable age can be explained by a model with a lognormal distribution of seepage velocities, which was proposed for describing the dispersion curves. The simplest model of a quasi-diffusion type was examined in a spherically symmetric system. (Baker-IVI)
W85-04123

COMPUTER PROCESSING AND INTERPRETATION OF DATA OF EXPERIMENTAL STUDIES IN AQUIFERS CONFINED IN PLAN,
O. A. Dul'kite.
Water Resources, Vol. 10, No. 5, p 469-478, September-October, 1983. 4 Fig, 3 Tab, 10 Ref. Translated from Vodnye Resursy, No. 5, p 108-118, September-October, 1983.

Descriptors: *Confined aquifers, *Computers, Data processing, Groundwater management, Aquifers.

Processing of almost all initial data with the use of a computer should begin with the scheme of an unconfined aquifer for the original segment and the changes in the values of the parameters should be traced by adding moments of time. The character of the boundary in plan can be determined by analyzing the tendencies of the changes in the values of the parameters in all processing methods. Using the criterion of minimum average error, one can rather accurately determine the original tracing segment, when the effect of boundaries in plan is still negligible. The values of parameter T calculated by the areal processing method for wells located on a ray parallel to the boundary of inhomogeneity most correspond to the real value of transmissivity of the aquifer regardless of the hydrodynamic scheme. Calculated values of all parameters close to the actual values of the aquifer are obtained in the combined processing method. The values of the parameters obtained by the temporal or areal processing method depend considerably on the given initial values. (Baker-IVI)
W85-04134

NEW MODELS FOR INTERPRETING DATA ON THE CONTENT OF ENVIRONMENTAL TRACERS IN GROUNDWATERS AND THEIR COMBINED USE,
Institute of Nuclear Physics, Krakow (Poland).
J. Grabczak, K. Rozanski, A. Zuber, P. Maloszewski, and I. Sliwka.
Water Resources, Vol. 10, No. 5, p 479-483, September-October, 1983. 4 Fig, 3 Tab, 7 Ref. Translated from Vodnye Resursy, No. 5, p 119-123, September-October, 1983.

Descriptors: *Groundwater, *Isotope studies, *Tracers, *Model studies, Helium, Tritium, Krypton, Freon, Carbon, Radioisotopes.

A qualitative interpretation of data on the concentration of natural radioactive isotopes in groundwaters usually consists in constructing rough parametric models, often called black box models. New models have been presented which are characterized by two main parameters. In using the combined exponential and piston model (EPM) the main parameters are the turnover time T and the ratio of the total volume to the volume with an exponential distribution of the transition time. In using the dispersion model, such parameters are the turnover time T and a dispersion parameters. In certain cases it is necessary to introduce an additional parameter which is equal to the ratio of the velocity of the flow of the component without a tracer to the total velocity of the flow with a tracer. For methods based on the use of tritium and helium-3 still another parameter is needed, even in the simplest cases. It is always necessary to use from two to four parameters to solve the inverse problem, that is to characterize groundwaters on the basis of known concentrations of tracers at the inlet and outlet of the system. Direct solutions, calculations of the concentrations at the inlet on the basis of presumed values of the parameters, are useful for evaluating the possible applicability of a particular tracer, planning the sampling program, and finally, for obtaining approximate solution of the inverse problem. Several examples based on regime observation during several years of the concentrations of tritium and carbon-14 and also on preliminary measurements of krypton-85, helium-3, and Freon-11 are examined. (Baker-IVI)
W85-04135

ANALYSIS OF THE POSSIBILITIES OF USING HYDROCHEMICAL EARTHQUAKE PRECURSORS,
V. T. Dubinchuk.
Water Resources, Vol. 10, No. 5, p 489-495, September-October, 1983. 2 Fig, 12 Ref. Translated from Vodnye Resursy, No. 5, p 130-136, September-October, 1983.

Descriptors: *Earthquakes, *Groundwater, Chemical analysis, Isotope studies, Radon, Hydrogeology, Geochemistry, Residence time.

During buildup of earthquakes many investigators have observed an increase of the content of certain chemical, gaseous, and isotope components of groundwaters, and after the main shock the comparatively rapid restoration was also noted. The changes in composition are selective with respect to components, depend on the particular geological, hydrogeological-hydrochemical, and seismic conditions, and were detected at considerable distances from the earthquake focal zone at depths accessible for hydrogeological wells and even in surface outflows. Radon is a short-lived isotope, and therefore no model of its transport from the focal zone is suitable for explaining the observed changes in its content in groundwaters far from the focus. It is necessary to assume that it is released wherever increased stress is created in the rock mass, including in zones distant from the focus. The possibility of explaining variations of radon content in waters of seismically active regions on a fundamentally new basis, proceeding from a molecular-kinetic theory, is examined. An essential and in certain cases a decisive role in the formation and decrease of the hydrochemical signal is played by the residence time of the water in the system. The property of systems which substantially affects the very manifestation and contrast of hydrogeochemical signals is the average residence time of the water in the system and of the given component in the solution. (Baker-IVI)
W85-04137

ELECTROLYTIC ENRICHMENT OF WATER SAMPLES WITH LOW TRITIUM CONCENTRATIONS,
N. V. Pyatnitskii, and V. A. Polyakov.
Water Resources, Vol. 10, No. 5, p 496-501, September-October, 1983. 4 Fig, 6 Ref. Translated from Vodnye Resursy, No. 5, p 137-141, September-October, 1983.

Descriptors: *Groundwater, *Tritium, *Isotope studies, Electrolysis, Water exchange, Tracers.

Tritium is an ideal tracer when studying groundwaters of the zone of active water exchange. The most common method of tritium enrichment of water samples presently used is an electrolysis enrichment method. Due to the high tritium enrichment factor on the given electrolytic device it is possible to achieve a counting rate on a liquid scintillation spectrometer of about 1 count/min per 1 TU, which makes it possible to expand the range of hydrogeological problems being solved with the use of natural tritium and to increase the reliability of the results. (Baker-IVI)
W85-04138

PRESENT STATUS OF THE PROBLEM OF INVESTIGATING THE INTERACTION OF GROUNDWATERS AND SEAWATERS,
I. S. Zektser.
Water Resources, Vol. 10, No. 6, p 537-543, November-December, 1983. 18 Ref. Translated from Vodnye Resursy No. 6, p 57-64, November-December, 1983.

Descriptors: *Groundwater, *Seawater, *Hydrologic budget, Salinity, Water exchange, Drainage, Hydrologic cycle, Groundwater movement, Groundwater discharge, Coastal aquifers.

Groundwater discharge into seas is the only component of the water balance which cannot be directly measured, and often there are no data for a substantiated quantitative calculation of this component. Waters of the underground hydrosphere can be divided according to the conditions of their distribution and occurrence into land groundwaters having an unsaturated zone in the upper part of the hydrogeological section and connected with the atmosphere and subaqueous groundwaters distributed under the bottom of seas and large lakes and hydraulically connected with these water bodies. Data on the dynamics of groundwaters of artesian structures adjacent to inland seas and large lakes show that the groundwater flow within the upper hydrogeological stage is directed, as a rule, seaward. Sedimentation waters are confined mainly to the most submerged parts of modern sea basins and as a result of vertical percolation are rather closely connected with seawaters. Flows of infiltrating waters arriving from land are distributed mainly in the shelf zone. The process of displacement and replacement of sedimentation waters by infiltration waters is quite long in time. The role of groundwater discharge in the total water balance of the earth and global hydrologic cycle is considered along with the effect of groundwaters on the formation of the water and salt balance of seas and large lakes and a study of the interaction of seawaters and groundwaters in coastal regions, discharge regions of fresh groundwaters in coastal zones of seas to use them for water supply, and the effect of groundwaters on the formation of mineral deposits. (Baker-IVI)
W85-04144

MASS CONSERVATION IN FINITE ELEMENT GROUNDWATER MODELS,
Thayer School of Engineering, Hanover, NH.
D. R. Lynch.
Advances in Water Resources, Vol. 7, No. 2, p 67-74, June, 1984. 8 Fig, 9 Ref.

Descriptors: *Model studies, *Mass conservation, *Groundwater, Mathematical models, Mass balance, Galerkin equations, Hydraulic models, Boundary conditions, Dirichlet boundaries.

One of the fundamental tests of any water resources model is its ability to conserve mass. Numerical mass balance relations are derived for common formulations of the hydraulic and species transport equations, by summing the Galerkin equations. Volume integrals in the mass balances use the same quadrature as employed in the individual Galerkin equations. Imperfect quadrature does not degrade the mass balance, provided the flux divergence terms are integrated by parts, or the quadrature is sufficient to exactly integrate the flux divergence. The surface integrals which arise naturally in the Galerkin formulation constitute additional numerical unknowns on Dirichlet boundaries. These surface integrals represent the numerical mass efflux from the system and are essential ingredients in the mass balance. If Galerkin equations are discarded along Dirichlet boundaries, the mass balance is destroyed by the requirement that these fluxes be approximated by differentiating the numerical solution. Transients, variable coefficients, boundary element configuation and boundary curvature all contribute to the resulting mass imbalance, and in each case the contribution is linear in the mesh spacing. The following rules are essential to successful mass balance: integrated the flux divergence term by parts; use the right quadrature in the mass balance volume integrals; retain the Galerkin equation at Dirichlet boundaries as the equation for the flux. (Moore-IVI)
W85-04162

NODAL DOMAIN INTEGRATION MODEL OF TWO-DIMENSIONAL ADVECTION-DIFFUSION PROCESSES,
California Univ., Irvine. Dept. of Civil Engineering.
T. V. Hromadka II.
Advances in Water Resources, Vol. 7, No. 2, p 76-80, June, 1984. 1 Fig, 7 Ref.

Descriptors: *Advection, *Diffusion, *Nodal domain integration, Model studies, Anisotropy, Groundwater, Mathematical models, Boundary conditions.

The nodal domain integration method is applied to a two-dimensional advection-diffusion process in an anisotropic inhomogeneous medium. The domain is discretized into the union of irregular triangle finite elements with vertex-located nodal points and a linear trial function is used to approximate the governing flow equation's state variable in each element. Non-linear parameters are assumed quasi-constant for small durations in time in each element. The resulting numerical model represents the Galerkin and subdomain integration weighted residual methods and the integrated finite difference method as special cases. Both Dirichlet and Neumann boundary conditions are accommodated in a manner similar to the Galerkin finite element approach. (Author's abstract)
W85-04163

STATIONARY PRINCIPLE FOR NON CONSERVATIVE SYSTEMS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. Sorek.
Advances in Water Resources, Vol. 7, No. 2, p 85-88, June, 1984. 6 Ref.

Descriptors: *Stationary principle, *Dissipation, *Mathematical studies, Mass balance, Porous media, Solute transport, Energy, Momentum, Darcys law, Groundwater movement.

A stationary principle is described to yield governing integral formulations for dissipative systems. Variation is applied on selective terms of energy of momentum functionals resulting with force or mass balance equations respectively. Applying the principle for a motion of a viscous fluid yields the Navier-Stokes equations as an approximation of the functional (i.e. equating to zero part of the integrand). When a Darcy's flow regime in a porous media is considered, implementing a space averaging method on the resultant integral derived by the principle, Forchheimer's law for energy accumulation and solute transport equation for momentum assembling are yielded in differential form approximation of a more extended functional formulation. (Author's abstract)
W85-04165

SHAPE OF THE NON-STEADY INTERFACE INTERSECTING DISCONTINUITIES IN PERMEABILITY,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
J. Bear, and A. M. Shapiro.
Advances in Water Resources, Vol. 7, No. 3, p 106-112, September, 1984. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Interfaces, *Permeability, Porous media, Saline-freshwater interfaces, Aquifers, Air-

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water interfaces, Groundwater movement, Viscosity.

In problems which involve the simultaneous movement of two miscible or immiscible fluids in a porous medium, it is often acceptable to treat these fluids as if they are separated by a sharp interface, such that each fluid totally occupies the void space of separate regions of the porous medium. Examples are the phreatic surface and the interface between fresh and salt water in a coastal aquifer. The orientation of such a sharp interface as it crosses a surface of discontinuity between media of different permeabilities, and as it intersects an impervious boundary, depends not only on the fluid and porous media properties, but also on the direction and rate of motion of the interface. Advancing and retreating interfaces intersect boundaries of discontinuity in permeability at different angles. For situations where an overlying medium has a larger permeability than the underlying one, the interface will be continuous while exhibiting a refracted angle as it crosses the boundary of the permeability discontinuity. For situations where the viscosities of the two considered fluids are equal, there is no effect on the angles of intersection due to the movement of the interface; this happens with the interface intersecting an impermeable boundary. Where the fluid viscosities are not equal and both fluids are in motion, the angles at which the interface intersects the discontinuity in permeability depend on two of the components of the fluid fluxes at the point of intersection between the interface and the boundary of the permeability discontinuity. (Moore-IVI)
W85-04168

EXPOSITION OF THE DISTRIBUTION FUNCTION USED IN PROVING THE AVERAGING THEOREMS FOR MULTIPHASE FLOW,
Princeton Univ., NJ. Dept. of Civil Engineering.
I. P. E. Kinnmark, and W. G. Gray.
Advances in Water Resources, Vol. 7, No. 3, p 113-115, September, 1984. 1 Fig, 3 Ref. NSF grant CEE-7920996 01.

Descriptors: *Multiphase flow, *Porous media, Distribution, Flow, Groundwater movement, Mathematicao studies.

In 1977 Gray and Lee (Intl. J. Multiphase Flow 1977, 3, 333) presented a proof of the averaging theorems for porous medium flow that made use of a distribution or indicator function. The distribution function has been found to be a very convenient and useful tool in developing equaitons for porous medium flow. The distribution function is amultidimensional analogue of the Dirac delta function as opposed to a more classical multidimensional delta distribution function. The differences between the actual Dirac and this analogy, discussed in Gray and Lee have been mathematically defined. (Baker-IVI)
W85-04169

FINITE ELEMENT-FINITE DIFFERENCE ALTERNATING DIRECTION ALGORITHM FOR THREE-DIMENSIONAL GROUNDWATER TRANSPORT,
Princeton Univ., NJ. Dept. of Civil Engineering.
D. K. Babu, and G. F. Pinder.
Advances in Water Resources, Vol. 7, No. 3, p 116-119, September, 1984. 5 Fig, 1 Ref. DOE DE-AC02-83ER60170.

Descriptors: *Groundwater transport, *Finite element-finite difference procedure, Algorithms, Simulation, Computers, Mathematical studies, Solute transport.

While technically feasible, three-dimensional finite element groundwater transport simulation has not found widespread application because of the considerable computational burden inherent in the approach. An operator splitting algorithm which treats the horizontal plane using finite elements in the first step and the vertical dimension using finite differences in the second step provides considerable savings in both computer memory requirements and computational effort. The algorithm reduces the problem of an (N x M) array of nodes from one in which NM equations must be solved simultaneously, to one of solving N equations M times in the first step and M equations N times in the second step. Applications to type problems and field situations indicate that the method is robust and accurate. (Author's abstract)
W85-04170

MULTICOMPONENT SOLUTE TRANSPORT WITH SORPTION AND SOLUBLE COMPLEXATION,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-04171

FOURIER INTERPRETATION OF MULTIPHASE AVERAGING THEORY,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
J. H. Cushman.
Advances in Water Resources, Vol. 7, No. 3, p 126-131, September, 1984. 14 Ref, 1 Append.

Descriptors: *Multiphase transport, *Fourier analysis, Mathematical studies, Boundary conditions, Impulse-response filters, Mathematical equations, Distribution filtering.

The fundamental reason for averaging the continuum scale equations when dealing with immiscible multiphase transport theory is the inability to describe a complicated geometrical structure of the phase boundaries. An averaging procedure is invoked to increase the scales of motion in the transport equations. An attempt is made to elucidate some of the inherent properties of impulse-response filters used in multiphase transport theory. To indicate the properties that are inherently important to multiphase filters, the process was transferred to frequency space. By use of a spatial autocorrelation function, it was shown how spatial correlations of the microscale affect spatial correlations on the macroscale. For three basic reasons the classical filtering of a multiphase process was generalized to a distributional setting: to interpret averaging in a relativistic sense, the filtering process need not exist as an integral; mathematical generalizations often lead to significant advances in physical insight; and because the field properties are discontinuous across phase boundaries, the transport equations are properly considered in the sense of distribution theory. Because delta distributions generally have compact support and are not generated by integrable functions, distributional filtering allows for such functions, whereas the classical theory does not. (Moore-IVI)
W85-04172

SATURATED-UNSATURATED TRANSIENT FINITE ELEMENT SEEPAGE MODEL FOR GEOTECHNICAL ENGINEERING,
Saskatchewan Univ., Saskatoon. Coll. of Engineering.
For primary bibliographic entry see Field 8B.
W85-04173

PERIODIC RECHARGE TO FINITE AQUIFERS FROM RECTANGULAR AREAS,
Thessaloniki Univ., Salonika (Greece). School of Technology.
P. Latinopoulos.
Advances in Water Resources, Vol. 7, No. 3, p 137-138, September, 1984. 4 Fig, 1 Tab, 10 Ref.

Descriptors: *Groundwater recharge, *Aquifers, *Groundwater movement, Laplace equation, Fourier analysis, Seasonal variation.

Analytical solutions for groundwater flow in unconfined rectangular aquifers are presented for the case of recharge from rectangular areas. The linearized differential equation of the flow is solved using Laplace and finite Fourier transforms. The problem concerns the response of finite aquifers to periodic (seasonal) recharge schemes of variable duration. Results can be obtained for various combinations of Dirichlet and Neumann boundary conditions and can be easily used in a preliminary study of water resources management. (Author's abstract)
W85-04174

SIMPLE MODEL OF A PHREATIC SURFACE THROUGH AN EARTH DAM,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
T. V. Hromadka, II.
Advances in Water Resources, Vol. 7, No. 3, p 141-142, September, 1984. 2 Fig, 5 Ref.

Descriptors: *Air-water interfaces, *Earth dams, *Mathematical models, Soil water, Isotropy, Seepage face, Groundwater level.

The classic problem of estimating the phreatic surface in a homogeneous isotropic soil uses either a domain method or a boundary element technique to develop the approximate seepage face and corresponding approximate water-surface elevations, and an iteration procedure is used which adjusts the phreatic surface elevations until the predicted potentials coincide with the surface elevations. A simple procedure is presented for estimating a phreatic surface in an earthen dam, without an iterative procedure. The approach is based upon the Complex Variable Boundary Element Method (CVBEM), but produces estimates for the phreatic surface elevations with a single matrix solution, as against by iteration in the previous approaches. The CVBEM approximation geometric functions are expanded into a first order Taylor series, so that the unknown phreatic surface location geometrics can be approximated without iteration. The technique provides for the numerical solution of the inverse problem of locating the phreatic surface coordinates. In the phreatic surface problem considered, good results were obtained by this technique. (Moore-IVI)
W85-04175

SUBSURFACE TRANSPORT WITH EMPHASIS ON HYDROLOGY: RESEARCH NEEDS,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Chemistry Section.
For primary bibliographic entry see Field 5B.
W85-04217

USE OF A DIGITAL MODEL TO EVALUATE HYDROGEOLOGIC CONTROLS ON GROUNDWATER FLOW IN A FRACTURED ROCK AQUIFER AT NIAGARA FALLS, NEW YORK, U.S.A.,
Geological Survey, Doraville, GA. Water Resources Div.
M. L. Maslia, and R. H. Johnston.
Journal of Hydrology, Vol. 75, No. 1/4, p 167-194, 1984/1985. 10 Fig, 3 Tab, 19 Ref.

Descriptors: *Groundwater movement, *Geological fractures, *Hydrogeology, *Niagara Falls, *New York, Hyde Park Landfill, Simulation, Velocity, Path of pollutants, Groundwater recharge.

The Hyde Park landfill is a 15-acre (6.1 ha) chemical waste disposal site located north of Niagara Falls, New York. A low-permeability glacial till and lacustrine deposits, a moderately permeable fractured rock aquifer - the Lockport Dolomite, and a low-permeability unit - the Rochester Shale underlie the site. The mechanism by which groundwater moves through fractured rocks underlying a hazardous waste site was investigated using a digital simulation approach. A saturated-unsaturated flow model was used to test three different groundwater flow scenarios with varying hydraulic conductivities, ratios of anisotropy, recharge rates and boundary conditions. Among the three scenarios tested, scenario 2 (with strongly anisotropic conditions in the Lockport Dolomite with added recharge through the landfill cap and limited flow through the Rochester Shale) is considered the most realistic hydrogeological model. Based on simulation with the hydrogeologic parameters of scenario 2, specific discharge (Darcy velocity) ranges from about 0.01 to 0.1 ft./day (0.003 to 0.03 m/day) in the upper unit of the Lockport Dolomite to slightly more than 0.0001 ft./day (0.00003 m/day) in the Rochester Shale.

Real velocities are highest in the upper unit of the Lockport, ranging from about 1 to 5 ft./day (0.3 to 1.5 m/day) if the average effective porosity is assumed to be 0.02. A groundwater divide exists east of the landfill, indicating that all groundwater originating near of flowing beneath the landfill will flow toward and discharge in the gorge. Highest flow velocities (and presumably greatest potential for transporting chemical contaminants) occur in the upper unit of the Lockport and part of the lower unit of the Lockport Dolomite between the landfill and the gorge. The average time required for groundwater to move from the landfill to the discharge points at the gorge along selected flow paths in the Lockport Dolomite is estimated to be 5-6 yr. (Moore-IVI)
W85-04273

DETERMINING DISPERSION COEFFICIENTS AND SOURCES OF MODEL-DEPENDENT SCALING,
Texas A and M Univ., College Station. Dept. of Geology.
G. A. Robbins, and P. A. Domenico.
Journal of Hydrology, Vol. 75, No. 1/4, p 195-211, 1984/1985. 7 Fig, 1 Tab, 23 Ref.

Descriptors: *Dispersion, *Model studies, Tracers, Path of pollutants, Groundwater pollution, Convection, Model scale.

This paper deals primarily with methods for determining dispersion coefficients in multidimensional dispersion problems. The methods developed are applicable to field and laboratory tracer tests, contamination spills, or long-term contamination histories. The analysis of three-dimensional data from instantaneous sources is simplified by embedding two unknown coefficients into an experimentally determined variable, namely the maximum observed concentrations. The analysis of multidimensional continous point-source data takes advantage of centerline solutions that possess the same form as the simple one-dimensional dispersion-convection problem. Importantly, all coefficients can be determined independently of initial concentrations and source volumetric flow rate, two parameters that are seldom known in contamination problems. Finally, some aspects of model-dependent scaling are discussed. Modeling factors found to produce scaling in the measured dispersion coefficients include finite-source influences on point-source methods and a nonconcurrence between the dimensionality of a particular model and the field dispersion condition it is supposed to represent. (Author's abstract)
W85-04274

EFFECT OF ANISOTROPY AND GROUNDWATER SYSTEM GEOMETRY ON SEEPAGE THROUGH LAKEBEDS; 1. ANALOG AND DIMENSIONAL ANALYSIS,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
H. O. Pfannkuch, and T. C. Winter.
Journal of Hydrology, Vol. 75, No. 1/4, p 213-237, 1984/1985. 12 Fig, 2 Tab, 21 Ref.

Descriptors: *Lake beds, *Anisotropy, *Analog models, Seepage, Streamline crowding, Surface-groundwater relations, Groundwater movement, Dimensional analysis, Lake morphology.

Distribution of seepage through lakebeds is controlled partly by geometric configuration of the lake and of the groundwater system interacting with the lake. To evaluate the effect of these factors, conductive-paper electric-analog models were used to analyze a number of lake and groundwater settings having different geometric configurations. Most settings analyzed are of lakes that do not penetrate the groundwater system. The width ratio, the ratio of half the lake width to thickness of the groundwater system, is the principal geometric characteristic used in this study. Because the distribution of groundwater seepage into a lake is not uniform across the lakebed, the concept of a streamline-crowding factor is developed, and is used to determine seepage patterns from geometric characteristics of the lake and its contiguous groundwater system. Analysis of fourteen different width ratios of lake and groundwater systems indicates that lakes can be defined by three general groups of seepage patterns, which include flow pattern, volumes and rates: (1) lakes having width ratios less than about 0.6 show relatively uniform distribution of seepage across the lakebed; (2) lakes having width ratios of about 0.6 to 2.0 change in absolute and relative streamline crowding in the near-shore region; and (3) lakes having width ratios greater than about 2.0 show stable flow patterns near shore; however, with increasing lake width, the relative streamline crowding increases relative to that width. For deep lakes and those in anisotropic media, the crowding effect is decreased, resulting in more uniform seepage across the lakebed. (Author's abstract)
W85-04275

EFFECT OF ANISOTROPY AND GROUNDWATER SYSTEM GEOMETRY ON SEEPAGE THROUGH LAKEBEDS; 2. NUMERICAL SIMULATION ANALYSIS,
Geological Survey, Denver, CO. Water Resources Div.
T. C. Winter, and H. O. Pfannkuch.
Journal of Hydrology, Vol. 75, No. 1/4, p 239-253, 1984/1985. 8 Fig, 16 Ref.

Descriptors: *Anisotropy, *Lake beds, *Seepage, *Simulation, Mathematical models, Surface-groundwater relations, Groundwater movement, Lake morphology, Porous media.

The interaction of lakes and groundwater is controlled partly by the geologic framework through which the water flows. Two interrelated geometric factors of the groundwater system that affect flow are overall geometry of the system, and anisotropy of the porous media within the system. Numerical simulation analysis was made for variations in the coefficient of anisotropy for each of several lake and groundwater settings having different geometric configurations. These analyses indicate that, for a given geometric setting, as the anisotropy of geologic materials decreases, seepage from a lake decreases and depth of the local groundwater flow system associated with the lake increases. Transformation of scale of groundwater systems that have anisotropic media to isotropic equivalents results in a change in the overall geometry. Because of the different slopes of the water table and lakebed resulting from the scale transformations, a series of numerical experiments were made for various geometric configurations for a given anisotropy. These analyses indicate that as thickness of the groundwater system decreases, relative depth of the local flow system increases and seepage from the lake decreases. (Author's abstract)
W85-04276

INTERCONNECTED GROUNDWATER SYSTEMS SIMULATION (IGROSS) - DESCRIPTION OF THE SYSTEM AND A CASE HISTORY APPLICATION,
Aquater S.p.A., San Lorenzo in Campo (Italy).
G. Pizzi, and L. Sartori.
Journal of Hydrology, Vol. 75, No. 1/4, p 255-285, 1984/1985. 17 Fig, 4 Tab, 21 Ref.

Descriptors: *Groundwater management, *Simulation, *Interconnected groundwater systems, *Libya, Computer models, Aquifers, Groundwater potential, Aquifers, Aquitards, Water resources development, Transmissivity, Permeability coefficient.

IGROSS (interconnected groundwater systems simulation) is an industrial system of digital programs specially designed for multiaquifer groundwater systems simulation, and is based on the quasi-three-dimensional finite-element (FE) approach. Lateral aquifer connections and an accurate aquifer balance method are introduced in the FE scheme. The numerical solution of the system of equations is based on the substructured frontal method integrated in the steady case with a forcing iterative procedure and in the transient case with a predictor-corrector procedure. The system of computer programs is modular and the different programs are linked by means of auxiliary data files. The model of the Western Libya groundwater system is presented as a relevant application of IGROSS. This aquifer system extends over 800,000 sq km and is composed of four aquifers hydraulically interconnected both along aquifer branchings and through interbedded aquitards. The FE grid network contains 4407 aquifer elements ranging from 3 to 3000 sq km, 3104 aquitard elements and 62 aquifer branching nodes. The steady-state model calibration was made with reference to the natural state of the groundwater system prior to its modern development (year 1960), adjusting the aquifer transmissivity and the vertical hydraulic conductivity of the aquitards. The calibration error has been less than 1 m. The volumetric balance of the groundwater system has been performed. Transient model calibration was made by simulating the history of exploitation in the period 1960-1979. During the transient calibration the storage parameters of the aquifers and aquitard were adjusted. The most suitable future exploitation of the groundwater system has been selected among ten different exploitation hypotheses simulated over the period 1979-2030. It is concluded that IGROSS represents a useful tool for the effective management of large interconnected groundwater systems. (Author's abstract)
W85-04277

EFFECTIVE INFILTRATION INTO GREEK KARST (INFILTRATION EFFICACE DANS LE KARST HELLENIQUE),
Thessaloniki Univ., Salonika (Greece). Dept. of Geology and Palaeontology.
G. Soulios.
Journal of Hydrology, Vol. 75, No. 1/4, p 343-356, 1984/1985. 7 Fig, 4 Tab, 15 Ref.

Descriptors: *Infiltration, *Karst hydrology, *Greece, Precipitation, Percolation, Specific efficiency.

Representative karstic aquifer systems showing simple geological structure and clear boundaries were chosen for the calculation of the coefficient of effective infiltration into karst in Greece. Based on the observation of total discharge and precipitation falling on these systems, the coefficient of effective percolation was calculated. By extrapolation, the specific efficiency of the Greek karst was calculated. The specific efficiency for the annual precipitation is 8-10 l/s/sq km at P=550-650 mm, 10-12 l/s/sq km at P=650-750 mm, 12-15 l/s/sq km at P=750-850 mm, and 15-18 l/s/sq km at P=850-950 mm. Efforts were made to establish empirical methods for the calculation of the infiltration in the karstic areas. (Moore-IVI)
W85-04282

MODELING OF GROUNDWATER CONDITIONS IN THE LEIPZIG-DELITSCH MINING REGION (MODELLIERUNG DER GRUNDWASSERVERHALTNISSE IM BERGBAUGEBIET LEIPZIG-DELITZSCH),
Institut fuer Wasserwirtschaft, Leipzig (German D.R.).
K. Dybek, G. Hennig, and U. Kesse.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 10, p 346-349, October, 1983. 6 Fig, 7 Ref.

Descriptors: *Leipzig-Delitzsch, *Germany (Democratic Republic), *Groundwater, *Model studies, Forecasting, Groundwater management.

The development of a computer model to forecast groundwater volume in the 1,400 sq km Leipzig-Delitzsch mining region in the German Democratic Republic is described, and results of model tests are given. A 'constantly working model' (CWM) was devised to describe the groundwater conductor of the region, including existing, future, and disused mines and groundwater use by industry, and taking into account the two significant quaternary and tertiary groundwater strata. It consists of a material model of natural conditions with two interconnected components: an informational model composed principally of a data store; and simulation model composed mainly of a quantified structural model. Testing showed that CWM Leipzig-Delitzsch was suitable for mid- and long-term forecasting of regional groundwater dynamics, groundwater pumping by mines, the origin of the

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pumped water, the extent of mine drainage, rises in groundwater table, the filling process in disused mines, reciprocal effects of regional intrusions into the groundwater system, the capacity of large waterworks, volume of water available in the groundwater conductor, hydrogeological parameters, and infiltration from rivers. Forecasts were made up to the year 2000. The research phase for the model lasted 17 months, development and testing lasted 14 months, and the model has been used for 7 months. Principal users are the Saale-Werra water district and the Leipzig upper-river authority. (Gish-IVI)
W85-04321

THERMAL EFFECTS OF THREE-DIMENSIONAL GROUNDWATER FLOW,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
A. D. Woodbury, and L. Smith.
Journal of Geophysical Research, Vol. 90, No. B1, p 759-767, January, 1985. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Groundwater movement, *Thermodynamics, *Water table, Heat transport, Fluid flow.

Numerical solutions of the coupled equations of fluid flow and heat transport are used to investigate how the near-surface thermal regime is perturbed by groundwater flow in a basin with a three-dimensional water table configuration. We consider specifically those conditions where the hydraulic gradient on the water table drives the flow system, thermally induced buoyancy forces modify but do not control the flow field. The hydrologic disturbance of the thermal field and the significance of a water table gradient transverse to the regional slope depend upon the interplay of the three-dimensional water table configuration, the basin geometry including the depth of the basal impermeable boundary, the anisotrophy, and the permeability of the subsurface formations. These factors act together to determine groundwater flow patterns, depths of circulation along individual flow lines, and areal distribution of groundwater recharge and discharge. The uniformity of surface heat flow values determined from a series of shallow boreholes in an advectively disturbed regime will depend on the location of the measurement sites relative to the hinge line separating areas of groundwater recharge and discharge and on the extent of the region centered about the hinge line where fluid inflow/outflow rates are insufficient to perturb the thermal field. (Author's abstract)
W85-04339

EFFECT OF DOMESTIC EFLUENTS ON GROUNDWATER QUALITY: A CASE STUDY,
North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Plant Science and Technology.
For primary bibliographic entry see Field 5B.
W85-04361

2G. Water In Soils

COMPARISON OF DIFFERENT METHODS OF ESTIMATING INFILTRATION AT A LANDFILL SITE IN SOUTH ESSEX WITH IMPLICATIONS FOR LEACHATE MANAGEMENT AND CONTROL,
Cleansway Ltd., Rayleigh (England).
For primary bibliographic entry see Field 5G.
W85-03767

EFFECTS OF GEL-FORMING POLYACRYLAMIDES ON MOISTURE STORAGE IN SANDY SOILS,
Liverpool Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 3B.
W85-03797

COUPLED HEAT AND MOISTURE FLOW THROUGH SOILS,
Ontario Hydro, Toronto. Research Div.
H. S. Radhakrishna, K.-C. Lau, and A. M. Crawford.
Journal of Geotechnical Engineering, Vol. 110, No. 12, p 1766-1784, December, 1984. 11 Fig, 19 Ref.

Descriptors: *Fluid flow, *Soil water, *Temperature gradient, *Computer models, Model studies, Geophysics.

With the existence of temperature gradients in a soil medium, the moisture in the medium will redistribute itself to new equilibrium values to conform with the applied temperature gradient. Subsequently, the new moisture content distribution will affect the temperature distribution in the soil medium. A method for numerically modeling the transient coupled heat and moisture flow in a multi-dimensional soil domain subjected to time-dependent heat and moisture generation was developed. The computer program, TRUCHAM, which is based on a model for flow in soils (Philip, J.R. and DeVries, D.A., 1957. Trans. American Geophysical Union, Vol. 38, p 222-232), utilizes an integrated finite difference procedure. Explicit, implicit, and mixed explicit-implicit solution schemes are built into the program, making it versatile in handling problems of different classes. The technique accommodates different types of linear and nonlinear boundary conditions and material properties. Validation of the program has been made with data from exact solutions, controlled laboratory experiments and field tests. This program will be useful in solving many heat and mass transport problems encountered in the field of underground power cables, heat storage and nuclear waste disposal programs. When a method is available for accomodating a stress-strain tensor within the framework of this computer code, the program could be extended to model coupled mechanical-thermal and fluid flow problems. (Collier-IVI)
W85-03814

INFILTRATION FROM TRICKLE IRRIGATION SOURCE,
California Univ., Davis. Dept. of Civil Engineering.
S. A. Taghavi, M. A. Marino, and D. E. Rolston.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 4, p 331-341, December, 1984. 8 Fig, 2 Tab, 10 Ref, 1 Append.

Descriptors: *Infiltration, *Trickle irrigation, *Irrigation, *Soil water, Model studies, Mathematical equations, Flow.

The two-dimensional nonlinear partial differential equation that describes the transient movement of water in an unsaturated porous medium is investigated by using the zero-order continuous linear finite element method. The governing equation is transformed logarithmically to smooth the abrupt changes in the soil-water characteristic relations. The Newton-Raphson method is used to iterate toward the 'exact' solution of the original nonlinear equations. In addition, a modified implicit finite difference scheme is used to approximate the time derivatives. Predictions of the finite element model are verified with a one-dimensional example. The model is then used to investigate two-dimensional infiltration from a trickle irrigation source. The numerical results compare well with those obtained from laboratory and field experiments. The advantage of the present model is its capability to simulate water movement through very dry soil environments, which causes a steep moisture front, as well as its potential applicability in irregularly shaped flow regions, which are commonly encountered in the field and are difficult to model with finite difference or other numerical methods. (Author's abstract)
W85-03816

SOIL SURVEY INTERPRETATIONS FROM WATER RETENTION DATA: I. DEVELOPMENT AND VALIDATION OF A WATER RETENTION MODEL,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
R. A. McBribe, and E. E. Mackintosh.
Soil Science Society of America Journal, Vol. 48, No. 6, p 1338-1343, November/December, 1984. 4 Fig, 2 Tab, 33 Ref.

Descriptors: *Soil water, *Water retention, Mathematical models, Soil porosity, Clay, Organic matter, Soil physical properties, Hysteresis, Soil adsorption.

The prediction of spatial and temporal variations in the soil water regime provides the basis for proposed soil survey interpretive system. A water retention model estimates the boundary desorption curve from saturation to pF 4.2 for mineral soils in situ using limited soil physical data (standard error of estimate $< 2.2\%$ g/g). The total porosity (structural parameter) and clay content (adsorptive parameter) define the position of the moisture characteristic in logarithmic coordinates and the silt content its configuration. Organic matter affects the structural parameter by reducing both the dry bulk and particle densities but only significantly influences the adsorptive parameter at organic matter contents of 5% or greater. Model validation shows that the state and quantity of water retained by field soils near equilibrium is dependent on the position of the phreatic surface. Under field conditions, the psi (theta) relationship establishes an effective equilibrium midway between the predicted wetting and drying curves of the hysteresis loop. (Author's abstract)
W85-03963

SOIL SURVEY INTERPRETATIONS FROM WATER RETENTION DATA: II. ASSESSMENT OF SOIL CAPABILITY RATINGS AND CROP PERFORMANCE INDICES,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
R. A. McBride, and E. E. Mackintosh.
Soil Science Society of America Journal, Vol. 48, No. 6, p 1343-1350, November/December, 1984. 2 Fig, 6 Tab, 32 Ref.

Descriptors: *Soil water, *Water retention, *Soil capability, *Ontario, Canada Land Inventory, Soil porosity, Corn, Soil properties.

The Canada Land Inventory (CLI) system of soil capability for agriculture and the accompanying crop performance indices are used almost exclusively to assess the relative productivity of agricultural lands in strategic and structural planning activities in Ontario. A water retention model developed for Ontario soils is used to estimate the preseason plant-available moisture-holding capacity of the soil root zone in equilibrium with a phreatic surface and the air-filled porosity of the surface 30 cm. CLI soil capability class ratings are assessed from regional guidelines based on class intervals of moisture-holding capacity and air-filled porosity. Crop performance indices are determined using a statistical corn productivity model which relates long-term mean grain corn yields in Ontario to a seasonal soil moisture deficit or surplus. Total seasonal field water supply is budgeted against potential crop evapotranspiration to estimate the extent to which plant water stress from excess or deficit soil water availability limits the attainment of regional agro-climatic potential yields. The more important soil qualities limiting crop production in Ontario do so primarily through their influence on excess or deficit soil moisture availability. (Moore-IVI)
W85-03964

HYDRAULIC PROPERTIES OF SOME SOILS WITH PARALITHIC CONTACTS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
R. F. Paetzold, and M. J. Mausbach.
Soil Science Society of America Journal, Vol. 48, No. 6, p 1355-1359, November/December, 1984. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Paralithic contacts, *Soil hydraulic properties, *Soil physical properties, Permeability coefficient, Density, Soil porosity, Water retention, Roots.

Several soils containing paralithic contacts over sedimentary materials were studied. Hydraulic and related soil physical properties were determined in an effort to explain root restriction associated with paralithic contacts. These properties were evaluat-

ed for their usefulness as criteria in confirming the presence and location of paralithic contacts. Bulk density ranged from 1.21 to 1.78 Mg/cu m in C horizons and from 1.17 to 2.05 in Cr horizons. No statistical difference was found between C and Cr horizon bulk densities. Paired determinations showed no statistical difference in bulk density between the horizon immediately above and the horizon immediately below a paralithic contact. Similar results were obtained for total porosity and air-filled porosity at 33 kPa water content except that there was a statistical difference in air-filled porosity at 33-kPa water content between C and Cr horizons in fine-textured soils. Although Cr horizons retained more water at both 33 and 1500 kPa than C horizons, the water retention difference was the same for both C and Cr horizons. Hydraulic conductivity values were similar for all horizons within a particular soil. No abrupt or unusual change in any soil property measured was observed at a paralithic contact. High bulk density and poor water supplying ability were eliminated as aids useful in identifying and locating paralithic contacts in the materials studied. (Author's abstract)
W85-03965

STOCHASTIC MODELS OF SUBSURFACE FLOW: LOG LINEARIZED GAUSSIAN MODELS ARE 'EXACT' FOR COVARIANCES,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Mathematics.
A. Gutjahr.
Water Resources Research, Vol. 20, No. 12, p 1909-1912, December, 1984. 6 Fig, 3 Tab, 36 Ref, 1 Append.

Descriptors: *Stochastic hydrology, *Model studies, Storm seepage, Conductivity, Gaussian processes, Flow, Head.

Stochastic solutions for steady state infinite domain flow models are studied under the assumptions that low conductivity and head are second-order stationary jointly Gaussian processes. The covariance relationships previously derived are exact solutions for the nonlinearized equations no matter how large the input variance is. Steady flow models are studied under the following assumptions: conductivity and head are stationary processes; conductivity is statistically isotropic; and conductivity and head are jointly Gaussian processes. (Baker-IVI)
W85-03997

RELATION OF WATER TABLE DEPTH AND SOIL MORPHOLOGY IN TWO CLAY-RICH SOILS OF NORTHWESTERN OHIO,
Ohio State Univ., Columbus. Dept. of Agronomy.
T. M. Zobeck, and A. Ritchie, Jr.
Ohio Journal of Science, Vol. 84, No. 5, p 228-236, December, 1984. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Soil water, *Soil color, *Soil properties, *Clays, *Ohio, *Soil water table, Color, Precipitation distribution, Water table.

Soil properties, particularly soil color, are often used to predict the depth to saturated zones. Previously unpublished multi-year observed water table depths were related to soil properties in representative clay-rich soils of northwest Ohio. Water table levels within the upper 165 cm of the soil and precipitation were measured, and soil samples were taken, over a three-yr period for two forested soils representative of clay-rich soils common throughout much of northwestern Ohio. The soils included very poorly drained Hoytville taxadjunct (fine, illitic, mesic Typic Haplaquept) and moderately well drained Glynwood (fine, illitic, mesic Aquic Hapludalf). A water table was observed from February to June in the Hoytville taxadjunct and from March to June in the Glynwood. The highest water table was observed at a depth of 10 cm during the last two weeks of April in the Hoytville taxadjunct and at a depth of 30 cm during the first two weeks of April in the Glynwood. The water regimes of each soil were correlated with soil color features. The Hoytville taxadjunct was dominantly gray throughout the subsoil, and the Glynwood had gray coatings only on ped surfaces. The gray soil matrix of the Hoytville taxadjunct formed in horizons where water tables were observed for as little as 1.5 months, and the gray coatings of the Glynwood formed in horizons where water tables were present for an average of only two weeks each year. (Collier-IVI)
W85-04052

SOIL WATER AND TEMPERATURE RESPONSE TO PRESCRIBED BURNING,
Brigham Young Univ., Provo, UT. Dept. of Botany.
S. G. Whisenant, C. J. Scifres, and D. N. Ueckert.
Great Basin Naturalist, Vol. 44, No. 4, p 558-562, October, 31, 1984. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Soil water, *Soil temperature, *Fire, *Grasslands, Infiltration, Temperature, Vegetation, Litter, Evapotranspiration, Solar radiation, Primary productivity.

A somewhat different postburn soil water response was reported for a cool season grass dominated rangeland than has been reported in warm season grass dominated rangelands. Soil temperatures were increased on burned plots for most of the first year following burning compared to adjacent, unburned rangeland. Fire indirectly affected postburn soil temperatures through removal of living vegetation and litter, which increased solar radiation on the soil surface, thus increasing soil temperatures. Soil water contents were reduced for two to six months following burning and again when the next crop of cool-season grasses and forbs began growth. In contrast to other studies where reductions in soil water were accompanied by and attributed to increased plant production, soil water contents and net primary production were reduced by burning in this experiment. The reductions in soil water contents following burning were possibly a result of increased evaporation from the soil and greater transpiration from the remaining plants. Soil water reductions were greater at 15 to 45 cm than in the upper 15 cm, presumably because the deeper soil layers were in the zone of greatest root activity and received little or no water from the relatively light late spring and summer rains. In addition, capillary flow, caused by evaporation from the soil, may have depleted lower soil layers of water while increasing soil water in the upper layer. (Baker-IVI)
W85-04071

SIMILARITY SOLUTIONS TO THE SECOND BOUNDARY VALUE PROBLEM OF UNSATURATED FLOW THROUGH POROUS MEDIA,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano.
Advances in Water Resources, Vol. 6, No. 4, p 205-213, December, 1983. 26 Ref.

Descriptors: *Unsaturated flow, *Porous media, *Similarity, *Boundary conditions, Soil water, Diffusivity, Wetting fronts, Infiltration.

The flow of water in a homogenous porous medium that obeys the extended Darcy's law for unsaturated porous flow is considered. Similarity solutions to the second boundary value problem of unsaturated flow are studied in one-dimensional, semi-infinite porous media with the soil-water diffusivity proportional to some power of the water content. The existence and uniqueness of two types of similarity solutions to the problem are investigated and the properties of these solutions are presented. These two types of similarity solutions exist and they may not be unique for every parameter range studied. The phenomena of absorption of water by semi-infinite homogeneous soil under flux boundary conditions when the gravitational effects are either absent or negligible actually occur in nature, for instance, during the early stage of rainfall infiltration into dry soil. Under certain conditions the problem becomes a free boundary (wetting front) problem. A physical interpretation is presented for mathematical theorems on the propagating speed of wetting fronts. The similarity solutions may have use for the the experimental determination of soil-water diffusivity. (Moore-IVI)
W85-04156

TRANSPORT OF WATER IN FROZEN SOIL: IV. ANALYSIS OF EXPERIMENTAL RESULTS OF THE EFFECTS OF ICE CONTENT,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano, A. Tice, and J. Oliphant.
Advances in Water Resources, Vol. 7, No. 2, p, 58-66, June, 1984. 5 Fig, 19 Ref, 2 Append.

Descriptors: *Frozen ground, *Soil water, *Ice, Unsaturated flow, Diffusivity, Porous media, Mathematical equations, Water content.

When a porous medium obeys the extended Darcy's law for unsaturated flow and gravitational effects are negligible, the flux of water (q sub 1) in one direction under an isothermal condition is given as q sub 1 = -D(W)rho delta w/delta x, where w is the weight of water per weight of dry soil, x is the space coordinate, rho is the dry density and D(W) is the soil-water diffusivity. A physical law, that the flux of water in unsaturated frozen soil is proportional to the gradient of total water content is proposed. The two-phase flow theory is used to show that the extention to frozen soil of an equation for the flux of water under an isothermal condition can be justified if the equilibrium phase composition prevails in the system. The diffusivity function was deduced from the experimental results previously obtained in part III (Nankano, Y., Tice, A. and Oliphant, J. Adv. Water Resour. 1984, 7, 28). Despite uncertainty as to the equilibrium phase composition, none of the experimental results contradict the validity of the equation. (Moore-IVI)
W85-04161

SHAPE OF THE NON-STEADY INTERFACE INTERSECTING DISCONTINUITIES IN PERMEABILITY,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
For primary bibliographic entry see Field 2F.
W85-04168

FOURIER INTERPRETATION OF MULTIPHASE AVERAGING THEORY,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 2F.
W85-04172

EVALUATION OF THE BURNS MODEL FOR NITRATE MOVEMENT IN WET SANDY SOILS,
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
For primary bibliographic entry see Field 2K.
W85-04248

DIFFUSION OF UREA, AMMONIUM AND SOIL ALKALINITY FROM SURFACE APPLIED UREA,
Oxford Univ. (England). Soil Science Lab.
For primary bibliographic entry see Field 2K.
W85-04249

WETTING AND DRYING OF A GRAZED AND UNGRAZED CLAY SOIL,
Birkbeck Coll., London (England). Dept. of Geography.
I. Reid, and R. J. Parkinson.
Journal of Soil Science, Vol. 35, No. 4, p 607-614, December, 1984. 4 Fig, 25 Ref.

Descriptors: *Wetting, *Drying, *Clay soil, *Grazing, Soil water, Desiccation cracks, Topsoil, Seasonal variation, Rainfall infiltration, Soil structure, Diffusion.

A 4 year field experiment clearly demonstrates the role played by desiccation cracks in the redistribution of rainfall during the autumn re-wetting of a Windsor Series clay soil. Where topsoil structure is damaged by the trampling of grazing animals, cracks are well developed and a portion of rain water is diverted down them, by-passing the topsoil. Redistribution takes place from two centers, the bottom of the cracks and the surface. But

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where structure is unaffected by trampling, the soil accommodates seasonal shrinkage without cracking and redistribution is by diffusion from the surface only. Summer evaporation is shown to be linearly related to Penman's potential evapotranspiration over a wide range of soil moisture deficits, and simple constants are provided to correct E sub t to obtain E sub A. The M.A.F.F. (Ministry of Agriculture, Fisheries and Food) method of estimating evapotranspiration is shown to be too conservative and fails to identify the October maximum soil moisture deficit common in this soil. (Author's abstract)
W85-04250

COMPARISON OF SOIL-WATER HYSTERESIS MODELS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. B. Jaynes.
Journal of Hydrology, Vol. 75, No. 1/4, p 287-299, 1984/1985. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Hysteresis, *Soil water, Pumping, Wetting, Drying, Mathematical models, Simulation, Model studies.

Four methods for calculating the hysteretic differential soil-water capacity are described and compared. The methods included three procedures used in earlier studies and a fourth method that uses the slope of the soil-water characteristic. The methods were chosen because they are easy to use and require only the main hysteresis curves of the soil-water characteristic to generate all higher-order curves. Two methods, the Point and Slope methods, showed considerable pumping when the soil-water pressure was cycled between -36 and -25 cm for a typical soil. These methods would not be satisfactory when numerous wetting-drying cycles are to be modeled. None of the methods was consistently better than the others for simulating primary wetting or drying curves for three test soils. Also, each method performed equally well when used as part of a numerical model for simulating hysteretic flow. However, because of the simplicity of use and limited storage requirements, the Linear method appears to be the method of choice for calculating the hysteretic differential soil-water capacity for most modeling applications. (Author's abstract)
W85-04278

SIMILARITY AND FIRST-INTEGRAL SOLUTIONS FOR AIR AND WATER DIFFUSION IN SOILS AND COMPARISON WITH OPTIMAL RESULTS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
G. C. Sander, J. Y. Parlange, W. L. Hogarth, and R. D. Braddock.
Soil Science, Vol. 138, No. 5, p 321-325, November, 1984. 1 Fig, 1 Tab, 15 Ref, 1 Append.

Descriptors: *Air diffusion, *Soil water, *Mathematical analysis, *Diffusion, Optimization.

In the absence of gravity, first integral techniques can be used to predict, exactly, water intake in soils when air movement is included, for special forms of the soil-water properties and for specific boundary conditions without the need for extensive numerical iteration. Optimization can also be used to predict, approximately but under more general conditions, water intake in the soil, providing a basis for comparison with the first integral results. The present analysis shows that for the same water pressure at the surface, water intake decreases when air is taken into account, though for the same water content at the surface, water intake is actually greater. (Author's abstract)
W85-04343

USING SOIL PHYSICAL PROPERTIES TO ESTIMATE HYDRAULIC CONDUCTIVITY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. B. Jaynes, and E. J. Tyler.
Soil Science, Vol. 138, No. 4, p 298-305, October, 1984. 2 Fig, 5 Tab, 26 Ref.

Descriptors: *Permeability coefficient, *Soil water, Soil properties, Soil texture, Sand, Silt, Bulk density, Porosity, Soil types.

Hydraulic conductivity of a coarse-textured C horizon was measured at 15 sites. The hydraulic conductivity over the soil water potential range of 0 to -10 kPa was measured in situ with crust test method, and the data were fit to a simple empirical equation. The resulting regression coefficients were found to be significantly correlated at the 1% confidence level with the percentage of sand, percentage of silt, bulk density, and porosity of the soil. An equation based only on the sand content of the soil was developed that described 83% of the hydraulic conductivity variation. The equation also successfully described the hydraulic conductivity of a soil with similar physical properties, but was inadequate when applied to a fine-textured soil. The technique shows potential of serving as an easy, reliable, and accurate means for estimating soil hydraulic conductivity. (Author's abstract)
W85-04345

ESTIMATED SOIL WATER RESERVES APPLICABLE TO A WHEAT-FALLOW ROTATION FOR GENERALIZED SOIL AREAS MAPPED IN SOUTHERN SASKATCHEWAN,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
R. DeJong, J. A. Shields, and W. K. Sly.
Canadian Journal of Soil Science, Vol. 64, No. 4, p 667-680, November, 1984. 5 Fig, 6 Tab, 32 Ref.

Descriptors: *Soil water, *Wheat, *Saskatchewan, *Crop rotation, Fallowing, Drought.

Long-term mean soil water reserves for a spring wheat-fallow rotation in the southern half of Saskatchewan were calculated using the Versatile Soil Moisture Budget. Four different available water-holding capacity classes and climatic data from 53 stations were used as input to the model. Soil water reserve data for the following times, seeding on 1 May in the crop year, at heading on 30 June, and on 1 May in the fallow year, were mapped. These were then combined with an available water-holding capacity map to portray in a single map the combined droughtiness due to climatic and soil attributes. Estimated soil water reserves compared well with measured data from one location in the Brown soil zone. The temporal and spatial changes in water reserves are discussed and related to summerfallowing. The maps provide information for use in making potential grain yield estimates. (Author's abstract)
W85-04355

2H. Lakes

SCATTERING AND ABSORPTION OF LIGHT IN ONONDAGA LAKE,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, M. C. Wodka, and S. D. Field.
Journal of Environmental Engineering, Vol. 110, No. 6, p 1134-1145, December, 1984. 2 Fig, 1 Tab, 30 Ref.

Descriptors: *Onondaga lake, *Light absorption, *Light scattering, Temporal distribution, Absorption, Lakes, Water quality, Transparency.

A reasonable first step to providing a reliable mechanistic basis for lake management focusing on transparency is to quantify the relative contributions of attenuating substances to existing attenuating conditions. Execution of in-lake light measurements and rather routine lab analyses plus the application of a simple model framework presented herein are usually sufficient to help in this type of study. The necessary data to be collected includes: up- and down-welling irradiance, chlorophyll a, phaeophytin, turbidity, and spectrophotometric absorption. The approach is mechanistically attractive as it is based on the accurate partitioning of light attenuation between the fundamental processes of absorption and scattering, and is expected to be broadly applicable. The approach of this method to hypereutrophic Onondaga Lake provided valuable insights for lake management. Nearly 40% of the attenuation during the stratification period of 1978 was due to light scattering. The analysis of the relative contributions of attenuating substances to these processes was necessarily more speculative, as the data were in some cases nonsynoptic or fragmentary, and thus was limited to time averaged conditions. The evaluation indicates that there were at least two significant attenuating components other than phytoplankton in Onondaga lake, calcite precipitate and dissolved yellow substances. Thus substantial improvements in transparency in the lake may be achieved by management efforts other than reduction of the loading of phytoplankton nutrients. The magnitudes, dynamics, and interaction of these components need to be substantiated for Onondaga Lake with an appropriate synoptic data set, and should be investigated for other lakes of different attenuating characteristics. Further, the relative importance of internal versus external sources of attenuating substances should be investigated for a range of systems to assist in the identification of manageable fractions. (Baker-IVI)
W85-03805

EXAMINATION OF RECENT FIELD DATA ON STREAM REAERATION,
Wright-McLaughlin Engineers, Denver, CO.
For primary bibliographic entry see Field 2E.
W85-03808

INTRASPECIFIC RESOURCE PARTITIONING BY YELLOW PERCH (PERCA FLAVESCENS) IN A STRATIFIED LAKE,
Iowa Cooperative Fishery Research Unit, Ames.
M. B. Sandheinrich, and W. A. Hubert.
Canadian Journal of Fish and Aquatic Sciences, Vol. 41, No. 12, p 1745-1752, December, 1984. 2 Fig, 6 Tab, 44 Ref.

Descriptors: *Population dynamics, *Fish, *Stratified lakes, Lakes, Stratification, Perch, Seasonal variation, Thermoclines.

Resource use by different sexes and size classes of yellow perch inhabiting the littoral and limnetic zones of a stratified glacial lake was investigated. Specifically, the relative importance of food and habitat partitioning in reducing niche overlap was investigated and the effects of thermocline formation on resource use was assessed. Size classes spatially segregated into different habitats, but not different depths within a habitat type. Segregation of sexes at different depths was observed with females occupying warm, shallow areas, whereas males were more common in cool, deep water Formation of an anoxic hypolimnion restricted perch to the epilimnion in late summer, but patterns of habitat segregation observed prior to thermocline formation were maintained. Food partitioning was relatively unimportant in reducing niche overlap. Spatial segregation of perch size classes and sexes may compensate for high diet overlap between conspecifics and reinforces the importance of habitat partitioning in structuring fish communities. (Baker-IVI)
W85-03826

WIND RESUSPENSION OF SEDIMENTS IN A PRAIRIE LAKE,
Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 2J.
W85-03827

INFLUENCE OF RESERVOIR TRANSIT ON RIVERINE ALGAL TRANSPORT AND ABUNDANCE,
Iowa State Univ., Ames. Dept. of Animal Ecology.
D. M. Soballe, and R. W. Bachmann.
Canadian Journal of Fishing and Aquatic Sciences, Vol. 41, No. 12, p 1803-1813, December, 1984. 6 Fig, 8 Tab, 51 Ref. US Army Corps of Engineers contracts DACW 25-78-C-0077, DACW 25-80-C-0002, DACW 25-80-C-0008, and DACW 25-80-0009. Martin Marietta Energy Systems contract DE-AC05-840R21400.

Descriptors: *Rivers, *Algal growth, *Impoundments, Temperature, Light intensity, Chlorophyll, Nutrients.

The Des Moines River lost 65-75% of its algal standing crop in passing through each of two impoundments and chlorophyll concentrations within both impoundments were 50-90% below the predictions of empirical chlorophyll-nutrient models. Major loss processes were identified as sedimentation of river borne algae and light limitation within the impoundments. A reduction in algal size from upstream to downstream in one reservoir paralleled the loss of algal biomass. Algal losses in each impoundment increased with both increasing retention time and water temperature so that chlorophyll concentration below the dams was uncoupled from the temperature and flow dependence seen in river reaches not influenced by impoundments. In the Des Moines River above the main stem impoundments, the algal concentration is dependent upon water temperature and flow. In-reservoir removal processes that depend upon temperature and retention time tend to weaken or even reverse these patterns in the river below the dams. The reduction in riverine algal transport associated with reservoir transit was cumulative over the two-reservoir series; this reduction can be interpreted as a reset to river head water conditions. (Baker-IVI)
W85-03829

CONTRIBUTION TO THE WETLAND FLORA OF SITAPUR DISTRICT, UTTAR PRADESH,
National Botanical Research Inst., Lucknow (India).
J. K. Maheshwari, and R. P. S. Tomar.
Bombay Natural History Society Journal, Vol. 80, No. 3, p 529-538, December, 1983. 2 Ref.

Descriptors: *Wetlands, *Flora, *Uttar Pradesh, *Sitapur District, *India, Plant populations, Benthic flora.

An account of wetland flora in the Sitapur district, Uttar Pradesh is offered. Such a study encounters an appeciable number of endangered species of plants and animals. These wetlands also support a number of migratory birds from the North European, Arctic and Siberian regions. Thorough explorations of this area were carried out during 1979-1981 with 147 species of angiosperms belonging to 54 families identified as inhabiting the lakes, ponds, pools and marshes in the district. A complete enumeration of the species with their places of occurrence, time of discovery and local names is included. (Baker-IVI)
W85-03830

CORRELATION OF TOTAL AND 'ANGLER-ACCEPTABLE' CRAPPIE STANDING STOCKS WITH LAKE BASIN SLOPES AND SILTATION INDEXES,
Iowa State Conservation Commission, Lewis. Southwest District Office.
K. R. Hill.
North American Journal of Fisheries Management, Vol. 4, No. 4A, p 350-354, Fall, 1984. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Fish management, *Crappie, *Lakes, *Siltation, *Slopes, Sedimentation, Silting, Fish populations, Lake morphology.

Fifty-seven Iowa lakes were classified into five groups using mean basin slopes and adjusted siltation indexes. Crappie standing stocks were estimated in 16 lakes by applying rotenone to two or three small coves in each lake. Classification hierarchical groups were formed using the followng criteria: Group I = mean basin slope (S) 12% or greater and an adjusted siltation index (AI) of 50-250; Group II = S of 7-12% and AI of 50-250; Group III = S below 7% and AI of 50-250; Group IV = S above 7% and AI of 250-600; and Group V = S below 7% and/or very high AI. Mean total crappie standing stock in Group I lakes was estimated at 66 lbs/acre. For Groups II, III, IV, and V lakes the mean total crappie standing stock figures were 65, 108, 104, and 56 lbs/acre, respectively. Group II lakes had more than twice the biomass of crappie of an acceptable size to anglers as lakes in groups I and III. The percent of total crappie biomass that were more than 8.0 inches in length varied from 41% in Group I to 3.0% in Group V. Lakes in groups I and II had 41% of their total crappie standing stock that were of a size acceptable to anglers. There was a significant negative correlation between percentage of acceptable crappie and lake classification. The correlation indicates that lakes in Group I should have nearly 40% of their total crappie standing stock acceptable to anglers while lakes in Group IV should have about 10% acceptable to anglers. (Baker-IVI)
W85-03832

PHOSPHORUS-BASED FISH KILL RESPONSE FUNCTION FOR USE WITH STOCHASTIC LAKE MODELS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W85-03836

LAKE DEVELOPMENT IN THE BOREAL PEATLANDS OF SOUTHEASTERN LABRADOR, CANADA,
Minnesota Univ., Minneapolis. Limnological Research Center.
D. R. Engstrom.
Arctic and Alpine Research, Vol, 16, No. 4, p 447-452, November, 1984. 4 Fig, 1 Tab, 18 Ref. NSF grant DEB 79-13419.

Descriptors: *Labrador, *Newfoundland, *Peat soils, *Lake development, *Lake morphology, Fens, Phosphorus, Iron, Color, Lakes.

One of the most striking features of the boreal peatlands of southeastern Labrador is the pattern of depressions (pools, flarks) and raised areas (ridges, strings) that dissects the surface of many open mires. The shallow circular lakes apparently formed by the coalescence of fen pools and small lake basins through the degradation of intervening peat deposits. Geomorphic evidence suggests that lake development proceeds through three stages: (1) initial deepening and enlargement of pools through peat decomposition, (2) shoreline stabilization by ice-ramparts, and (3) formation of compound lakes through the fusion of adjacent basins. This process is not dependent on permafrost, which is absent from the region. The water chemistry of these peatland lakes is very similar to that found in nearby bedrock-controlled basins except that total phosphorus, iron, and apparent color are significantly higher in the former. This extreme version of paludification provides a striking contrast to classical concepts of hydrarch succession through which lakes are filled rather than formed by the growth of peat. (Collier-IVI)
W85-03842

DENITRIFICATION ASSOCIATED WITH STREAM PERIPHYTON: CHAMBER ESTIMATES FROM UNDISRUPTED COMMUNITIES,
Geological Survey, Menlo Park, CA.
J. H. Duff, F. J. Triska, and R. S. Oremland.
Journal of Environmental Quality, Vol. 13, No. 4, p 514-518, 1984. 3 Fig, 2 Tab, 20 Ref.

Descriptors: *Fluvial sediments, *Denitrification, *Periphyton, Temperature effects, Nutrients, Nitrates.

Denitrification was measured in chamber experiments with undisturbed periphyton mats at in situ temperature and nutrient concentrations. This activity appears to be variable temporally but may contribute significantly toward removal of NO3(-) from fluvial environments. Actual denitrifying activity in stream periphyton would be highly dependent upon the dissolved oxygen concentration within the community. Short-term, in situ experiments with large chambers appear to be an excellent method of assessing streambed periphyton denitrification. Denitrification estimates made with undisrupted periphyton communities at in situ temperature and nutrient concentrations (40-L chambers) were less variable than estimates made with periphyton scrapings in small flasks (room temperature). The calculated diel periphyton-asssociated denitrification rate based on a 14 hr light, 10 hr dark day was 651 micromol N2O/sq m/day. The data suggest denitrification within periphyton mats may contribute toward removal of NO3(-) from N-rich fluvial environments. (Baker-IVI)
W85-03852

EFFECTS OF SEDIMENT TRANSPORT ON DEPOSIT FEEDING: SCALING ARGUMENTS,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2J.
W85-03875

ORGANIC MATTER DIAGENESIS IN FRESHWATER SEDIMENTS: THE ALKALINITY AND TOTAL CO2 BALANCE AND METHANE PRODUCTION IN THE SEDIMENTS OF LAKE WASHINGTON,
Washington Univ., Seattle. School of Oceanography.
K. M. Kuivila, and J. W. Murray.
Limnology and Oceanography, Vol. 29, No. 6, p 1218-1230, 1984. 4 Fig, 5 Tab, 41 Ref. NSF grant OCE 80-18317.

Descriptors: *Lake sediments, *Sediments, *Lake Washington, *Washington, *Organic matter, *Diagenesis, Interstitial waters, Sedimentation, Carbon dioxide, Methane, Alkalinity, Lakes.

The interstitial water chemistry of Lake Washington (Washington) sediments collected with an in situ sampler was studied. Lake Washington is mesotrophic, 87 sq km in area with a maximum depth of 65 m. The depth where the sulfate concentration reaches a low background value appears to delineate a transition within the sediments above and below which profiles of total carbon dioxide, alkalinity, methane, and ammonium are linear, suggesting zones dominated by diffusion separated by a narrow zone of reaction. The increase of alkalinity with depth in the interstitial waters was identified by a stoichiometric model. The largest contribution to this increase was made by ammonium production, followed by iron reduction. The C:N ratio of the decomposing organic matter increases systematically, from 3.9 at 5 cm to over 14 ar 50 cm. The organic matter being decomposed becomes nitrogen-poor with age. About a fourth of the detrital rain of carbon is recycled to the lake as a diffusive flux of carbon dioxide and methane. (Baker-IVI)
W85-03876

EVIDENCE OF ECTOCARPENE AND DICTYOPTERENES A AND C IN THE WATER OF A FRESHWATER LAKE,
Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie.
F. Juttner, and K. Wurster.
Limnology and Oceanography, Vol. 29, No. 6, p 1322-1324, 1984. 2 Fig, 7 Ref.

Descriptors: *Lakes, *Chemical analysis, *Ectocarpene, *Dictyopterenes, Terpenes, Water analysis, Olefins, Volatile compounds, Organic compounds.

Ectocarpene and dictyopterenes A and C were detected for the first time in a freshwater lake during a study of volatile organic substances in the waters of eutrophic shallow Federsee (Germany (F.R.)) These changes were found in only one fortnightly sample during the year, indicating that marked short term chemical changes occur in small lakes, perhaps indicative of some physiological or reproductive changes in an organism or a rapidly reproducing agent rather than the appearance of a new phytoplankton species. While the origin of these substances could not be determined, a common source seems likely due to their synchronous appearance and biosynthetic relationship. The unique behavior of the C-11 olefins among the many other substances such as unsaturated alcohols, aldehydes, ketones, and nor-carotenoids may point to the fact that C-11 olefins play a physiological role in the water body although their source

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and effects remain unknown. The study has demonstrated that short term chemical changes can be detected in small lakes. (Baker-IVI)
W85-03879

WETLANDS IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
P. S. Hampson.
Florida Bureau of Geology, Tallahasse, Map Series 83-W-0946, 1984. 1 Map, 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Wetlands, Land use, Land classification, Land development, *Florida, Maps, *Hydrologic maps.

According to interpretation of satellite remote-sensing imagery taken in 1972-74, wetland was the third largest land cover category in the State of Florida, following only the forest land and agricultural land classifications in total acreage. Wetlands covered more than 8.3 million acres or 21.6 percent of the total area of the State; essentially the same acreage as agriculture. Forested wetland accounted for about 5.3 million acres of the State's wetlands and nonforested wetland about 3 million acres. This report presents a map of the State of Florida portraying the area and location of the wetland and open water areas of Florida during 1972-74 and county acreages of total wetland, forested wetland, and nonforested wetland. It has been estimated that the total loss of wetland in Florida from 1870 to 1971 was about 5.0 million acres. Available data indicate that about 3.0 million acres of this loss occurred between 1955 and 1972-74. Past losses were largely the result of drainage for mosquito control and agricultural development. Since the mid-1960's, however, wetland destruction has resulted primarily from urbanization. (USGS)
W85-03894

CLIMATIC FORCING: EFFECTS OF EL NINO ON A SMALL, TEMPERATE LAKE,
California Univ., Davis. Div. of Environmental Studies.
P. T. Strub, T. Powell, and C. R. Goldman.
Science, Vol. 227, No. 4682, p 55-57, January, 1985. 2 Fig, 25 Ref. NSF grant NSF-BSR 84-09448, NASA grant NAG5-217.

Descriptors: *Climatic forcing, *El Nino, *Water temperature, *Castle Lake, *California, Subalpine lakes, Snowfall, Mixing, Wind, Thermal stratification, Primary productivity.

Temperaturg profiles measured regularly for 21 years reveal the interannual differences in winter-to-summer heat gain in Castle Lake, California, a small subalpine lake. Year-to-year changes in large-scale climatic surface forcing, especially the amount of snowfall from February through April (which determines the date of thaw) coupled with the early heating and wind mixing after thaw, causes this interannual variation. The seasonal thermal structure for years in which the lake gains significantly more or less heat than normal - all of the El Nino years and several others - shows that the depth of the mixed layer and the mixing of heat into the stratified thermocline region control the storage of heat. The temperature of the mixed layer does not reflect abnormal thermal storage. Variations in mixing during early spring, which controls the heat content at Castle Lake, may also affect the annual average of the primary productivity. (Author's abstract)
W85-03972

HYDROLOGIC ANALYSES OF ACIDIC AND ALKALINE LAKES,
Systech Engineering, Inc., Lafayette, CA.
C. W. Chen, S. A. Gherini, N. E. Peters, P. S. Murdoch, and R. M. Newton.
Water Resources Research, Vol. 20, No. 12, p 1875-1882, December, 1984. 7 Fig, 1 Tab, 23 Ref.

Descriptors: *Acid lakes, *Alkaline lakes, *Hydrology, *Panther Lake, *Woods Lake, *New York, Hydrologic models, Groundwater hydrology, Soil horizons, Acid deposition, Watersheds.

Woods and Panther lakes, located within 30 km of each other in the Adirondack Mountains of New York, receive about the same amount of acidic deposition on a per unit area and time basis, and yet Woods Lake is acidic and Panther Lake is alkaline. The watershed characteristics of each lake were analyzed for their capacity to transmit water to the lake through inorganic horizons. Surface runoff recession curves were analyzed to determine the base flow contributions to the lakewater. Changes in groundwater storage in the thick till areas were analyzed for an independent estimate of base flow contributions. Panther Lake water is more alkaline than Woods Lake because a larger proportion of the precipitation falling on the Panther basin passes through deeper soil horizons before entering the lake. The hydrologic analyses support the thesis that flow paths through the watersheds control the acidity of the lakes. (Baker-IVI)
W85-03993

ORGANIC ACTIVATORS AND INHIBITORS OF ALGAL GROWTH IN WATER OF A EUTROPHIC SHALLOW LAKE,
Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie.
F. Juttner, and H. Faul.
Archiv fur Hydrobiologie, Vol. 102, No. 1, p 21-30, November, 1984. 5 Fig, 12 Ref.

Descriptors: *Algal growth, *Eutrophic lakes, *Federsee, *Germany (Federal Republic), Eutrophication, Cyanophyta, Chlorophyta, Seasonal variation.

To determine the growth inhibiting or activating properties of lake water, samples were taken from the Federsee, a shallow eutrophic lake in southwestern Germany. The sampling period lasted from May to October. The occurrence of inhibitory and activating substance was followed useing a growth bioassay with various green and blue-greeen algae. During the course of the year, marked differences were noted in the growth supporting activity of the fractionated and unfractionated lake water. The lipophilic fraction exhibited without exception inhibitory properties while the other fractions were in some cases inhibitory and in other cases growth activating. The inhibiting and activating features of the fractions offered differed significantly over the period of a fortnight indicating high dynamics of the compounds responsible for the action in the water body. Often inhibiting and promoting activities were present in the water simultaneously, the total effect representing the sum of opposing influences. (Baker-IVI)
W85-04055

LIMNOLOGY OF A PERTURBED HIGHLY SALINE CANADIAN LAKE,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
U. T. Hammer, and R. C. Parker.
Archiv fur Hydrobiologie, Vol. 102, No. 1, p 31-42, November, 1984. 5 Fig, 3 Tab, 20 Ref.

Descriptors: *Saline lakes, *Limnology, *Patience Lake, *Saskatchewan, Wind, Chemical analysis, Algae, Manganese, Iron, Diatoms, Heliothermal lakes, Water pollution effects, Mine wastes, Salinity.

In October 1958 operation began at a potash mine at Patience Lake, Saskatchewan. In the extraction process, waste salts are piled up and brine enters at the south end of the lake. Patience Lake is very shallow and exposed to wind action. The salinity of the lake has increased from about 170 in 1966 to as high as 428 g/l in 1981 at similar periods of the year. The increase is attributable to the solution of potash mine tailings. Total phosphorus and orthophosphate tend to be high. Ammonia nitrogen concentrations were very high (9.8 to 49.8 mg/l), while nitrate nitrogen was low at 0.03 to 0.07 mg/l. Iron varied from 4.3 to 10.4 mg/l while manganese varied around 0.80 mg/l. The halophilic green algae Dunaliella salina waas the only organism of importance in 1981-1982. Chlorophyll ranged from 4.2 to 45.6 mg C/cu m. Life is restricted to relatively small cells adapted to living in such a rigorous habitat. The increasing salinity has resulted in a loss of bird life in the area due to decreases in the aquatic animal based food chain. Normally, Patience Lake remains free of ice, in contrast to all other Saskatchewan lakes. With the addition of more salt, Patience Lake may become a heliothermal lake which will permit its use as a heat storage facility which may be practical in a cold climate. (Baker-IVI)
W85-04056

ECOLOGICAL STUDY OF THE MESO AND MACRO FAUNA OF THE LITTORAL REGION OF LAKE KANDY IN SRI LANKA,
Sri Lanka Univ., Peradeniya. Dept. of Zoology.
P. K. de Silva, and K. H. G. M. de Silva.
Archiv fur Hydrobiologie, Vol. 102, No. 1, p 53-72, November, 1984. 6 Fig, 2 Tab, 27 Ref.

Descriptors: *Littoral zones, *Lake Kandy, *Sri Lanka, *Fauna, Fish, Reservoirs, Invertebrates, Aquatic plants, Mollusks, Aquatic insects.

The meso and macro fauna of the littoral region of a small, tropical man-made lake was studied over two years by monthly sampling from Lake Kandy. Lake Kandy was created in 1810-1812 by the last king of Sri Lanka as an ornamental lake. The lake has an area of 18 ha and a maximum depth of 14 m. Water temperature, pH, concentrations of dissolved oxygen and inorganic ions did not vary significantly either from site to site or from month to month. Water temperature varied from 25 to 30 C, pH varied between 7.0 and 7.8, and the concentration of dissolved oxygen varied between 7.0 and 8.0 mg/l during the study. The lake received rains during most of the year, but the main rainy season was from September to December. The annual rainfall was about 200 cm. There was a distinct dry period from January to March. The lake is characterized by the paucity of aquatic macrophytes. The number of animal species present in the littoral region was relatively small, but all the major freshwater phyla were represented. The common invertebrates were shrimp, gastropods, bivalves and insect larvae. The populations of common invertebrates increased following the rains but decreased during the dry period. The increase of populations appears to depend on the availability of more marginal vegetation such as grasses to the animals during the rain when the water level is high. All common species of animals were found at all sampling stations, but their relative abundance varied from station to station. There were only a few species of fish, and the fish fauna was dominated by the recently introduced, foreign species. Two species of Sarotherodon were common and accounted for more than 75% of the total number caught. Although these fish species appeared to breed throughout the year there was a marked increase of the fry during the dry period following the main rainy season. (Baker-IVI)
W85-04057

INVESTIGATIONS ON THE LIMNOLOGY OF SMALL FERTILIZED PONDS (UNTERSUCHUNGEN ZUR LIMNOLOGIE GEDUNGTER KLEINTEICHE),
Technische Univ. Berlin (Germany, F.R). Inst. fuer Oekologie.
G. Heisig-Gunkel, and H. Kausch.
Archiv fur Hydrobiologie, Suppl. 66, No. 2, p 181-213, October, 1984. 11 Fig, 64 Ref.

Descriptors: *Zooplankton, *Productivity, *Ponds, *Fertilizers, Daphnia, Aeration, Nitrogen, Thermal stratification, Wind, Phosphates.

The effects of fertilization on zooplankton development (Daphnia pulicaria) are investigated in small ponds. Addition of 1 mg PO4-P/l as H3PO4 and 5 mg NO3-N/l as Ca(HO3)2 with frequent nitrogen additions leads to an acceptable fertilizing program for this sort of zooplankton. Addition of low concentrations of organic fertilizers leads to no further rise in productivity. After each addition of nitrogen fertilizer, concentration always quickly diminishes due to denitrification. Thermal stratification from light influx and warming was only found in the upper part of the pond. This stratification was small and regularly disturbed within a short time by unfavorable meterological condi-

tions, mainly by the wind. The effect of aeration is mainly seen in quantitative development of phytoplankton, but not in species succession. Aeration leads to increased phytoplankton biomasses and further to rising reproduction and density of the zooplankton population. (Baker-IVI)
W85-04060

COMPARISON OF 1980 LAKE HURON, GEORGIAN BAY - NORTH CHANNEL SURVEILLANCE DATA WITH HISTORICAL DATA,
Canada Centre for Inland Waters, Burlington (Ontario).
R. E. Kwaitkowski.
Hydrobiologia, Vol. 118, No. 3, p 255-266, 1984. 7 Fig, 5 Tab, 20 Ref.

Descriptors: *Lake Huron, *Saginaw Bay, *Georgian Bay, *North channel, *Ontario, *Water quality, Phosphates, Nitrates, Nitrites, Silicates, Chlorophyll a, Water analysis, Statistical analysis.

A statistical regionalization procedure was used to delineate significantly different areas, for a variety of surveillance parameters measured in 1980 in Lake Huron and Georgian Bay-North Channel. The analyses performed were compared with similar analyses done on 1971 (Lake Huron) and 1974 (Georgian Bay-North Channel) data. From the zonation maps it is apparent that Georgian Bay displays virtually identical zonation for both time periods (1980 and 1974) for four of the five parameters studied, with the exception being NO3NO2-N. Georgian Bay continues to be dominated by a single homogeneous zone with the exceptions of the Penetanguishene-Midland and the French River areas, where significantly higher soluble reactive silica (RSiO2), total phosphorus, (TP), and chlorophyll a concentrations are found. The lowest yearly mean concentration of NO3NO2-N occurred in the Penetanguishene-Midland area. The North Channel continues to be a highly variable system. Concentrations of parameters TP and RSiO2 decreased from the St. Mary's River to central Georgian Bay by more than 50%. Lake Huron is still dominated by a large central homogeneous area. The north-south differences in water quality have become even greater in 1980, as compared to 1971. Higher concentrations of TP and RSiO2 continue to enter northern Lake Huron from the St. Mary's River and the North Channel. Significantly lower concentrations of RSiO2 and NO3NO2-N flow into Lake Huron from Lake Michigan. NO3NO2-N concentrations are 40% higher in the main lake as compared to that coming in from Lake Michigan. Even greater nearshore versus offshore differences are noted in 1980 vs 1971, especially in southern Lake Huron. Saginaw Bay continues to greatly influence southern Lake Huron. The effects of the Sarnia-Goderich area on the water quality in southern Lake Huron can now be noted, especially with respect to NO3NO2-N, chlorophyll a and to a lesser extent with TP. (Baker-IVI)
W85-04062

PHYTOPLANKTON PRIMARY PRODUCTION IN A EUTROPHIC COOLING WATER POND,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
P. V. Eloranta, and R. Salminen.
Hydrobiologia, Vol. 118, No. 3, p 267-274, 1984. 6 Fig, 1 Tab, 30 Ref.

Descriptors: *Phytoplankton, *Primary productivity, *Cooling ponds, *Finland, *Vasikkalampi, Eutrophic lakes, Powerplants, Thermal pollution, Temperature effects, Seasonal variation, Diatoms, Mixing, Water circulation.

The effect of longer ice-free periods on the seasonal variation and total annual value of phytoplankton primary production was considered along with the efficiency and productivity of the phytoplankton communities at different water temperatures but constant light. The studied pond, Vasikkalampi, is located in the town Jvyaskyla in central Finland. The pond is slightly eutrophic and its water is used for cooling purposes by a 35 MW thermal powerplant. The cooling water is taken in the middle of the pond and it returns as heated effluent to the northern part, near the surface, about 100 m from the intake pipe. This circulation and warming of the water keeps the pond open throughout the year except during the coldest weeks in the winter when some parts freeze over. The increase of the water temperature was not sufficient to be optimal for the photosynthesis at the radiation in the spring. The phytoplankton biomass starts to increase early in the spring when the zooplankton grazing pressure is still low and the water circulation decreases the sedimentation of algal cells. In autumn the mixing of the pond water by the powerplant keeps the large diatom cells in the eutrophic zone and supports nutrients from the deeper water layers. (Baker-IVI)
W85-04063

LIMNOLOGY OF A DESERTIC TERMINAL LAKE, WALKER LAKE, NEVADA, U.S.A.,
Nevada Univ. System, Reno. Desert Research Inst.
J. J. Cooper, and D. L. Koch.
Hydrobiologia, Vol. 118, No. 3, p 275-292, 1984. 16 Fig, 5 Tab, 72 Ref.

Descriptors: *Terminal lakes, *Limnology, *Walker Lake, *Nevada, Desert regions, Salinity, Fish, Phytoplankton, Zooplankton, Productivity, Saline lakes, Eutrophication.

Past and present limnological characteristics of Walker Lake are reported both for management purposes and because of the lake's intrinsic scientific interest. Walker Lake is a large terminal lake in west-central Nevada, rapidly desiccating and becoming more saline. The total dissolved solids increased from 5650 to 10650 mg/l from 1973 to 1977. The lake is a chlorocarbonate one. As desiccation continues it should have about equal amounts of chloride, sulfate and carbonate in time. The lake appears to be nitrogen limited with regard to algal nutrients. At times the phytoplankton, dominated by Nodularia spumigena, produces noxious blooms. The zooplankton community is depauperate and composed of three species. Fish are limited to three endemic fishes with tui chub, Gila bicolor, dominant. During the summer, the Lahontan cutthroat trout, Salmo clarki henshawi, is restricted to a narrow mid-water zone low enough in temperature and high enough in dissolved oxygen to meet the needs of the fish. (Baker-IVI)
W85-04064

METHOD FOR MEASURING THE RESPONSE OF SEDIMENT MICROBIAL COMMUNITIES TO ENVIRONMENTAL PERTURBATIONS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
A. Furutani, J. W. M. Rudd, and C. A. Kelly.
Canadian Journal of Microbiology, Vol. 30, No. 11, p 1408-1414, November, 1984. 4 Fig, 3 Tab, 14 Ref. National Sciences and Engineering Research Council grant A2671.

Descriptors: *Lake sediments, *Microorganisms, Nitrates, Sulfates, Mercury, Sediments, Lakes, Organic matter, Decomposition, Acidification, Water pollution effects.

A method has been developed for studying direct and indirect responses of microbial processes in lake sediments to environmental perturbations. The sediment incubation system as described is a versatile tool for investigating a variety of ecological problems. Its advantages include continuous monitoring of community activity and the use of multiple replicates which can be manipulated and studied on community and specific process levels. With this approach it is possible to determine if a specific microbial process is affected directly by an environmental perturbation or if an effect is an indirect consequence of a change in the community. It is also possible to investigate adaptation to environmental perturbations. Effects of perturbations at the community level are determined by comparing rates of organic matter decomposition in the control and test systems. At the same time and under the same conditions, rates of specific processes such as mercury methylation and sulfate and nitrate reduction were assayed to see if these processes responded in the same manner as did the activity of the entire community. Acidification did not affect either community activity or nitrate reduction. Decreases were observed in sulfate reduction and mercury methylation which were independent of community activity, suggesting that acidification may affect these two specific processes directly. (Baker-IVI)
W85-04067

TESTING THE BENTHIC LAKE TYPE CONCEPT BASED ON CHIRONOMID ASSOCIATIONS IN SOME FINNISH LAKES USING MULTIVARIATE STATISTICAL METHODS,
Kemira Oy, Espoo (Finland). Research Centre.
P. H. Kansanen, J. Aho, and L. Paasivirta.
Annales Zoologici Fennici, Vol. 21, No. 2, p 55-76, 1984. 11 Fig, 8 Tab, 32 Ref.

Descriptors: *Statistical analysis, *Finland, *Lakes, *Midges, Benthic environment, Trophic levels, Eutrophication, Stratification.

The profundal chironomid associations in 9 Finnish lakes were analyzed using a hierarchical cluster analysis technique in order to test the usefulness of the lake typology of Brundin in the study area. The classification results were evaluated by analyzing the corresponding physico-chemical water quality data with discriminant analysis. The same procedure was also applied with the shallow water associations. The hierarchical classification and discriminant analyses of the benthic fauna and water quality data showed that the lake type system of Brundin is a valid basis for the monitoring of stratified lake basins in the study area. The composition of the profundal chironomid fauna is dependent on the trophic status. The primary mechanism governing the chironomid associations in the profundal is the availability of food. Oxygen depletion and other harmful consequences of the intensified saprobic processes come into effect only in lakes of advanced eutrophy or in some special instances. With multivariate statistical methods, it is possible to take into account the whole association, not just some indicator species. A need to produce a benthic lake typology based on a sublittoral or littoral fauna is apparent from the practical point of view. This kind of typology would provide a more universal basis for the monitoring of Finnish lakes than Brundin's typology is capable of. A study of that type would call for more comprehensive material from all kinds of lakes. (Baker-IVI)
W85-04069

PHYSICAL MODEL STUDY OF LAKE CONSTANCE,
State Univ. of New York at Buffalo. Dept. of Biological Sciences.
K. M. Stewart, and E. Hollan.
Schweizerische Zeitschrift fur Hydrologie, Vol. 46, No. 1, p 5-40, 1984. 18 Fig, 3 Tab, 45 Ref.

Descriptors: *Lake Constance, *Lakes, *Model studies, Stratification, Circulation, Seiches, Storm surges, Hydraulic models, Wind, Tributaries, Water circulation, Mathematical models.

Seiches, frictional damping, and circulation patterns of Lake Constance have been simulated in a rotating hydraulic model. This physical model investigation, mainly qualitative in nature, has been used to predict the response of the prototype to varying stresses of easterly inflows and westerly winds. Two tracing techniques were used, dyed inflows for the scaled Alpenrhein (71% of inflow) and Bregenzer Ach (15% of inflow) tributaries during the homogeneous experiments, and electrical tagging from stripped portions of wires during stratification experiments. These physical model experiments more easily isolate and suggest possible cause and effect in prototype studies. For example, the river-induced flow demonstrates a distinct general reaction to Coriolis effects. The spreading of river water distributed over the whole width of the lake, in the case of no rotation changes with rotation to a narrower flow along the northerly boundary and may be deflected partially at different locations into the open lake. As another example, the influence of minute density differences are readily apparent on the disposition of inflows during non-wind homogeneous experiments. Westerly wind stresses enhance inflow en-

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trainment and may lead to a bifurcated transport in the easterly end of the lake. There is some evidence that the prototype may respond in a similar manner. In both homogeneous and stratified experiments, wind driven displacements tend to dominate over inflows in the development of circulation patterns. A two dimensional mathematical model was also utilized to help provide further insights into the stratified physical model findings and prototype as well as to the effect of various wind stress fields on both. Because of the dynamic nature of water movement in both model studies and the prototype under variable forces, it is questionable whether the earlier classical impression of mean epilimnetic circulation in Lake Constance is representative. (Baker-IVI)
W85-04072

TURBIDITY CURRENTS IN LAKES: OXYGEN-INPUT BY UNDERFLOWING RIVER WATER (TRUBESTROME IN SEEN: SAUERSTOFFEINTRAG DURCH GRUNDNAH EINGESCHICHTETES FLUSSWASSER),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
V. A. Lambert, K. Kelts, and U. Zimmermann.
Schweizerische Zeitschrift fur Hydrologie, Vol. 46, No. 1, p 41-50, October, 1984. 4 Fig, 16 Ref.

Descriptors: *Lakes, *Turbidity, *Oxygen, *Water currents, *Walensee, *Lake Constance, *Switzerland, Suspended solids, Water temperature, Nutrients, Phosphorus, Ecological effects.

The phenomenon of turbidity underflows that penetrate into the deepest waters of lakes is discussed. The literature shows that these currents are usually correlated with increased rates of discharge and suspended-solids concentration in the river that generated them; that in the Walensee and Lake Constance (Switzerland), respectively, mean velocities of 20 and 30 cm/sec with peaks of 50 and 130 cm/sec have been recorded; that the duration of the phenomenon is usually several hours but can be several days; and that currents can occur in any season even in a thermally stratified lake. In 1978, two devices were installed 3 and 7 m above the floor of the Walensee at a lake depth of 85 m to measure currents generated by the Linth river. A turbidity current was registered by both devices simultaneously in the night of 7/13-14/78, demonstrating that the current was at least 7 m high; in addition a temperature increase of a few degrees C occurred. Temperature increases of up to 5 C were recorded during two turbidity currents generated by the Rhine in Lake Constance in summer 1980. The level of oxygen input by these currents can be significant when their frequency is considered: the flood-stage discharge of the Glarner Linth on 7/31/77 is estimated to have introduced 80,000 kg 02 into the Walensee, sufficient to oxidize 65,000 kg organic material (4% of the lake's biomass); and in summer 1977 and 1978, 15 turbidity currents were recorded in the Walensee. The oxygenating effect may be a complement to a previously published hypothesis that nutrients, especially phosphate, could be removed from lake water through adsorption onto suspended clay particles, which would work against eutrophication. In this case, hydraulic structures such as dams and flood-control facilities could promote eutrophication by preventing the occurrence of turbidity currents. (Gish-IVI)
W85-04073

EQUILIBRIUM APPROACHES TO NATURAL WATER SYSTEMS - PART 4; DETERMINATION OF ALKALINITY OF ORGANIC BASES IN AN ANOXIC HYPOLIMNETIC LAKE WATER,
Umea Univ. (Sweden).
For primary bibliographic entry see Field 2K.
W85-04074

ORIGINS AND EFFECTS OF COAGULATION IN LAKES,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
C. R. O'Melia, and K. S. Bowman.
Schweizerische Zeitschrift fur Hydrologie, Vol. 46, No. 1, p 64-85, October, 1984. 7 Fig, 6 Tab, 14 Ref. NSF grant CEE81-21501.

Descriptors: *Lakes, *Coagulation, *Sedimentation, Sediment transport, Model studies, Particulate matter.

A physical model for the transport and deposition of particles in lakes is formulated mathematically, solved numerically, compared with some field results available in the literature, and used to simulate the effects of coagulation and sedimentation in some limnetic systems. The results indicate that the effects of coagulation in lakes depend significantly upon the chemistry of the system, the hydrology of the lake, and the size distribution of particles entering or produced with the lake. Lesser effects are indicated for hypolimnetic depth and particle density. The analyses presented are based on steady-state conditions. Coagulation and sedimentation were least effective in lakes subject to high hydraulic loadings. (Baker-IVI)
W85-04075

HYDROCHEMISTRY OF HIGH ALTITUDE ALPINE LAKES,
Istituto Italiano di Idrobiologia, Novara.
R. Mosello.
Schweizerische Zeitschrift fur Hydrologie, Vol. 46, No. 1, p 87-99, October, 1984. 7 Fig, 3 Tab, 22 Ref.

Descriptors: *Alpine lakes, *Italy, *Chemical properties, Water analysis, Altitude, Nitrates, Nitrogen, Conductivity, Phosphorus, Silica, Nutrients, Bicarbonates, Sulfates, Acidification.

The chemical characteristics of 320 Italian alpine lakes are presented and discussed: 38% of them have low ionic concentration and conductivities below 20 microS/cm; 56% have a conductivity range of 20.1 to 200 micro S/cm, and 6% are characterized by higher solute concentrations, up to 34.5 meq/l, with a corresponding maximum conductivity of 1,265 micro S/cm. The lakes are located at altitudes ranging from 1,800 to 2,700 m above sea level. No strong acid lakes were detected, whle 16 lakes have pH values in the range 5.0-6.0. The acidification tendency of these waterbodies is discussed in relation both to the geological features of their watersheds and to precipitation chemistry. As regards nutrient concentrations, reactive and total phosphorus are present in levels generally below 1 micro g P/liter; ammonia peaks in the range of 0-25 micro g N/liter while nitrate is below 300 micro g N/l in 81% of the samples. Reactive silica concentrations fall in the range of 0-1.5 mg Si/liter in 84% of the cases. (Baker-IVI)
W85-04076

NATURE OF PRIMARY PRODUCTION IN A TROPICAL BACKWATER OF THE SOUTH-WEST COAST OF INDIA,
Kerala Univ., Trivandrum (India). Dept. of Aquatic Biology and Fisheries.
For primary bibliographic entry see Field 2L.
W85-04079

LIMNOLOGY OF BADUA RESERVOIR OF BHAGALPUR, BIHAR,
Bhagalpur Univ. (India).
P. K. Verma, and J. D. Munshi.
Proceedings of the Indian National Science Academy, Vol. 49, Part B, No. 6, p 598-609, December, 1983. 5 Fig, 4 Tab, 28 Ref.

Descriptors: *Badua Reservoir, *Bhagalpur, *Bihar, *India, *Reservoirs, *Fish populations, *Primary production, Phytoplankton, Stratification, Energy transfer, Seasonal variation, Alkalinity, Dissolved oxygen, Silicates, Phosphates, Nitrates.

An account is given of limnological features of Badua reservoir of Bhagalpur, Bihar. The dam was built up in 1963 across a seasonal river called Badua, forming a deep medium size reservoir for irrigation and fish culture. On the basis of seasonal variation of water temperature the reservoir appeared to be of monomictic type having therma stratification during the summer and isotherma condition in the monsoon and winter seasons. The medium was alkaline (7.5-8.1) and the oxyger curve was clinograde (surface = 6.9 mg/1, bottom = 5.6 mg/1) during the summer. The entire wate column was saturated with 80-100% of oxyger throughout the year, suitable for fish culture. Sili cate, phosphate and nitrate were high near deepe zones. The minimum value of primary productivity (0.0188-0.0107 gC/cu m/hr) at 2.0 m depth sug gested the extent of euphotic zone. The Cyanophy ceae and Bacillariophyceae were the dominan groups among phytoplankton whereas Rotifers and Copepods formed the dominant groups among zooplankton. Assessment of fish population by Rounsefell and Everhart was on the basis o number of major carp fingerlings released in the reservoir. During 1978-79, population was estimat ed at 1,81,032 (13,75,843 kg) for Catla catla 1,35,886 (5,02,778 kg) for Labeo rohita and 1,36,860 (8,07,474 kg) for Cirrhinus mrigala. The weight of the fishes captured was in the range o 1.5-12.1 kg. The annual fish production ranged from 0.04-0.07 g/sq m. Catla catla has proved to have the highest efficiencey in transfer of energy from the first and second trophic levels of the reservoir. (Author's abstract)
W85-04080

WATERFOWL POPULATIONS AND LIMNOLOGIC CHARACTERISTICS OF TAIGA PONDS,
Alaska Univ. Museum, Fairbanks.
S. M. Murphy, B. Kessel, and L. J. Vining.
Journal of Wildlife Management, Vol. 48, No. 4, p 1156-1163, October, 1984. 1 Fig, 3 Tab, 37 Ref

Descriptors: *Taiga, *Ponds, *Alaska, *Ducks, *Nutrients, Phosphates, Nitrites, Population density, Species richness.

A study of duck habitat use-patterns and limnology in eastern interior Alaska revealed that ponds hydrologically connected to a creek system had greater use by ducks and higher levels of most nutrients and ions than those hydrologically isolated from a system. Phosphate level was the best limnologic characteristic for discriminating between connected and isolated ponds. Levels of both phosphate and nitrite were highly correlated with levels of duck use, and both emerged in regression equations as predictors of duck species richness (R2 = 0.94) and duck density (R2 = 0.79). Hydrologic connection with a creek system appeared to be the key link in the nutrient dynamics of the system and was reflected in the pattern of habitat use by ducks. (Author's abstract)
W85-04081

ACTIVITIES OF BENTHIC NITRIFIERS IN STREAMS AND THEIR ROLE IN OXYGEN CONSUMPTION,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre
A. B. Cooper.
Microbial Ecology, Vol. 10, No. 4, p 317-334, 1984. 3 Fig, 7 Tab, 27 Ref.

Descriptors: *Nitrification, *Oxygen consumption, *Benthic environment, Bacteria, Ammonium, Nitrate, Water temperature, Hydrogen ion concentration.

The in situ rates of oxygen consumption by benthic nitrifiers were estimated at 11 study sites in streams. Two methods were used: an in situ respiration chamber method and a method involving conversion of nitrifying potential measurements to in situ rates. Estimates of benthic nitrogenous oxygen consumption (BNOC) rate ranged from 0 380 mmol of O2/sq m/day, and BNOC contributed between 0-85% of the total benthic oxygen consumption rate. The activity of nitrifiers residing in the sediments was influenced by O2 availability, temperature, pH, and substrate. Depending upon site, nitrification could approximate either first order or zero-order kinetics with respect to ammonium concentration. The source of ammonium for benthic nitrifiers could be either totally from within the sediment or totally from the overlying

water. Nitrate produced in the sediments could flux to the water above or be lost within the sediment. The sediments could act as a source (positive flux) or sink (negative flux) for both ammonium (-185 mmol/sq m/day to + 195 mmol/sq m/day) and Nitrate (-135 mmol/sq m/day to + 185 mmol/sq m/day). This study provides evidence to suggest that measurements of downstream mass flow changes in inorganic nitrogen forms may give poor estimates of in situ rates of nitrification in flowing waters. (Author's abstract)
W85-04087

BENTHIC BACTERIAL BIOMASS SUPPORTED BY STREAMWATER DISSOLVED ORGANIC MATTER,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
T. L. Bott, L. A. Kaplan, and F. T. Kuserk.
Microbial Ecology, Vol. 10, No. 4, p 335-344, 1984. 4 Fig, 1 Tab, 37 Ref. NSF grant DEB-7921963.

Descriptors: *Biomass, *Benthic environment, *Bacteria, *Dissolved organic matter, *Saw Mill Spring, *Chester County, *Pennsylvania, *Dissolved solids, *Organic carbon, Adenosine triphosphate, Epifluorescence microscopy, Surface sediments, Streams.

The support of bacterial populations in surface sediments by the heterogenous supply of dissolved organic matter (DOM) in overlying water was studied in Saw Mill Spring - a small headwater stream in the White Clay Creek drainage, Chester County, Pennsylvania. Bacterial biomass in surface sediments was measured as a function of dissolved organic carbon (DOC) flux and temperature. Plastic trays placed in troughs were filled with sediment and glass wool filtered spring water was fed into the troughs; the apparatus was covered with black plastic. Bacterial biomass was estimated using epifluorescence microscopic counts (EMC) and ATP determinations during exposure to streamwater containing 1,788 micro g DOC/liter and after transfer to groundwater containing 693 micro g DOC/liter. Numbers of bacteria and ATP concentrations averaged 1.36 x 10 to the 9th power cells and 1,064 ng per gram dry sediment, respectively, under initial DOC exposure. After transfer to low DOC water, biomass estimates dropped by 53 and 55% from EMC and ATP, respectively. The decline to a new steady state occurred within 4 days from ATP assays and within 11 days from EMC measures. A 4 C difference during these exposures had little effect on generation times. The experiment indicated that 27.59 mg/hour of natural DOC supported a steady state bacterial biomass of approximately 10 micro g C/g dry weight of sediment (from EMC determinations). Steady state bacterial biomass estimates on sediments that were previously muffled to remove organic matter were approximately 20-fold lower. The ratio of GTP:ATP indicated differences in physiological condition or community composition between natural and muffled sediments; the higher ratios on the muffled sediments are indicative of a community with higher growth potential than on the natural sediments. DOC in transport in the water column of this small stream supported about 55% of the bacterial biomass in surface sediments. (Collier-IVI)
W85-04088

MODEL OF THE DEVELOPMENT OF PHYTOPLANKTON IN THE UCHA RESERVOIR,
S. V. Bagotskii, V. A. Vavilin, Yu. S. Datsenko, and L. S. Ovchinnikova.
Water Resources, Vol. 10, No. 2, p 182-188, 1983. 5 Fig, 1 Tab, 9 Ref. Translated from Vodnye Resursy, No. 2, p 124-131, 1983.

Descriptors: *Phytoplankton, *Productivity, *Reservoirs, *Ucha Reservoir, *USSR, Seasonal variation, Model studies, Mathematical studies, Diatoms, Cyanophyta, Algae, Phosphorus, Photosynthesis.

A mathematical model of the seasonal dynamics of phytoplankton in the Ucha reservoir was developed. The presence of two peaks is characteristic for the seasonal dynamics of the phytoplankton content in the reservoir. The spring peak is determined by the development of several species of diatoms, and the drop is related to the establishment of stratification of the water masses of the reservoir. The summer peak is determined by the development of blue-green alga. The model includes three independent variables (diatoms, blue-greens, and inorganic phosphorus dissolved in water) and one dependent variable, phosphorus on the bottom. It is assumed that the reservoir can be in two states - a state of mixing and a state of stratification. The model takes into account the following processes: photosynthesis, rate of die-off of algae, rates of uptake of phosphorus during algae growth and release of inorganic phosphorus during their die-off, the rate of settling of algae, the rate of fall of phosphorus to the bottom with the settled algae, the rate of mineralization of algae that settled to the bottom with regeneration of phosphorus, rise of blue-greens in a dormant stage from the bottom, the rate of rise of phosphorus from the bottom, the rate of entry of components of the ecosystem into the reservoir from without, and the rate of removal of algae and phosphorus from the reservoir. The model is written as a system of four differential equations for the rates of variation of the biomass of diatoms and blue-greens, inorganic phosphorus, and phosphorus on the bottom. The main purpose of the model is to investigate the rate of development of algae as a function of the initial phosphorus content in the reservoir and its further entry into it. As a first approximation, the model satisfactorily describes the seasonal dynamics of phytoplankton development. (Baker-IVI)
W85-04097

COMPARISON OF BIOLOGICAL INDICATION METHODS EXEMPLIFIED BY NORTH UKRAINIAN WATER BODIES,
V. V. Polishchuk, I. G. Garasevich, and Yu. I. Onanko.
Water Resources, Vol. 10, No. 2, p 204-210, March-April, 1983. 3 Tab, 15 Ref. Translated from Vodnye Resursy, No. 2, p 152-159, March-April, 1983.

Descriptors: *Hydrobiology, *Lakes, *Rivers, *Ukrainian SSR, *USSR, Zooplankton, Phytoplankton, Zoobenthos, Chemical analysis, Phytoperiphyton, Water analysis.

A complete hydrobiological investigation of Kiev reservoir and the Sozh, Dnepr, Desna, and Snov rivers was carried out for comparing various saprobity systems and indices of various hydrobiological parameters. The resolving possibilities of the tested methods were evaluted with the use of data on phytoperiphyton, phytoplankton, zooplankton, and zoobenthos against the background of the hydrochemical characteristics. The data were used for evaluating the resolving possibilities of the Pantle-Buck method and Sladeckek's modification when indicating water quality on the basis of zooplankton indices. While both methods give similar results, preference should be given to Sladecek's modification because this method produces easily comparable results both in time and in space. It is universal and does not require cumbersome calculations. In the case of water-quality indication on the basis of zoobenthos, the resolving possibilities of the oligochaete method and chironomid index were evaluated in addition to the resolving possibilities of the Kolkwitz-Marsson system and Chandler methods. The weaknesses of the oligochaete and chironomid indices are clearly revealed: insufficiently reliable results are obtained in the cleanest zones. The evaluations of water quality at sampling stations obtained on the basis of data on phytoperiphyton, phytoplankton, zooplankton, and zoobenthos proved to be quite close to each other. (Baker-IVI)
W85-04100

INVESTIGATION OF THE SPACE-TIME VARIABILITY OF PHYSICAL, CHEMICAL, AND BIOLOGICAL INDICES IN RESERVOIRS FOR THE PURPOSE OF THEIR REGIONALIZATION WITH SPECIAL REFERENCE TO THE IVANKOVO RESERVOIR,
A. B. Avakyan, N. G. Dmitrieva, G. L. Margolina, V. P. Saltankin, and L. O. Einor.
Water Resources, Vol. 10, No. 3, p 242-253, May-June, 1983. 4 Fig, 6 Tab, 23 Ref. Translated from Vodnye Resursy, No. 3, p 70-83, May-June, 1983.

Descriptors: *Reservoirs, Physicochemical properties, Water management, Water quality, Efficiency, Design criteria, Spatial distribution, Spatial distribution, Biological properties.

An investigation of the space-time inhomogeneities of indices of reservoir water masses, including physicochemical, is one of the necessary conditions for the most rapid formation and development of the new scientific-methodological direction of increasing the efficiency of using reservoirs on the basis of regionalization, planning, and engineering development. Regionalization of reservoirs is defined as a method of territorial classification on the basis of a formulated criterion or their aggregate in conformity with the purpose of the investigations being undertaken. Investigations of the water mass of a reservoir revealed spatial inhomogeneities of the investigated physicochemical indices. The noted tendencies of inhomogeneities of the spatial distribution over the water area of the investigated physicochemical indices integrally reflect the inhomogeneities of in situ processes on various stretches of the water area of the same water body. Consequently these indices can be used as criteria of regionalization according to water quality. (Baker-IVI)
W85-04104

HYDROLOGIC AND MORPHLOGIC REGIONALIZATION OF FLATLAND VALLEY-TYPE RESERVOIRS,
Yu. M. Matarzin, and Yu. I. Novosel'skii.
Water Resources, Vol. 10, No. 3, p 253-261, May-June, 1983. 1 Fig, 3 Tab, 27 Ref. Translated from Vodnye Resursy, No. 3, p 84-93, May-June, 1983.

Descriptors: *Reservoirs, *Morphology, *Hydrology, *Kama Reservoir, *USSR, Water management, Waves, Wind, Morphometry.

A scheme of hydrologic and morphologic regionalization (HMR) of valley-type reservoirs is proposed. According to the regionalization scheme, the principal pool and large marginal pools, hydrographic regions, and morphometric stretches are distinguished along the length of the reservoir. Within each region and stretch, morphodynamic zones are identified by use of the relationship between the depth, length, and height of a wind wave, and the critical depth of the breaking of the wave. The HMR of the Kama Reservoir represents multistage regionalization with the successive use of different leading factors and is carried out on a genetic-typological basis according to the following scheme: reservoir; pool; region; stretch; zone; subzone. The first stage is individual regionalization with consideration of the width and average depth of the reservoir, in which each of the distinguished taxa has its own characteristics. The second stage is singling out morphodynamic zones according to the degree of effect of wind waves on the bottom, and the third stage is singling out of morphological subzones with consideration of the position of the drowned channels and terrace surfaces and typology of the shores. A combination of two opposite and noninterchangeable types of regionalization is achieved during HMR. By means of HMR it is possible to improve the method of observations, to refine and understand more thoroughly in situ processes, and processes of the interaction of the reservoir with the adjacent territory, to estimate more objectively the resources and potential possibilities of individual parts of reservoirs. Regionalization is acquiring particular importance in connection with schemes of improvement of the technical state and amenities of reservoirs and creating an operating service at them. The results of HMR can help to refine and detail the goals, problems, scope, and methods of operation of the services being organized. (Baker-IVI)
W85-04105

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EVALUATION OF THE EFFECT OF LAKE BALKHASH LEVEL AND ILI RIVER RUNOFF ON STOCK AND CATCHES OF COMMERCIAL FISH SPECIES,
A. P. Eriskovskii, and E. I. Makhniboroda.
Water Resources, Vol. 10, No. 4, p 412-416, July-August, 1983. 3 Fig, 1 Tab, 7 Ref. Translated from Vodney Resursy, No. 4, p 160-165, July-August, 1983.

Descriptors: *Runoff, *Fisheries, *Environmental effects, *Lake Balkhash, *Ile River, *USSR, Water level, Hydroelectric plants, Lake fisheries, Reservoirs.

The development of sectors of the economy in the Ili-Balkhash basin is being accompanied by the intense use of the natural resources of this region, including water. Water-management construction in the basin is related to regulating the river runoff, nonreturnable water withdrawals for irrigation and other needs, and initial filling of reservoirs. Before the 1960s the main commercial species was the common carp and of the other commericial species the marinka and perch predominated. The design and construction of the Kapchagai hydroelectric scheme on the Ili River with a reservoir whose design capacity is about one fourth of the volume of Lake Balkhash made it necessary to evaluate the effect of this scheme and the development of irrigation accompanying it on fishery of the Ili-Balkhash basin. A close correlation between the lake levels and subsequent total catches and carp catches was observed in the period immediately after a rise of the levels (1946-1962) until there was a increase in the proportion of acclimatized introduced species in the catches. After a drop of the lake levels (from 1931 to 1946) the significance of the relation between the levels and catches was considerably less. In Lake Balkhash the effect of changes in the Ili runoff on the size of the fish catches does not depend on the annual distribution of the runoff (within limits of its natural variations). (Baker-IVI)
W85-04127

CHARACTERISTICS OF THE DISTRIBUTION OF ORGANIC MATTER IN MIDDLE DNEPR RESERVOIRS,
A. I. Korableva.
Water Resources, Vol. 10, No. 5, p 429-432, September-October, 1983. 1 Fig, 1 Tab, 20 Ref. Translated from Vodnye Resursy, No. 5, p 64-67, September-October, 1983.

Descriptors: *Reservoirs, *Organic matter, *Distribution, *Dneprodzerzhinsk Reservoir, *Zaporozh'e Reservoir, *USSR, Amino acids, Dissolved solids, Cyanophyta, Phytoplankton, Nitrogen.

The distribution of organic matter in the Dneprodzerzhinsk and Zaporozh'e reservoirs depends on the effect of a number of natural and anthropogenic factors. Using the data obtained on the distribution of organic nitrogen and nitrogenous components of dissolved organic matter (DOM), an attempt was made to elucidate the characteristics of this distribution in each of the indicated reservoirs. In the period of study (1972-4) 19 free and 16 bound amino acids were identified in the DOM. The dynamics of amino acids of DOM in the reservoirs depends on the dynamics and decomposition of phytoplankton, which amounts to 13.9 mg/liter in the Dneprodzerzhinsk reservoir and 7.0 mg/liter in the Zaporozh'e, the bulk of which being composed of blue-green algae. In both reservoirs there is a constant localization of concentration fields of amino acids of DOM and organic nitrogen. Centers of reproduction of blue-green algae and the maximum numbers and biomass of microorganisms are confined precisely to these stretches. The data obtained on the distribution of nitrogenous DOM, being in a certain sense a reserve of inorganic forms of nitrogen, can be used when forecasting the distribution of biogenic elements in the reservoir. (Baker-IVI)
W85-04129

SOME RESULTS OF CALCULATING THE BALANCE OF MINERAL SUBSTANCES OF THE KAMA RESERVOIRS AND ITS STRETCHES,
A. B. Kitaev, T. P. Devyatkova, and E. A. Burmatova.
Water Resources, Vol. 10, No. 5, p 433-439, September-October, 1983. 4 Fig, 1 Tab, 11 Ref. Translated from Vodnye Resursy, No. 5, p 68-74, September-October, 1983.

Descriptors: *Reservoirs, *Kama Reservoir, *USSR, *Morphometry, *Minerals, Hydrological regimes, Chemical analysis.

The Kama reservoir is an important link of the Volga-Kama cascade. The chemical balance of individual regions and characteristic stretches of the Kama Reservoir was compiled, to provide information for ecological monitoring and conservation. The dynamics of the content of mineral substances in the water masses of individual stretches over the entire length of the reservoir was determined and related to the characteristic of its morphometry and hydrologic regime with consideration given to the specific features of each individual morphometric stretch of the reservoir. The method of investigating the balance of chemical substances of morphometric stretches of the reservoirs of the Kama cascade is based on regionalization of the reservoir according to its morphometry, determination of the water balance of stretches of the reservoir on the basis of data of observations of its level regime, determination of the role of the most important hydrodynamic factors in the formation of the hydrochemical regime of morphometric stretches of the reservoir, and determination of the balance of chemical substances in regions and stretches of the reservoir on the basis of actual data on the chemical composition of the water. (Baker-IVI)
W85-04130

STABLE-ISOTOPE METHOD FOR DETERMINING THE WATER BALANCE OF LAKES,
Institute of Nuclear Physics, Krakow (Poland).
A. Zuber.
Water Resources, Vol. 10, No. 5, p 484-489, September-October, 1983. 5 Fig, 13 Ref. Translated from Vodnye Resursy, No. 5, p 124-129, September-October, 1983.

Descriptors: *Lake Bagri, *Krakow, *Poland, *Hydrologic budget, *Isotope studies, Lakes, Tracers, Tritium, Turnover time.

Equations of the balance of natural isotopes can be used for determining the water balance of lakes. The traditional method in this case is based on the assumption of the existence of both anisotopic and hydrologic steady state. Another approach consists in solving short-term balance equations. The most correct approach is a numerical solution of balance equations when the temporal variations of all parameters and possible stratification of the lake are taken into account. The first method is investigated and developed. The experimental part of this work concerns an artificial water body with an inflow and outflow. The water body (Lake Bagri) is located in Krakow, and its turnover time is of interest in connection with its recreational use. The turnover time of the lake was also investigated by means of an artificial tracer. The use of artificial tritium as a tracer was not promising owing to the high moisture content of the atmosphere, which can lead to large losses of the tracer during molecular exchange. The stable-isotope method is the best alternative for this case. (Baker-IVI)
W85-04136

RESERVOIRS AS SPECIAL HYDROLOGIC OBJECTS,
Yu. M. Matarzin.
Water Resources, Vol. 10, No. 6, p 577-585, November-December, 1983. 3 Fig, 24 Ref. Translated from Vodnye Resursy, No. 6, p 108-118, November-December, 1983.

Descriptors: *Reservoirs, *Hydrology, Water management, Forecasting, Geography, Measuring instruments.

Two main types of problems are of concern for reservoirs: the effect of reservoirs on the runoff process, water balance, and water exchange; artificial water bodies themselves and their interaction with the environment. Several main problems are identified related to reservoir hydrology: a need to improve methods of field and permanent hydrologic investigations and observations and of the instruments and equipment being used; organization of combined geographic-hydrologic investigations at a number of reservoirs for studying the system of water body-environment interaction; development of the hydrologic principles artificial water bodies; methods of calculation and forecasting; the relationship and role of zonal and azonal factors in the formation of reservoirs; the hydrological regime of small reservoirs and ponds; and the development of the theoretical principles of reservoir hydrology as a special and specific division of general land hydrology. (Baker-IVI)
W85-04149

MAIN TRENDS IN THE FORMATION OF THE HYDROCHEMICAL REGIME OF DNEPR RESERVOIRS,
A. I. Denisova.
Water Resources, Vol. 10, No. 6, p 601-609, November-December, 1983. 4 Fig, 2 Tab, 6 Ref. Translated from Vodnye Resursy, No. 6, p 156-166, November-December, 1983.

Descriptors: *Dnepr River, *USSR, *Reservoirs, *Chemical properties, Mineralization, Organic matter, Nitrates, Streamflow, Regulated flow, Regulation.

At least six reservoirs have been constructed on the Dnepr River from the mouth of the Pripyat to Novaya Kakhovka. These reservoirs play a major part in regulating the Dnepr runoff. The natural hydrologic and hydrochemical regime of the river before streamflow regulation was formed mainly in its upper stretch to Kiev under the effect of the natural conditions of the basins and tributaries debouching here. Unlike the river, in reservoirs inhomogeneity of all ingredients along the longitudinal axis, area, and depth of the reservoirs and a change in their seasonal and daily dynamics are observed. In this case the hydrochemical regime of upstream and downstream, sluggish and flow reservoirs is different in years different in wetness. Changes occurring in the hydrochemical characteristics of the river water include mineralization and ionic composition of water, the gas regime of the reservoirs, and biogenic and organic substances. (Baker-IVI)
W85-04152

DISPERSION OF MARKED FLUID IN RESERVOIRS,
Liverpool Univ. (England). Dept. of Civil Engineering.
K. H. M. Ali, and D. R. Pateman.
Advances in Water Resources, Vol. 6, No. 4, p 190-199, December, 1983. 15 Fig, 2 Tab, 14 Ref.

Descriptors: *Reservoirs, *Mixing, *Dispersion, *Model studies, Inlets, Outlets, Tangential jets, Radial jets, Conductivity, Fluorimetry.

Mixing in model reservoirs was measured using conductivity and fluorimetric methods. Relationships for predicting reservoir circulation generated by radial and tangential jets show the importance of the reservoir's aspect-ratio, and the Reynolds number of the jet. Concentrations were measured incorporating various inlet and outlet arrangements. Peripheral and radial dispersion-coefficients were obtained, and found to be the same order of magnitude; the use of continuous injection in most of these experiments is justified. These coefficients were dependent on the size of the model and on the local Reynolds numbers. The values of dispersion coefficients for reservoirs are similar to those for one-dimensional open channel flow. Except for small regions near to the outlets and inlets, the flow was in the horizontal plane and the surface velocities were close to those at mid-depth. (Collier-IVI)
W85-04154

PH-RELATED CHANGES IN ATTACHED ALGAL COMMUNITIES OF SOFTWATER LAKES,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5C.
W85-04201

AQUATIC MACROPHYTES AND PH AS CONTROLS OF DIVERSITY FOR LITTORAL CLADOCERANS,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 5C.
W85-04202

ACIDIFICATION AND CHANGES OVER TIME IN THE CHYDORID CLADOCERA ASSEMBLAGE OF NEW ENGLAND LAKES,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 5C.
W85-04203

RESPONSES OF FISH COMMUNITIES TO ACIDIC WATERS IN ONTARIO,
Fisheries and Marine Service, Sault Ste. Marie (Ontario). Great Lakes Biolimnology Lab.
For primary bibliographic entry see Field 5C.
W85-04204

FISH POPULATION RESPONSES TO EXPERIMENTAL ACIDIFICATION OF A SMALL ONTARIO LAKE,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W85-04205

SPECIES COMPOSITION OF FISH COMMUNITIES IN NORTHERN WISCONSIN LAKES: RELATION TO PH,
Columbia National Fisheries Research Lab., La Crosse, WI. Field Research Station
For primary bibliographic entry see Field 5C.
W85-04206

POTENTIAL FOR AQUATIC ECOSYSTEMS ACIDIFICATION IN THE SIERRA NEVADA, CALIFORNIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5C.
W85-04207

GROWTH OF PHENOL-MINERALIZING MICROORGANISMS IN FRESH WATER,
Rutgers - The State Univ., Newark, NJ. Dept. of Zoology and Physiology.
M. E. Rubin, and S. Schmidt.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 11-14, January, 1985. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Phenols, *Microorganisms, *Mineralization, Fungi, bacteria, Nutrients, Most-probable-number, Lakes.

A most-probable-number technique was adapted to enumerate the procaryotic and eucaryotic phenol-mineralizing microoganisms present in samples of fresh water. Phenol mineralization rates were obtained by measuring the amount of exogenous phenol that disappeared from solution over time in the presence or absence of microbial inhibitors. Less than 100 phenol-mineralizing bacteria per ml and 1 phenol-mineralizing fungus per ml were initially present at both 200 pg and 100 micro-g of phenol per ml. Phenol mineralization rates were 3 times greater for the mineralizing bacteria than for the fungi at 200 pg of phenol per ml. Phenol concentrations above 10 micro-g/ml were inhibitory to the microorganisms capable of mineralizing phenol. The phenol mineralizers grew in the water samples in the absence of phenol, indicating that there were sufficient indigenous nutrients in the lake water to support growth. In experiments, 1 ng of phenol per ml was not, but 1 micro-g of phenol per ml was, a sufficient concentration to increase the rate of growth of the mineralizing microorganisms above that obtained with the indigenous nutrients alone. There were no differences for the phenol-mineralizing microorganisms capable of metabolizing 1 ng or 1 micro-gram of phenol per ml in initial numbers, lag phases, growth rates, or final numbers after 24 hr incubation. This indicates that there may be one mesotrophic population that can mineralize phenol at both low and high concentrations, rather than two distinct phenol-mineralizing populations. (Moore-IVI)
W85-04256

SEDIMENT-WATER EXCHANGE IN LOUGH ENNELL WITH PARTICULAR REFERENCE TO PHOSPHORUS,
Foras Forbartha, Dublin (Ireland).
L. J. Lennox.
Water Research, Vol. 18, No. 12, p 1483-1485, 1984. 4 Ref.

Descriptors: *Phosphorus, *Lake sediments, *Lough Ennell, *Ireland, Eutrophic lakes, Iron, Citrate dithionite bicarbonate, Aluminum, Calcuim carbonate, Manganese, Internal load.

The significance and evaluation of sediment phosphorus in the continuing eutropic conditions noted in Lough Ennell was assessed. A high positive correlation exists between the concentrations of total Fe, citrate dithionite bicarbonate (CDB) extractable Fe, organic content, total Al and a number of phosphorus fractions (total P, inorganic P, apatite P and CDB extractable P) for all samples recovered. A significant inverse correlation was noted between CaCO3 and most of the other parameters measured whereas no correlations were found for Mn. The sediment adsorption capacity for orthophosphate was found to be about 450 micro-g P/g sediment. Phosphate release from hypolimnetic anaerobic sediments was considered unimportant in the biological sense due to the lack of mobility of this nutrient to the photic zones. Bioavailable P in the littoral zones (assumed to be non-apatite inorganic phosphorus (NAIP) comprised 14.5 tons in the uppermost 2 cm sediment layer, which is about 2.5 times the average annual external total P load. Littoral zone sediments, which are normally aerobic, accounted for an internal areal loading of 134 mg P/sq m/yr which is equivalent to 17 and 30% of the average external total P and inorganic P loadings respectively. This internal loading is a major contributory factor in the continuing eutrophic status of the lake. (Author's abstract)
W85-04294

SIMPLE GRAVITY CORER AND CONTINUOUS-FLOW ADAPTOR FOR USE IN SEDIMENT/WATER EXCHANGE STUDIES,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 7B.
W85-04300

STREAM PRODUCTIVITY ANALYSIS WITH DORM - I; DEVELOPMENT OF COMPUTATIONAL MODEL,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
J. S. Gulliver, and H. G. Stefan.
Water Research, Vol. 18, No. 12, p 1569-1576, 1984. 4 Fig, 25 Ref. EPA grant R-804736-01-1.

Descriptors: *Stream biota, *Productivity, *Dissolved oxygen, Photosynthesis, Respiration, Mathematical models, Solute transport, Dispersion, Water temperature, Wind.

A numerical dissolved oxygen routing model (DORM) is developed to determine total stream community photosynthesis (P) and community respiration rates (R) through iterative routing of two-station diel DO measurements. The model differs from existing procedures for diel curve productivity analysis; it uses the complete stream DO transport equation, including longitudinal dispersion, dependence of respiratory rate on water temperature and dissolved oxygen and wind dependent oxygen transfer through the water surface. The model, DORM, is more accurate than the traditional graphical procedures of diel curve analysis and is simple to apply. DORM is also valuable in an analysis of the results' sensitivity to the numerous coefficient and parametric assumptions required in diel curve analysis. The model is not a predictive DO model, but is designed for the interpretation of DO measurements in a stream, channel or river. (Author's abstract)
W85-04304

STREAM PRODUCTIVITY ANALYSIS WITH DORM - II; PARAMETER ESTIMATION AND SENSITIVITY,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
J. S. Gulliver, and H. G. Stefan.
Water Research, Vol. 18, No. 12, p 1577-1588, 1984. 11 Fig, 4 Tab, 20 Ref. EPA grant R-804736-01-1.

Descriptors: *Dissolved oxygen, *Stream biota, *Productivity, Mathematical models, Respiration, Hydraulic residence time, Aeration, Reaeration coefficient, Water temperature, Dispersion.

The dissolved oxygen routing model DORM, which determines productivity and respiration of a stream biological community, requires in addition to stream geometry and stream flow, parameter values for reaeration coefficients and temperature and dissolved oxygen (DO) limitations on respiration. Illustrated are the methods used to obtain numerical values in a field study at the U.S. EPA Monticello Ecological Research Station. The calculated community productivity and respiration rates are sensitive to certain input parameters and assumptions. Analysis showed that, among the many parameters needed, hydraulic residence time and reaeration coefficients should be determined with utmost care. Other sensitivity tests included temperature effects, half-saturation values and longitudinal dispersion. (Author's abstract)
W85-04305

STREAM PRODUCTIVITY ANALYSIS WITH DORM - III; PRODUCTIVITY OF EXPERIMENTAL STREAMS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
J. S. Gulliver, and H. G. Stefan.
Water Research, Vol. 18, No. 12, p 1589-1595, 1984. 8 Fig, 1 Tab, 24 Ref. EPA grant R-804736-01-1.

Descriptors: *Productivity, *Stream biota, *Dissolved oxygen, Mathematical models, Photosynthesis, Respiration, Seasonal variation, Diel variation, Hydrogen ion concentration, Hysteresis.

Thirty-two two-station diel dissolved oxygen surveys were made in the experimental streams of the U.S. EPA Monticello Ecological Research Station. The data were analyzed by a numerical Dissolved Oxygen Routing Model (DORM) to determine total community respiratory and photosynthetic rates. The artificial channels consisted of pools and riffles and had pH of 8.0, 6.3 and 5.4. Community photosynthetic production and respiration ranged from highs of 14.8 and 10.7 g/sq m/day to lows of 1.5 and 2.6 g/sq m/day between June and September 1979. P/R ratios varied from 2.1 in May to 0.6 in August. Seasonal trends were affected by pH and/or age of the channel. The channels also exhibited large diel variations in photosynthetic efficiency, where dependence of photosynthetic production upon light was nonlinear and had a strong hysteresis. This hysteresis cannot be explained by physical processes and is attributed to several biological processes. (Author's abstract)
W85-04306

DISCOVERY OF PERMANENT AMAZON LAKES AND HYDRAULIC DISTURBANCE IN THE UPPER AMAZON BASIN,
Ohio State Univ., Columbus. Dept. of Zoology.
P. A. Colinvaux, M. C. Miller, K.-B. Liu, M. Steinitz-Kannan, and I. Frost.

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Nature, Vol. 313, No. 5997, p 42-45, January, 1985. 1 Fig, 4 Tab, 15 Ref.

Descriptors: *Amazon Basin, *Lakes, *Ecuador, Limnology, Flooding, Crater lakes, Chemical properties, Plankton, Thermal stratification, Productivity.

The first autonomous permanent deep lakes in the Amazon lowlands were found in field surveys in the summers of 1982 and 1983. The six lakes are in the rain forests of Ecuador in western Amazonia, within 100 km of the Andes mountains, but at elevations below 700 m. The lakes occupy either deep abandoned channels of high energy rivers or closed volcanic basins. Data are given on the plankton, water chemistry, productivity, thermal stratification and light penetration. In both the riverine and crater lakes, the prime determinants of productivity are allochthonous. Sedimentary histories and pollen data over several millennia from these lakes record disturbance of the Amazonian ecosystem by flooding, encouraging the view that high Amazonian species-richness is maintained by non-equilibrium processes. (Baker-IVI)
W85-04307

SEASONAL GROWTH AND COMMUNITY COMPOSITION OF PHYTOPLANKTON IN A EUTROPHIC WISCONSIN IMPOUNDMENT,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
J. W. Barko, D. J. Bates, G. J. Filbin, S. M. Hennington, and D. G. McFarland.
Journal of Freshwater Ecology, Vol. 2, No. 6, p 519-533, December, 1984. 5 Fig, 1 Tab, 44 Ref.

Descriptors: *Phytoplankton, *Algal growth, *Eau Galle reservoir, *Wisconsin, Reservoirs, Diatoms, Dinoflagellates, Cyanophyta, Silica, Nitrogen, Eutrophic lakes, Mixing, Species composition.

During 1981 the seasonal growth and community composition of phytoplankton were investigated at six sampling stations in Eau Galle reservoir, a shallow eutrophic basin located in central Wisconsin. Eau Galle was strongly dominated by diatoms (spring and fall), and co-dominated by cyanophytes and dinoflagellates (summer). Three species (Stephanodiscus hantzschii Grun., Aphanizomenon flos-aquae (L.) Ralfs, and Ceratium hirundinella (O.F.M.) Schrank) collectively contributed about 50% of total annual phytoplankton biomass. Phytoplankton response was quite similar at open water sampling stations, but differed at a station in the littoral zone and at another located near the mouth of the primary inflowing river. Depressed epilimnetic silica concentrations occurred during spring and fall periods of diatom growth. The development of nitrogen-fixing cyanophyte populations during the summer reflected reduced dissolved inorganic nitrogen availability. Midsummer mixing events reduced water column stability. Shifts in the phytoplankton species composition of Eau Galle appeared to occur in response to major changes in water column stability. (Author's abstract)
W85-04311

RELATIONSHIPS BETWEEN PHOSPHORUS FUNCTIONAL CLASSES AND ALKALINE PHOSPHATASE ACTIVITY IN RESERVOIR LAKES,
Oklahoma State Univ., Stillwater. Dept. of Botany and Microbiology.
D. A. Francko.
Journal of Freshwater Ecology, Vol. 2, No. 6, p 541-547, December, 1984. 3 Fig, 16 Ref.

Descriptors: *Phosphorus, *Reservoirs, *Alkaline phosphatase, Enzymes, Eutrophic lakes, Phosphate esters, Oklahoma.

Dissolved phosphorus fractions present in the surface waters of a eutrophic reservoir lake in north-central Oklahoma were characterized by chemical, enzymatic, and chromatographic techniques. Simultaneous measurements of alkaline phosphatase activity (APA) were also conducted on each lakewater sample. An inverse biphasic linear relationship was found between soluble reactive phosphorus concentrations (SRP) and APA on a seasonal basis. Phosphomonoesters (PME) comprised from 0-65 percent of the soluble unreactive phosphorus (SUP) pool and an inverse linear relationship was found between PME concentrations and APA on a seasonal basis. Gel filtration chromatography of filtered lake water from the above system and a mesotrophic lake exhibiting high clay turbidity supported the view that the majority of complex phosphorus in these systems existed as low molecular weight phosphate esters. (Author's abstract)
W85-04313

CHARACTERISTICS AND FREQUENCY OF COOL-WATER AREAS IN A WESTERN WASHINGTON STREAM,
Weyerhaeuser Co., Centralia, WA. Centralia Research Center.
R. E. Bilby.
Journal of Freshwater Ecology, Vol. 2, No. 6, p 593-602, December, 1984. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Streams, *Water temperature, *Cool-water areas, *Thrash Creek, *Washington, Seeps, Tributaries, Dissolved oxygen.

Causes, sizes, frequency and level of temperature depression were determined in Thrash Creek, a fifth-order tributary of the Chehalis River in the Coast Range of western Washington. Four distinct types of cool-water areas were located during this midsummer survey. These areas were termed lateral seeps, pool bottom seeps, cold tributary mouths and flow through the bed, depending upon the entry point and source of the cool water. Lateral seeps were the most common on Thrash Creek, accounting for 64% of the cool water areas located. Five of the cool water areas were pool bottom seeps, 5 were caused by flow through the bed, and four were formed by tributaries. Temperatures in the cool water areas averaged 4.7 C lower than ambient streamwater on warm afternoons. Thirty-nine such spots were found on a 3.5 km reach of the study stream. They accounted for 1.6% of the surface area and 2.9% of the water volume on this stretch of stream. No evidence was seen to indicate that slower heating of deeper water compared to surface water caused the formation of cold-water pockets. Dissolved oxygen concentrations measured in three cool water areas were lower than the ambient stream water, with a lateral seep exhibiting the lowest average level of about 50% saturation, compared with 98% saturation in the adjacent streamwater. Oxygen levels in an area fed by flow through the bed and a pool bottom seep had higher average concentrations of dissolved oxygen than the lateral seep but they were still depressed below concentrations in the stream water. (Moore-IVI)
W85-04315

FISH PRODUCTION IN OUED SEBAOU, A SEASONAL RIVER IN NORTH ALGERIA,
Lodz Univ. (Poland). Inst. of Environmental Biology.
T. Penczak, and M. Molinski.
Journal of Fish Biology, Vol. 25, No. 6, p 723-732, 1984. 2 Fig, 6 Tab, 25 Ref.

Descriptors: *Oued Sebaou, *Algeria, *Fisheries, *Productivity, *Seasonal rivers, Eels, Barbels, Water temperature, Population density, Biomass.

The Oued Sebaou is a seasonal river in North Algeria which has a range of discharge from from 300 cu m/s in the peak of the rainy season to 0.1 cu m/s at the end of the dry season. Extensive gravel extraction from the river bed takes place during the dry season when the middle of the 150 m wide river bed is used as a road for cars, cattle and sheep. Fish were sampled by electrofishing on June 9, 10, and 11, 1982, at three contiguous sites 26 km from the source of the river. At the time of sampling, the study area did not exceed 20 m in width and flowed close to one side of the river bed. Water temperature on June 10th ranged from 18 C at 04.00 hours to 31 C at 16.00 hours in flowing water and 36 C in the pools. Mean water discharge for the three sites at the time of sampling was 1.2 cu m/s and ranged from 1.1 to 1.38 cu m/s. Two species were recorded at each site: Barbus callensis, which is heavily fished locally, and An guilla anguilla. The three sample maximum likel hood Zippin method was used to estimate mea density and standing crops, which were: barbe 452 fish/ha, 5.33 kg/ha, eels, 149 fish/ha 3.04 kg ha. Estimated average biomass and productio were: barbel, 2.31 kg/ha, 4.27 kg/ha/year; eel 1.51 kg/ha, 2.60 kg/ha/year. Extreme temper tures, the lack of oxygen, and the lack of wate during the several months of the dry season ar factors, next to importance to the continual inter sive fishing, in limiting the fish stock. (Collier-IVI
W85-04318

DECOMPOSITION OF EMERGENT MACRO PHYTES IN FRESH WATER,
N. V. C. Polunin.
Advances in Ecological Research, Vol. 14, p 11 166, 1984. 6 Fig, 282 Refs.

Descriptors: *Emergent plants, *Macrophyte *Decomposition, *Reviews, Detritus, Litter, Di solved organic matter, Microbiological studie Swamps, Aquatic plants, Aquatic animals.

Processes of carbon flux involved in decompos tion are reviewed. Beginning with a description the sources of emergent plant organic matte reaching fresh water, what happens to this materi is assessed, particularly in terms of the agents decomposition, of how they act, and of how the change, thus influencing the detritus itself, ove time. The fate of the dissolved and particula material is treated separately as its characteristic tend to be different from those of the litter. Effec of macroinvertebrate animals are mentioned some detail, while distinctive environmental fe tures of emergent macrophyte swamps are d scribed and an attempt made to assess how decom position there may be a significant element in th functioning of freshwater systems. Specific topic discussed include sources of detritus, colonizatio by aquatic organisms, decomposition of the litte effects of animals on litter decomposition, chemic changes in the litter, decomposition of dissolve and particulate matter, the swamp environmen and the fate of detritus. (Baker-IVI)
W85-04320

RESULTS OF LIMNOLOGICAL RESEARC AND THEIR APPLICATION IN WATER-MAN AGEMENT PRACTICE (ERGEBNISSE LIMNO LOGISCHER FORSCHUNG UND IHRE AN WENDUNG IN DER WASSERWIRTSCHAFTL CHEN PRAXIS),
H. Klapper.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 1 p 426-428, December, 1983. 11 Ref.

Descriptors: *Limnology, *Water managemen *Germany (Democratic Republic), *Darss-Zinge Bodden, *Stechlin, *Berlin, *Meggelsee, *Saide bach dam, Water quality standards, Nitrate remov al, Oxygen, Aeration, Destratification.

The contribution of limnological research water-management practice in the German Demo cratic Republic (GDR) is based on a two-pronge orientation: toward reductionist studies at the ce lular level combined with holistic investigations the ecosystem level. Water-management profe sionals are interested in not only the effects individual organisms on the ecosystem but als their effects on water quality. Future research wi concentrate on biological phenomena. Current re search concentrates on four main inland-wate areas in the GDR from north to south. Interna circulation of matter and water-sediment relatio ships are being studied in the shallow predominan ly nitrogen limited Darss-Zinger Bodden chai Research is being conducted on the causal relatio ships between nutrient supply and primary produc tion in the deep, predominantly phosphorus-limite clear-water lakes of the Stechlin area the Berli lakes, with emphasis on the Muggelsee, since provides drinking water for the city (future re search should cover hydraulic/hydrological an meteorological influences). The Saidenbach-da region plus comparison lakes with varying troph conditions are being studied to determine the lin between use of the catchment area/extent of da

construction on bioproduction, the relationship between phoshorus and primary production, and biomanipulation as an instrument of water-quality control (control of algae by stocking with preying fish and promotion of zooplankton). Practical applications of research have included providing information to set water-quality standards used in the 1982 Water Law; work on surface-waters-protection standards; and development of ecotechnological procedures for nutrient-precipitation in lakes, control of oxygen concentration by gyro- or vortex aeration and pressurized-air destratification, nitrate-elimination in reservoirs, and deep-water removal to induce oligotrophy. Ecosystem modeling has also been an area of emphasis. (Gish-IVI)
W85-04323

GEOCHEMISTRY OF THE ONYX RIVER (WRIGHT VALLEY, ANTARCTICA) AND ITS ROLE IN THE CHEMICAL EVOLUTION OF LAKE VANDA,
Miami Univ., Oxford, OH. School of Interdisciplinary Studies.
W. J. Green, and D. E. Canfield.
Geochimica et Cosmochimica Acta, Vol. 48, No. 12, p 2457-2467, December, 1984. 1 Fig, 7 Tab, 28 Ref. NSF grant DPP 792060.

Descriptors: *Onyx River, *Lake Vanda, *Victoria Land, *Wright Valley, *Antarctica, *Glacial streams, *Glaciohydrology, *Chemical composition, Geochemistry, Chlorides, Sodium, Magnesium, Carbonates, Saline water, Brines.

The largest of the meltwater streams in the ice-free desert valleys of southern Victoria Land (Antarctica) is the Onyx River, in Wright Valley, which originates in the vicinity of the Wright Lower Glacier. The river has a depth of less than one half meter and a channel several meters wide. Onyx River supplies Lake Vanda with water over a six to eight week period, from mid-December to early- or mid-February. A permanent ice-cover about four meters thick covers the lake's surface, except near the shoreline where an annual moat develops during the warmest weeks of the austral summer. The river acquires a significant fraction of its salt content when glacial meltwaters contact Wright Valley soils at Lake Brownworth and the concentration of all ions increase with distance along the 28-km channel down to Lake Vanda. In spite of the large salt input from this source equilibrium evaporation of Onyx River water would have resulted in early calcite deposition and in the formation of a Na-Mg-Cl-HCO3 brine rather than in the Ca-Na-Mg-Cl waters observed in Lake Vanda. The river alone could not have produced a brine having the qualitative geochemical features of the lower saline waters of Lake Vanda. It is proposed that the Vanda brine is instead the result of past (> 1200 yrs BP) mixing events between Onyx River inflows and calcium chloride-rich deep groundwaters derived from the Don Juan Basin. The mixing model presented here shows that the Onyx River is the major contributor of K, HCO3, SO4, and (possibly) Mg found in the lake and a significant contributor (approximately one half) of the observed Na. Calcium and Cl, on the other hand, came largely from deep groundwater sources in Don Juan Basin. All concentrations except Mg are well predicted by this model. The evidence does not support significant present-day influxes of shallow groundwater. The composition of the upper waters of Lake Vanda is the result of ionic diffusion from the pre-formed brine, coupled with Onyx River inflows. Since ionic ratios are well predicted by this simple model, shallow inflows are not major contributors to this region of the lake. (Collier-IVI)
W85-04369

SEASONAL OCCURRENCE OF WATER-BORNE FUNGI IN KONAJE STREAM (MANGALORE), INDIA,
Mangalore Univ. (India).
K. R. Sridhar, and K. M. Kaveriappa.
Hydrobiologia, Vol. 119, No. 2, p 101-105, December, 1984. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Aquatic fungi, *Seasonal variation, *Konaje stream, *India, Sampling, Detritus, Rainfall, Leaves, Water temperature, Hydrogen ion composition, Dissolved oxygen.

Konaje stream flows adjacent to Mangalore University Campus in Konaje village and joins the Arabian Sea. Five sampling sites at 1 km intervals were surveyed during 1980-1981 for the occurrence of water-borne fungi by using three methods: leaf litter observations, foam analysis and water filtration. Twenty species of fungi were recorded. Of these, four species were found only with two of the methods and three species were found only with one method. Only thirteen species were detected with all three methods, indicating that the use of different methods increases the number of species recorded in a given region. Three species of fungi, Lunulospora curvula, Triscelophorus monosporus and Triscelophorus sp. were found to occur throughout the year. In all three methods Lunulospora curvula was most common. The occurrence of the different species appears to correlate with the rainfall and leaf deposition rather than with water temperature, pH and dissolved oxygen. (Moore-IVI)
W85-04387

ECOLOGICAL EFFECT OF ACID CONDITIONS AND PRECIPITATION OF HYDROUS METAL OXIDES IN A ROCKY MOUNTAIN STREAM,
Geological Survey, Denver, CO. Water Resources Div.
D. M. McKnight, and G. L. Feder.
Hydrobiologia, Vol. 119, No. 2, p 129-138, December, 1984. 3 Fig, 4 Tab, 22 Ref.

Descriptors: *Periphyton, *Invertebrates, *Acid streams, *Metal oxides, *Deer Creek, *Snake River, *Colorado, Oxides, Trace metals, Precipitates, Benthic animals, Liverworts, Algae.

Periphyton and benthic invertebrate assemblages were studied at the confluence of two Rocky Mountain streams, Deer Creek and the Snake River near Montezuma, Colorado. Upstream from the confluence the Snake River is acidic and enriched in dissolved trace metals, while Deer Creek is a typical Rocky Mountain stream. In the Snake River, downstream from the confluence, the pH increases and hydrous metal oxides precipitate and cover the streambed. The algal and benthic invertebrate communities in the upstream reaches of the Snake River and in Deer Creek were very different. A liverwort, Scapania undulata var. undulata, was abundant in the Snake River, and although periphyton were very sparse, there were as many benthic invertebrates as in Deer Creek. Downstream from the confluence, the precipitation of hydrous metal oxides greatly decreased the abundance of periphyton and benthic invertebrates. This study shows that in streams metal precipitates covering the streambed may have a more deleterious effect on stream communities than high metal-ion activities. (Author's abstract)
W85-04389

COMPARISON OF THE ACCURACY AND PRECISION OF SEVERAL OPEN-WATER OXYGEN PRODUCTIVITY TECHNIQUES,
Clemson Univ., SC. Dept. of Biological Sciences.
R. J. Kosinski.
Hydrobiologia, Vol. 119, No. 2, p 139-148, December, 1984. 2 Fig, 9 Tab, 24 Ref.

Descriptors: *Productivity, *Open-water oxygen methods, *Streams, Reaeration, Computers, Simulation, Oxygen, Photosynthesis, Solar radiation.

Stream productivity can be measured by open-water oxygen productivity techniques provided that K (coefficient of reaeration) can be estimated. The accuracy and precision of several techniques for doing this were compared by computer simulations which examined the ability of the techniques to extract the correct value of K from oxygen records which had been affected by a variety of non-ideal conditions. Noisy data and long observation intervals were not a serious problem for most methods. Serious impairment of all methods occurred with low productivity or high K. Daytime techniques (Hornberger-Kelly daytime, daytime regression and modified hysteresis methods) were more precise than nighttime techniques (Odum, nighttime regression and Hornberger-Kelley nighttime methods), but tended to be biased by nonlinear photosynthetic responses, afternoon photosynthetic depression and fluctuating light intensity. In general, the best-performing methods were the modified hysteresis, nighttime regression, daytime regression, Odum and Hornberger-Kelly daytime methods. Choice of a method should entail consideration of the non-ideal conditions likely to be encountered in the specific field situation, the data the method requires and its ease of use as well as its accuracy. (Moore-IVI)
W85-04390

2I. Water In Plants

WATER STRESS INDUCTION USING POLYETHYLENE GLYCOL IN NUTRIENT FILM TECHIQUE. EFFECTS OF THE PHOTOSYNTHETIC PARAMETERS OF THREE TOMATO SPECIES AND ONE HYBRID,
Ghent Rijksuniversiteit (Belgium). Lab. voor Morfologie and Systematiek.
A. Mougou, R. Lemeur, and J. Schalck.
Acta Oecologia-Oecologia Plantarum, Vol. 5, No. 4, p 375-385, 1984. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Water stress, *Plants, Nutrients, Tomatoes, Photosynthesis.

Lycopersicon esculentum cv. Motelle, Lycopersicon chilense, Solanum pennellii with two ecotypes Atico chala and Pan de Azucar and a hybrid were cultivated with a nutrient film technique. Addition of polyethylene glycol to the nutrient solution produced osmotic stress over a period of three to four weeks so that the test plants could gradually adjust and develop drought resistance. The results indicate that all tomato species are very sensitive to water stress, as indicated by a sharp increase of the carbon dioxide compensation point below solute osmotic potentials of -4 bar. In conditions of water stress it appears that the carbon dioxide compensation point permits better discrimination between species than the quantum yield and the internal carbon dioxide diffusion resistances. The light saturated photosynthesis rate shows only a gradual decrease with stress and discrimination between species is poor. The same is true for quantum yield showing poor discrimination as well. In non-stressed conditions, however, yield discrimination is much better. The wild Solanum pennellii species show better drought resistance than the two Lycopersicon sp. and the hybrid. (Baker-IVI)
W85-03838

EFFECTS OF WATER AND SALT STRESS ON GROWTH AND ACETYLENE REDUCTION IN ALFALFA,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
T. J. Keck, R. J. Wagenet, W. F. Campbell, and R. E. Knighton.
Soil Science Society of America Journal, Vol. 48, No.6, p 1310-1316, November/December, 1984. 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Salt stress, *Water stress, *Alfalfa, Plant growth, Plant physiology, Saline soils, Saline water, Irrigation effects, Nitrogen fixation, Acetylene.

The interactive effects of three irrigation water salinities (1.0, 3.0, and 9.0 dS/m) and three quantities of water applied per irrigation (2.3, 4.7, and 7.0 cm) on plant growth and N fixation by alfalfa (Medicago sativa L. cv. Resistador) were assessed in the greenhouse. Salt and water treatments were started after nodulation had been established in young plants and samples were harvested at 10, 30, and 50 d thereafter. Alfalfa top growth was limited by both salt and water stresses. Irrigation water salinity had a greater effect on top growth than root growth while root distribution was unaffected by either the quantity of water applied or by water salinity. The effects of salinity on plant growth were masked by water stress. Specific nodule ac-

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tivity (micro-mol C2H4/s/kg) was enhanced by increasing quantity of water applied at each irrigation and was adversely affected by increased irrigation water salinity. In contrast, both nodulation and total nodule mass were insensitive to salt stress and sensitive only to severe water stress. Alfalfa plants continued to reduce acetylene at the third sampling even under severe water and salt stress. These data indicate that the Resistador cultivar of alfalfa apparently continues to fix N2 during periods of substantial environmental stress. (Author's abstract)
W85-03962

GROWTH AND NUTRIENT STATUS OF LOBLOLLY PINE SEEDLINGS IN RELATION TO FLOODING AND PHOSPHORUS,
Southeastern Forest Experiment Station, Charleston, SC.
W. H. McKee, Jr., D. D. Hook, D. S. DeBell, and J. L. Askew.
Soil Science Society of America Journal, Vol. 48, No. 6, p 1438-1442, November/December, 1984. 1 Fig, 2 Tab, 22 Ref.

Descriptors: *Flooding, *Pine trees, *Phosphorus, *Plant growth, Drainage, Nutrients, Soil aeration, Biomass, Plant physiology.

The effects of soil waterlogging, drainage, and P additions under controlled conditions on height growth, biomass production, and nutrient assimilation were studied in loblolly pine seedlings over a 2-yr period. Growth and total biomass of 2-year-old loblolly pine were seriously suppressed by continuous flooding compared to dormant season flooding or drainage to a depth of 61 cm. Dormant season flooding produced larger seedlings than did maintaining the water table at 61 cm. Phosphorus added at 100 mg/kg to the surface 15 cm of topsoil increased total biomass with continuous flooding but not with other drainage treatments. The extractable mineral P supply and physiology of loblolly pine interact, allowing for opportunities to improve growing conditions for pine on wet sites by drainage or fertilization. Response of loblolly pine to P is not dependent on the amount of extractable P alone but also on the interaction of the plant to soil aeration (soil reduction) and extractable P. Foliage concentration values of P alone are not totally indicative of nutrient status of trees placed under flooding stress because translocation of the nutrients from roots to foliage is restricted by lack of soil aeration. (Moore-IVI)
W85-03968

MICROWAVE REMOTE SENSING OF PLANT WATER STRESS,
Consiglio Nazionale delle Ricerche, Florence (Italy).
For primary bibliographic entry see Field 7B.
W85-03999

WATER RELATIONS AND GROWTH OF THREE GRASSES DURING WET AND DROUGHT YEARS IN A TALLGRASS PRAIRIE,
Kansas State Univ., Manhattan. Div. of Biology.
A. K. Knapp.
Oecologia (Berlin), Vol. 65, No. 1, p 35-43, December, 1984. 5 Fig, 3 Tab, 44 Ref. NSF grant DEB 80-12166.

Descriptors: *Water requirements, *Drought, *Grasses, *Prairies, *Kansas, Plant growth, Water supply, Water needs, Irrigation effects, Turgidity, Water stress.

The water relations and growth of three tallgrass prairie species Panicum virgatum, Andropogon gerardii and A. scoparius were examined in irrigated and unwatered prairie in eastern Kansas. In 1983 the grasses received 11% more solar radiation, 54% less precipitation and air temperatures were warmer than in the 1982 growing season at the study site. The grasses monitored in this subhumid tallgrass prairie environment all osmotically adjusted in response to water stress. Panicum virgatum, normally restricted to mesic sites, was capable of increasing solute concentration in cells in response to drought, but was unable to lower zero turgor in 1983 as much as the more xeric grasses due to its relatively rigid cell walls. Andropogon gerardii was least effective at increasing solute concentration, but the relatively elastic cell walls in this grass allow A. gerardii to lower zero turgor significantly more than P. virgatum during the 1983 drought. The most xeric grass, A. scoparius, was able to concentrate solutes as well as P. virgatum in response to drought and, in combination with a relatively low E (less rigid walls), was able to lower zero turgor more than the other two species studied. In general, although reproduction in unwatered prairie in the drought year was considerably lower in all species compared to irrigated prairie, vegetative growth was not as severely affected. (Baker-IVI)
W85-04068

SPRUCE DECLINE IN THE NORTHERN APPALACHIANS: EVALUATING ACID DEPOSITION AS A POSSIBLE CAUSE,
Pennsylvania Univ., Philadelphia.
For primary bibliographic entry see Field 5A.
W85-04236

2J. Erosion and Sedimentation

LATERAL MIGRATION RATES OF RIVER BENDS,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
E. J. Hickin, and G. C. Nanson.
Journal of Hydraulic Engineering, Vol. 110, No. 11, p 1557-1567, November, 1984. 5 Fig, 2 Tab, 8 Ref. National Science and Engineering Research Council of Canada grant A8376.

Descriptors: *Lateral migration, *River bends, *Channel migration, Aerial photography, River channels, Channels, Sedimentation, Erosion.

Curved river channels shift laterally by erosion of the concave bank and concomitant deposition of point bar deposits at the convex bank. Time sequential aerial photographs flown approximately 20-30 years apart have been used to measure the lateral migration rates of 189 bends on 21 clay, sand and gravel rivers in Western Canada. Channel migration rates transformed to a reference bend curvature are shown to be a simple function of stream power, outer bank height, and a coefficient of resistance to lateral migration, Yb. This Yb, the opposing force per unit boundary area resisting migration, was shown to be largely dependent on grain size. The task of specifying the channel migration process is essentially a bed sediment entrainment problem. (Baker-IVI)
W85-03776

SEPARATION ZONE AT OPEN-CHANNEL JUNCTIONS,
Hull Univ. (England).
For primary bibliographic entry see Field 8B.
W85-03778

SEDIMENT TRANSPORT, PART II: SUSPENDED LOAD TRANSPORT,
Waterloopkundig Lab. te Delft (Netherlands).
L. C. van Rijn.
Journal of Hydraulic Engineering, Vol. 110, No. 11, p 1613-1641, November, 1984. 18 Fig, 1 Tab, 42 Ref, 2 Append.

Descriptors: *Sediment transport, *Suspended load, Mathematical equations, Turbulence, Flow velocity, Particle size.

A method is presented which enables the computation of the suspended load as the depth-integration of the product of the local concentration and flow velocity. The method is based on the computation of the reference concentration from the bed-load transport. The method gives detailed information about all parameters of importance to the sediment transport process. The proposed function for the reference concentration yields good results for predicting the sediment transport for fine particles in the range 100-500 micro m. The ratio of the sedi ment diffusion coefficient and the fluid diffusion coefficient may be larger than unity, but its value cannot be predicted with high accuracy. The damping of the turbulence by the sediment particles can be taken into account by a local concentration-dependent damping factor. In the case of flow conditions with a graded bed material the representative particle diameter of the suspended sediment can be described as a function of the flow stage parameter, the geometrical standard deviation and median size of the bed material. The concentration profile is rather sensitive to small variations in the particle fall velocity of the suspended sediment, the bed-shear velocity and the beta-factor, particularly for a reference level close to the bed. The total sediment load cannot be predicted with an inaccuracy less than a factor 2 because the accuracy of the main controlling parameters is too low, while also the total load data used for calibration and verification show deviations up to a factor 2. A verification analysis using about 800 data shows that about 76% of the predicted values are within 0.5 and 2 times the measured values. (Baker-IVI)
W85-03780

DYNAMIC FLOW RESISTANCE FOR HYDROLOGIC SIMULATIONS,
Agricultural Research Service, Columbia, MO North Central Region.
M. W. Van Liew, and K. E. Saxton.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1719-1732, December, 1984. 6 Fig, 3 Tab, 9 Ref.

Descriptors: *Hydrologic models, *Flow resistance, Runoff, Erosion control, Simulation analysis, Agricultural runoff, Vegetation effects.

The SEDLAB simulation model, which represents overland runoff and erosion from agricultural watersheds, has been revised to include dynamic overland and channel flow resistances, new infiltration methods, and improved sediment transport equations. Supplemental records and observations that describe watershed conditions were used to help calibrate relative roughness of overland and channel flow areas. Two parameters that govern flow resistance in the simulation model were calibrated from event data on W-1 near Treynor, Iowa. Methods were in turn developed to relate the calibrated parameter values for both overland and channel flow resistance to roughness features on the watershed. These parameters were found to change in a manner which represented the event-to-event variation in flow resistance due to tillage, rill development, residue, crop and vegetative cover. The methods and parameters developed on watershed W-1 to represent flow resistance were applied to events on adjacent W-2 near Treynor, Iowa. Good results were obtained in the water routing response for the W-2 storms, which demonstrates that appropriate flow resistance parameters can be selected for model simulation based upon roughness characteristics which prevail at the time of a particular event. The flow resistance parameters determined in this study are representative of watersheds with lossial soil, contoured fields, and a corn crop. Further testing is needed to define the roughness parameters for watersheds with other soil, crop, and vegetative conditions. The results of this study demonstrate the need for additional tests to define the dynamic variation of flow resistance caused by antecedent rainfall, runoff, crop, and land management conditions. (Baker-IVI)
W85-03785

SEDIMENT TRANSPORT, PART III: BED FORMS AND ALLUVIAL ROUGHNESS,
Waterloopkundig Lab. te Delft (Netherlands).
L. C. van Rijn.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1733-1754, December, 1984. 10 Fig, 3 Tab, 49 Ref.

Descriptors: *Sediment transport, *Alluvial channels, Bed load, Flumes, Suspended sediments, Sediment load, Sedimentation.

A method is presented that makes the classification of bed forms, the prediction of the bed-form dimensions and the effective hydraulic roughness of the bed forms feasible. The proposed relationships are based on the analysis of reliable flume and field data. The dimensions and the equivalent roughness of bed forms in the dune and plane bed regimes can be expressed by simple functions that are valuable for particles in the range of 160-1,300 micro m and flow depths of up to 20 m, as shown by a verification analysis using about 1,500 flume and field data. For field conditions, the proposed method yields considerably better results than previously proposed methods, which are reviewed. The proposed method has also been used to predict the flow depth and the total bed-material load. The proposed method for the prediction of the Chezy-coefficient and the total load transport is superior to several other methods in the case of field conditions. The type of bed forms in the lower and transitional flow regime can be expressed as a function of a dimensionless transport stage parameter and a particle parameter. (Baker-IVI)
W85-03786

VARIATION OF FLOW RESISTANCE THROUGH CURVED CHANNELS,
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W85-03788

UNIT STREAM POWER EQUATION FOR GRAVEL,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. T. Yang.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1783-1797, December, 1984. 7 Fig, 1 Tab, 24 Ref, 1 Append.

Descriptors: *Gravel transport, *Sediment transport, *Mathematical equations, Bed load, Gravel.

A brief review of the basic assumptions used in the derivation of gravel transport equations is offered. Theoretical derivations are made to determine the relationship between gravel concentration and unit stream power. Laboratory data are used to verify the assumptions used as well as the accuracy of some of the well-known transport equations. The assumption that bed load or gravel concentration can be determined by either shear stress or stream power is questionable. Based on the data shown there is a strong one-to-one correlation between unit stream power and bed load or gravel concentration. The reason that sediment concentration should be related to unit stream power can be derived from general physics as well as from basic theories in fluid mechanics and turbulence. Among the four equations compared, the dimensionless unit stream power equation for gravel transport is more accurate than others for the gravel data used in this paper. (Baker-IVI)
W85-03789

NUMERICAL INTEGRATION OF EINSTEIN'S INTEGRALS, I1 AND I2,
Iowa Inst. of Hydraulic Research, Iowa City.
T. Nakato.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1863-1868, December, 1984. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Bed load, *Mathematical equations, *Einstein's Bed-Load Function, Streamflow, Suspended sediment.

Einstein's Bed-Load Function for computing total-load discharge per unit width requires computation of Einstein's integrals, I1 and I2. The simple Simpson method or a polynomial-fitting technique applied in computing the integrals cannot give accurate estimates when the integrand at the lower limit is extremely large. The integration method proposed herein employs isolation of the singular point and, thus, estimates acurate, numerical integrations. The integrands I1 and I2 can be computed accurately as the sum of the exact integral near the lower integration limit and the numerical integral by a step integration method for the upper region using equations as provided. (Baker-IVI)
W85-03795

WIND RESUSPENSION OF SEDIMENTS IN A PRAIRIE LAKE,
Iowa State Univ., Ames. Dept. of Animal Ecology.
G. L. Carper, and R. W. Bachmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 12, p 1763-1767, December, 1984. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Lake sediments, *Little Wall Lake, *Iowa, *Sediment resuspension, *Wind velocity, Wind, Sediments, Prairie lakes.

Levels of inorganic suspended soilds were measured in Little Wall Lake, Iowa and it was concluded that sediment resuspension occurred when wind velocities exceeded critical velocities as calculated from wave theory. The percentages of the lake bed subject to resuspension for winds of given velocities were calculated, as were the percentages of time that winds of such velocities could be expected. Only a small percentage of the lake bed was subject to resuspension most of the time. When water depths were less than one-half the calculated wavelength for surface waves, sediment resuspension occurred in the lake. The same is likely to be true of other lakes with similar sediment characteristics. A map was developed which shows the areas of the lake affected by winds of different velocities and is a useful method of indicating where in a lake sediment resuspension is most likely to occur. A curve showing the probabilities that different percentages of the lake bed will be affected by waves driven by the prevailing wind summarizes information on both the lake morphometry and local wind distribution. The curve is a useful, descriptive tool for comparing lakes and may also have direct application in predicting water quality in new lakes or in determining the effects of lake deepening projects. (Baker-IVI)
W85-03827

PREDICTED EROSION AND SEDIMENT DELIVERY OF FALLOUT PLUTONIUM,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5B.
W85-03858

HOW WIND CAN AFFECT A SEDIMENTATION BASIN,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
M. W. Rodney, and H. G. Stefan.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1204-1208, November, 1984. 8 Fig, 13 Ref.

Descriptors: *Wind, *Sedimentation basins, Sedimentation, Model studies, Wind-driven currents.

Sediment that enters a basin will either remain in suspension, settle and remain settled, or settle and be resuspended. Processes that contribute to suspended sediment mixing include natural convection from cooling and forced convection by wind. Three types of water movements generated by wind must be considered: currents, progressive waves and seiche motion. Each produces a shear stress on the bed. Bed shear generated by wind shear was expressed in this study as 10% of the surface shear, wave action bed particles was analyzed and the seiche motion was gauged from mid-basin velocities and a bed friction factor on the order of f = 0.004. The main object of the study was to represent each of the wind-induced processes to evaluate the effects of wind on the quality of the sedimentation basin outflow. Wind needs to be considered whenever basin geometry favors wave formation and sediment characteristics cause the material to remain in suspension. Basins with broad areas of shallow beach are prone to sediment resuspension by wave action. The stronger the wind, the more intense the wave action and the greater the sediment resuspension. Wind effects on particles in the micron range should be considered when a mean seasonal wind exceeds 3 m/s. The wind effect diminishes as side slopes become steeper, dropping off to essentially zero for a basin with vertical banks. Wind effects are also offset by increasingly large particles which tend to settle out faster. (Baker-IVI)
W85-03874

EFFECTS OF SEDIMENT TRANSPORT ON DEPOSIT FEEDING: SCALING ARGUMENTS,
Washington Univ., Seattle. School of Oceanography.
D. C. Miller, P. A. Jumars, and A. R. M. Nowell.
Limnology and Oceanography, Vol. 29, No. 6, p 1202-1217, 1984. 4 Fig, 2 Tab, 63 Ref.

Descriptors: *Dimensional analysis, *Sediment transport, Feeding rates, Microbiological studies, Benthos, Cycling nutrients.

A dimensional analysis is presented based on the simplest, steady state case of an individual, sedentary surface-deposit feeder with both locally produced and advected microbial food. At least five dimensionless variables are needed for dimensional analysis of an individual surface deposit feeder using particles containing microbial food both locally produced and advected. From scaling arguments which provide the relationships among these variables, it is apparent that food availability is determined primarily by the ratios of geophysical sediment transport rate into the particle pool from which the animal feeds to its ingestion rate, and of particle residence time in the feeding pool to the microbial doubling time. Increasing sediment transport can either increase or decrease local food availability. Transport patterns beneath waves have dramatic effects: wave mixing makes available to the animal particles which otherwise would be literally out of reach. Specialization on advected particles and reliance on microbial gardening are favored under different environmental conditions, specified in terms of dimensionless ratios. The scaling model also places previous models of deposit feeding in an environmental context. It contrasts with an alternative, nutrient spiraling approach in having a basis in natural selection for its optimization arguments. (Baker-IVI)
W85-03875

FLUVIAL SEDIMENTATION OF KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
R. F. Flint.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4152, 1983. 75 p, 12 Fig, 33 Tab, 53 Ref.

Descriptors: *Kentucky, *Sedimentation, *Suspended load, *Fluvial sediments, *Suspended sediments, Sediment, *Sediment discharge, Sediment load, Sediment yield, Sediment transport.

Covering periods 1942-45 and 1951-81, this report documents the characteristics of sediments being transported from 79 drainage areas within the Commonwealth of Kentucky, and from eight stations on the main stem of the Ohio River. The drainage areas range in size from 0.67 square mile at Cane Branch near Parkers Lake to 40,330 square miles at Tennessee River near Paducah. Sediment yields and particle size of suspended and bed sediments are discussed by physiographic province. The Blue Grass had the highest average annual suspended-sediment yield for selected stations of 741 tons per square mile, and the Western Coal Field had the lowest with 197. The Eastern Coal Field had the broadest range of annual suspended-sediment yields. The range was from 25 tons per square mile at Helton Branch near Greenwood to 21,000 tons per square mile at Millers Creek near Phyllis. For selected stations bedload discharge was estimated to be 5 to 10 percent as much as the suspended-sediment discharge. Only three drainage areas had sediment yields that exceeded the average annual erosion rates for cultivated land in Kentucky of 9.93 tons per acre (6,355 tons per square mile). These three were in the Eastern Coal Field. (USGS)
W85-03897

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CHANNEL CHANGES OF POWDER RIVER BETWEEN MOORHEAD AND BROADUS, MONTANA, 1939-1978,
Geological Survey, Denver, CO. Water Resources Div.
H. A. Martinson.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4128, 1984. 62 p, 30 Fig, 5 Tab, 27 Ref.

Descriptors: *Bank erosion rates, Hydrologic data, Thresholds, *Annual peak discharge, *Daily mean discharge, Meanders, Cutoffs, Powder River, *Montana, Bankfull discharge, Valley slope, Channel sinuosity, Sedimentation, Sediment transport, Geomorphology.

Bank erosion and changes in channel width, length, and pattern were determined for the Powder River between Moorhead and Broadus, Montana using maps of the bankfull channel made from aerial photographs taken during 1939, 1954, 1967, 1973, and 1978. Contemporaneous daily mean and peak discharge records from Moorhead provide the hydrologic data used to interpret the measurements. Magnitudes and frequency of flows were determined for each interval of time delimited by photographs. Bank erosion is related to the number of days that mean discharge was equal to or greater than bankfull (1.5-year flood). Mean channel width ranged between 264 ft (1973) and 415 ft (1967). The channel was wider after periods of higher annual peak flows. The channel lengthened between 1939 and 1978, although at least 12 meanders cut off between Moorhead and Broadus. Variable rates of lengthening in the reach reflect the degree of bedrock control in the valley and local variations in valley slope. Data from the Powder River verify the concept of thresholds of channel pattern stability that were demonstrated experimentally. (USGS)
W85-03910

ANALYSIS AND CHARACTERISTICS OF SIMULATED FLOWS FROM SMALL SURFACE-MINED AND UNDISTURBED APPALACHIAN WATERSHEDS IN THE TUG FORK BASIN OF KENTUCKY, VIRGINIA, AND WEST VIRGINIA,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03918

USING CLAY MINERALOGY TO INFER SOURCES OF SUSPENDED CLAY AND SILT IN A WATERSHED: QUANTITATIVE APPROACH,
Florida A and M Univ., Tallahassee, FL. Div. of Agricultural Science.
Y. P. Hsieh.
Soil Science Society of America Journal, Vol. 48, No. 6, p 1446-1450, November/December, 1984. 4 Fig, 7 Tab, 20 Ref. USDA grant FLAX-79006.

Descriptors: *Silt, *Clay, *Suspended solids, *Mineralogy, Soil erosion, Soil loss, Watersheds, Rivers, Tributaries.

Identifying the sources of erosion in a watershed by direct measurement requires extensive hydrologic instrumentation and systematic seasonal sampling, which is impractical for many watersheds. A functional procedure is presented for using clay mineralogy to infer sources of suspended clay and silt in a watershed. The information could lead to estimation of soil loss from various parts of a watershed, if the dispersion factor of the source soils can be evaluated. The suspended clay and silt carried by a river and its tributaries were used to illustrate the methodology. Clay mineralogy of the clay and silt is expressed as the relative percent peak heights of minerals from the x-ray diffractogram. Clay mineralogy is significantly different among the tributaries. Discriminant analysis substantiated that clay mineralogy can be a signature of the suspended clay and silt carried by the river and its tributaries. The Q-mode factor analysis technique was applied to 'demix' the suspended clay and silt of the main stream into its source components. One of the advantages of the proposed method is that it does not require discharge data of streams, yet relative contribution of clay and silt among subwatersheds can be estimated quantitatively. The method is relatively simple and economical compared to the conventional stream monitoring methods. It provides an alternative method of assessing soil erosion in a watershed where only indirect methods are now available. (Moore-IVI)
W85-03969

DEVELOPMENT OF TRIBUTARIES OF DIFFERENT SIZES ALONG WINDING STREAMS AND VALLEYS,
State Univ. of New York at Buffalo. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W85-03984

RELIABILITY OF SUSPENDED LOAD ESTIMATES IN CHALK STREAMS,
Freshwater Biological Association, Wareham (England). River Lab.
I. S. Farr, and R. T. Clarke.
Archiv fur Hydrobiologie, Vol. 102, No. 1, p 1-19, November, 1984. 6 Fig, 5 Tab, 18 Ref.

Descriptors: *Suspended load, *Chalk streams, *River Frome, *England, Suspended solids, Discharge hydrographs, Rating curves, Erosion.

To assess the contribution of fine particulate organic matter carried in suspension to the energy budgets of chalk streams it is necessary to obtain reliable estimates of total suspended solids (s.s.) loads throughout the year. Several methods of estimating the throughput of suspended material were tested and compared for the River Frome, an English chalk stream. The use of a weekly sampling program for suspended solids concentration combined with a similar or continuous discharge record led to annual throughput estimation errors of between 25% underestimation and 50% overestimation. A daily sampling program gave accurate annual estimates, but monthly loads were still estimated imprecisely and still with a tendency for underestimation. The relationship between suspended solid concentration and discharge (in rating curves) was never close, not even when separate rating curves were fitted for summer and winter, nor for the 'rising' and 'falling or steady' sections of the hydrograph. For a given discharge, concentration was on average 82% higher on the rising stage of the hydrograph. Using these rating curves with a continuous discharge record gave more precise estimates than using the above weekly sampling of suspended solids concentration. The River Frome catchment is predominantly rural with no major effluents which significantly affect the s.s. concentrations. Channel erosion is probably a major source of sediment with some contribution from urban storm water drainage and runoff. It is possible that 'purer' chalk streams may have a lower range of both discharge and s.s. concentrations, which should lead to lower errors in all s.s. load estimation methods, but not necessarily to more precise estimates of total catchment denudation rates. (Collier-IVI)
W85-04054

USE OF THE ELECTRONIC PARTICLE COUNTER TO INVESTIGATE PHOSPHORUS ON PARTICLES IN STREAMS,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 7B.
W85-04061

MEANDERING CHANNEL RESPONSE TO ALTERED FLOW REGIME: MILK RIVER, ALBERTA AND MONTANA,
Calgary Univ. (Alberta). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W85-04078

DYNAMICS AND COMPOSITION OF SILT DEPOSITS IN THE NORTH DONETS-DONBAS CANAL,
Z. N. Khoreva, A. I. Kovrizhnykh, and M. I. Gerasimenko.
Water Resources, Vol. 10, No. 2, p 210-215, March-April, 1983. 2 Fig, 2 Tab, 13 Ref. Translated from Vodnye Resursy, No. 2, p 160-166, March-April, 1983.

Descriptors: *Silting, *North Donets-Donbas Canal, *USSR, *Canals, Erosion, Sedimentation, Chemical analysis, Organic compounds, Algae, Aquatic plants, Seasonal variation, Velocity.

Long-term investigations were carried out of the dynamics and chemical composition of silt deposits in the North Donets-Donbas canal (USSR), which since 1958 has been the main source of centralized domestic water supply of the Donets Basin. To study the chemical composition of silts, samples were taken seasonally during 1964-1979 at 3-5 sites along the canal route. The bed of the canal is constantly transformed due to processes of accumulation, scour, and redistribution of silt. The suspended and bed loads of the North Donets promoted siltation of the floodplain and initial stretches. The main factors causing siltation of the main route of the canal are: the velocity regime, lining of the slopes, erosion of the bed, washdown of terrigenous material from the surrounding slope and side slopes of the canal, change in the route of the channel, and transsedimentation of earlier deposited silts. Green filamentous algae have a substantial effect on the formation of bottom deposits. The silts of the canal are formed on clay soils and fine earth and have a fine clay texture. The silt is rich in organic matter with a total carbon in the silts varying from 1100 to 4790 mg, nitrogen 146-690 mg, and phoshorus 22-101 mg/100g dry silt. The seasonal variations of organic matter in the silts are characterized by a decrease of its quantity in the summer despite the fact that at this time phytobenthos and higher aquatic vegetation develop actively on the slopes. The chemical composition of the silts is characterized by a high content of organic compounds, the main source of accumulation of which is the algae of the benthos and high aquatic vegetation. The amount of organic substances in the silts periodically decreases with decreases of the abundance of green filamentous algae. (Baker-IVI)
W85-04101

ANTHROPOGENIC FACTOR IN THE DEVELOPMENT OF THE COASTAL ZONE OF THE BALTIC SEA,
For primary bibliographic entry see Field 6G.
W85-04111

RELATIONSHIP BETWEEN DECREASE OF COCKLE BIOMASS AND PARTICLE-SIZE DISTRIBUTION OF SHELL MATERIAL IN THE AZOV SEA,
D. A. Eliseev.
Water Resources, Vol. 10, No. 4, p 389-396, July-August, 1983. 3 Tab. 14, Ref. Translated from Vodnye Resursy, No. 4, p 134-142, July-August, 1983.

Descriptors: *Biomass, *Shells, *Beach formation, *Cockles, *Azov Sea, *USSR, Sediment transport, Bays, Detritus, Fish, Wave action.

To assess the effect of the size distribution of cockle biomass on the formation of beach-forming sediments of the Azov Sea, it is necessary to know the initial size distribution of the diminishing cockle biomass, the size distribution of the shell detritus in the beach zone, and the quantitative characteristics of the dynamic system which converts the shell valves into shell detritus of a given size distribution. The solution of the problem can be divided into five segments: the particle-size characteristics of dead shell valves; the size distribution of the shell detritus in the dynamic zone of some morphologic forms; particle-size and hydraulic characteritics of shell valves and detrital particles; the mechanism of reworking of shell valves into detritus; and the effect of the particle-size distribution and characteristics of shell valves on

the dynamics of reworking into shell detritus. The conditions favorable for functioning of the fish population in the Azov Sea as a whole promote a greater decrease of the biomass. In the zone of wave action the average thickness of the detrital particles is weakly related to the initial size distribution of the shell valves. (Baker-IVI)
W85-04124

PROCESSES OF TRANSFORMATION OF NITROGEN COMPOUNDS IN BOTTOM SEDIMENTS OF LAKES AND RESERVOIRS,
M. V. Martynova.
Water Resources, Vol. 10, No. 6, p 609-614, November-December, 1983. 1 Fig, 2 Tab, 41 Ref. Translated from Vodnye Resursy, No. 6, p 167-172, November-December, 1983.

Descriptors: *Lake sediments, *Bottom sediments, *Nitrogen cycle, Nitrogen compounds, Nitrates, Microorganisms, Sedimentation, Denitrification, Nitrogen fixation, Ammonia.

The processes of the nitrogen cycle in sediments occur mainly as a consequence of the vital activity of microorganisms. About 50% of the nitrogen of sediments is represented by protein substances. During their breakdown amino acids are formed, which can be incorporated into cell proteins or mineralized with the liberation of ammonia. About 50% of organic nitrogen arriving as a result of sedimentation is mineralized annually in the sediments. Denitrification occurs actively in the upper 3-5 cm layer of sediments under both anaerobic and aerobic conditions. Nitrogen fixation occurs in sediments up to a depth of 20-50 cm and varies from tenths to 28 mg N/sq m/day. As a consequence of ammonification of organic matter in sediments at least 40-50% of the total amount that arrives here as a result of sedimentation is, as a rule, mineralized; not more than 5-10% of the mineralized nitrogen (less for muds) is nitrified; 60-70% of the nitrified nitrogen is denitrified and 30-40% is immobilized, being transformed to organic nitrogen; and nitrogen fixation in sediments amounts to about 10-15% of nitrogen sedimentation, the bulk of it being fixed from water. Ammonification is the main process of microbiological transformation of nitrogen compounds in sediments. (Baker-IVI)
W85-04153

MEANDERING OF UNDERFIT STREAMS,
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W85-04280

EFFECTS OF BOTTOM CURRENTS AND FISH ON SEDIMENTATION IN A DEEP-WATER, LACUSTRINE ENVIRONMENT,
Duke Univ., Beaufort, NC. Marine Lab.
T. C. Johnson, J. D. Halfman, W. H. Busch, and R. D. Flood.
Geological Society of American Bulletin, Vol. 95, No. 12, p 1425-1436, December, 1984. 12 Fig, 1 Tab, 27 Ref. NSF grant OCE 8018339.

Descriptors: *Sedimentation, *Bottom currents, *Fish, *Sedimentary structures, *Lake Superior, Lake sediments, Sand, Mud, Particle size, Scour, Dish laminations.

Sands and muds accumulating under the influence of apparently strong bottom currents in a deep-water environment of Lake Superior were studied in detail using 3.5-kHz echo sounding; side-scan SONAR; piston, gravity, and box coring; and lake-floor photography. The study area includes a well-defined slope and basin environment. Bottom currents maintain a scoured trough, 20 m deep and 2 km wide, at the base of the slope and modify the shapes of large ringlike depressions that are common in many regions of Lake Superior. Side-scan SONAR records reveal lineations subparallel to the direction of bottom-current flow that are interpreted in different areas to be sand ribbons, slight depressions, or depositional furrows. The sediments range from silty sand in the scoured trough to sandy clays farther offshore. Radiocarbon dating and Pb-210 dating show the sediments to be postglacial rather than relic glacial-lacustrine sediments. Grain size distributions are affected by bottom currents and a nearby source of sand. Some sedimentary structures, including plane laminations and interbedded sands and muds, are due to bottom currents. Fish create dish laminations, however, that often obscure the effects of the bottom currents. Fish and fish-scour depressions are common in lake-floor photographs, whereas evidence for bottom currents is not. Biological activity therefore appears to erase traces of intermittent currents. (Author's abstract)
W85-04309

ERODIBILITY OF STRIP-MINE SPOILS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
D. Rubio-Montoya, and K. W. Brown.
Soil Science, Vol. 138, No. 5, p 365-373, November, 1984. 2 Fig, 5 Tab, 29 Ref.

Descriptors: *Erosion, *Mine wastes, *Soil loss, *Land reclamation, *Strip mine wastes, Prediction, Rainfall, Topography.

Bulk mine spoil samples were collected from two active strip mines and one exploratory area along the Texas and Louisiana Gulf Coast; in each case, a group of samples was collected representing the range of material considered for use in reclamation. Erodibility of the samples from these lignite-bearing geological deposits was evaluated using a rainfall simulator and predictive methods developed for agricultural soils. The materials studied represented a wide range of physical and chemical characteristics. They were subjected to two 100-year 30-min rainfall events at inclinations of 2, 9, and 18%. The eroded and splashed materials were collected and quantified. The topographical factor LS in the universal soil loss equation (USLE) was adjusted to allow extrapolation from small plots to the standard unit plot. The erodibility factor K was thus determined, and the resultant values were compared with those calculated from the physical and chemical properties of the samples. The K obtained with the adjusted topographic factor LS showed a very high predicting power for the erosion loss observed under the conditions of the present experiment. K values estimated from the physical properties of mine spoil are larger than those experimentally determined. The erodibility factor of mine spoil (Km) may be calculated as Km = (0.339 x Kw to the 0.48 power) where Kw is the erodibility factor estimated from the physical properties of the spoil using the Wischmeier equation. Even when spoil materials have physical and chemical characteristics similar to soils, they are less erodible. (Collier-IVI)
W85-04344

STOCHASTIC MODEL OF SUSPENDED SOLID DISPERSION,
Hochschule der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Hydromechanik und Hydrologie.
W. Bechteler, and K. Farber.
Journal of Hydraulic Engineering, Vol. 111, No. 1, p 64-78, January, 1985. 4 Fig, 21 Ref, 1 Append.

Descriptors: *Stochastic process, *Suspended solids, *Dispersion, Model studies, Probability, Open channel flow, Turbulence.

A stochastic model of suspended solid dispersion in turbulent open channel flow has been developed that can not only calculate concentration distributions in equilibrium, but also complex transition cases. The stochastic model gives a statement of probability for the constant movement of a dispersing particle based on measured turbulence parameters. By the Monte Carlo method, many random walks are calculated to determine the concentration of solids at a certain point. It is shown that the description by a diffusion equation is equivalent to that of a stochastic approach. The stochastic model of particle movement is composed from stochastic and deterministic velocity components, a time step, and a weighting function for the influence of concentration effects. A sensitivity analysis of the developed model is carried out. Applications are shown and compared with experiments and other analytical solutions. (Moore-IVI)
W85-04395

BED LOAD OR SUSPENDED LOAD,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
P. J. Murphy, and E. J. Aguirre.
Journal of Hydraulic Engineering, Vol. 111, No. 1, p 93-107, January, 1985. 14 Fig, 20 Ref.

Descriptors: *Bed load, *Suspended load, *Sediment transport, Saltation, Suspension, Model studies, Open channel flow, Sand, Velocity, Free fall velocity, Turbulence.

The difference between the sediment transport processes of bed load and suspended load is explained and quantified. The mean and fluctuating components of the particle motion are studied by examining both components of the particle's dynamics in open channel flows. A theoretical distinction between saltation and suspension is presented, with a model, based on Lagrangian particle dynamics, that gives a quantitative description of how this distinction works for sand in open channel flow. For sand particles, the time required for particles leaving the bed to attain the free fall velocity is the critical parameter for the saltation-suspension distinction. The turbulent velocity fluctuations are important in both saltation and suspension of sand. (Moore-IVI)
W85-04397

EQUILIBRIUM BOUNDARY CONDITION FOR SUSPENSION,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
P. J. Murphy.
Journal of Hydraulic Engineering, Vol. 111, No. 1, p 108-117, January, 1985. 5 Fig, 18 Ref, 1 Append.

Descriptors: *Suspension, *Boundary conditions, *Sediment transport, Advection, Diffusion, Open channel flow, Suspended solids, Sediment erosion, Prediction.

The suspension in the bed layer, and the deposition and erosion processes were examined in order to improve the prediction and understanding of the bottom boundary condition for the advection-diffusion equation, especially when it is used to determine the equilibrium concentration of suspended sediment in open channel flow. The erosion process introduces a source term into the advection-diffusion equation for sediment concentration. The source strength is nonzero in the bed load layer, which may be much thicker than is usually assumed. The concentration for open channel flow is predicted and compared with existing data. Comparison indicates that the predicted reference concentration agrees with river data. (Moore-IVI)
W85-04398

2K. Chemical Processes

GEOHYDROLOGY, AQUEOUS GEOCHEMISTRY, AND THERMAL REGIME OF THE SODA LAKES AND UPSAL HOGBACK GEOTHERMAL SYSTEMS, CHURCHILL COUNTY, NEVADA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03898

GROUND-WATER RESOURCES OF ST. JOHNS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03903

WATER IN SAND AND GRAVEL DEPOSITS IN MCHENRY COUNTY, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
J. R. Nicholas, and J. T. Krohelski.

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Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water Resources Investigations Report 83-4048, 1984. 34 p, 10 Fig, 3 Tab, 22 Ref, 1 Map.

Descriptors: *Glacial aquifers, *Groundwater levels, Unconfined aquifers, Groundwater movement, Glacial drift, *Local groundwater flow, Till, McHenry County, *Illinois, Water quality.

McHenry County, Illinois derives a major part of its ground-water supply from unconsolidated sand and gravel aquifers. Twenty-six public systems tap these aquifers for all or part of their supply. The county contains two types of sand and gravel aquifers--unconfined aquifers which are at or near the land surface, and semiconfined aquifers which are overlain by one or more till members. A map of water levels in unconfined and semiconfined aquifers shows that moraines and other topographically high features are ground-water divides of local flow systems. Distances from ground-water divides to discharge areas are a few miles or less. The quality of the ground water is good for most uses, although treatment may be required to reduce hardness (median concentration is 340 milligrams per liter) and dissolved iron (median concentrations is 140 micrograms per liter). Ground water is a calcium magnesium bicarbonate type. The range of specific conductance is from 260 to 1,170 micromhos. Values are higher near towns. (USGS)
W85-03907

GEOCHEMISTRY OF GROUND WATER IN THE SACRAMENTO VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
L. C. Hull.
Available from Supt. of Documents, GPO, Washington, D.C. 20402. USGS Professional Paper 1401-B, 1984. 36 p, 17 Fig, 16 Tab, 43 Ref.

Descriptors: *California, Nitrates, *Dissolved solids, *Water chemistry, Phase diagrams, Clay minerals, Time series analysis, *Groundwater, *Geochemistry, *Sacramento Valley.

Chemical analyses of ground water from the Sacramento Valley, California, were examined to evaluate both temporal changes in dissolved solids and nitrates, and processes controlling water chemistry. Six hydrochemical facies having unique chemical characteristics were defined using linear discriminant functions. One-third of the spatial variation in ground-water chemistry is related to the chemistry of recharge from the valley margins. Reducing conditions in the midvalley flood basins affect iron, manganese, arsenic, and nitrate concentrations. Five of the six hydrochemical facies showed significant increases in dissolved solids between the mid-1950's and mid-1970's. Trends in average dissolved solids ranged from 0.95 milligrams per liter per year to 4.75 milligrams per liter per year. Three of the six facies showed significant increases in nitrate during the same period. Trends in average nitrate-nitrogen ranged from 0.036 milligrams per liter per year to 0.099 milligrams per liter per year. Twenty percent of 140 wells examined for trends in dissolved solids and 29 percent of 62 wells examined for trends in nitrate showed significant increases. Feldspars comprised about two-thirds of the mineral grains in samples from a U.S. Geological Survey test well. X-ray diffraction and electron microscopy show illite and halloysite to be the primary clay minerals in a second well. Phase diagrams indicate montmorillonite would be the most stable clay mineral in equilibrium with Sacramento Valley ground water. Halloysite represents a metastable intermediate step in the diagenesis of primary minerals to more stable secondary phases. (USGS)
W85-03926

HYDROLOGIC CONDITION OF THE CHICOD CREEK BASIN, NORTH CAROLINA, BEFORE AND DURING CHANNEL MODIFICATIONS, 1975-81,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 4A.
W85-03928

RECONNAISSANCE OF THE QUALITY OF SURFACE WATER IN THE WEBER RIVER BASIN, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. R. Thompson.
Utah Department of Natural Resources, Division of Water Rights, Salt Lake City, Technical Publication No. 76, 1983. 74 p, 5 Fig, 7 Tab, 18 Ref.

Descriptors: *Water quality, Surface water, *Chemical analysis, Water types, Fluvial sediment, Trace elements, Surface geology, *Reconnaissance studies, *Utah, Great Basin, Weber River basin.

This reconnaissance study of the quality of surface water in the Weber River basin included an area of 2,080 square miles. Elevations in the basin range from 4,210 to 11,708 feet. Data were obtained by the U.S. Geological Survey one or more times at 107 sites in the basin from July 1979 to August 1980. The principal factors that affect water quality in the Weber River are tributary inflow from both surface-water and ground-water sources, irrigation-return flow, and reservoir storage. Dissolved-solids concentrations in the Weber River during winter base-flow periods generally are increased slightly and they fluctuate little except near the mouth of the river. During the spring-runoff periods, water typically has the smallest concentration of dissolved solids. Local exceptions are at sites affected by reservoir releases. During the summer-irrigation period, discharge of the river is decreased greatly by irrigation diversions. Dissolved solids tend to increase in a downstream direction primarily due to irrigation-return flows from both surface- and ground-water sources. The greatest change in water quality in the Weber River occurred during the irrigation season downstream from the confluence with the Ogden River. Suspended-sediment transported in the basin occurs primarily during storm runoff and secondarily during spring runoff. (USGS)
W85-03930

HYDROLOGY OF THE WIBAUX-BEACH LIGNITE DEPOSIT AREA, EASTERN MONTANA AND WESTERN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
W. F. Horak.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 83-4157, 1983. 89 p, 31 Fig, 7 Tab, 43 Ref.

Descriptors: *Aquifers, *Groundwater, Surface water, *Water chemistry, *Lignite, Aquifer testing, Hydraulic conductivity, Strip mines, Leaky aquifers, Observation wells, Test holes, Computer models, Wibaux, Montana, Beach, *North Dakota.

The geology and existing hydrologic regime of the Wibaux-Beach deposit area were studied to assess the potential impacts of proposed mining on the water resources. The Paleocene Harmon lignite of the Wibaux-Beach deposit constitutes a 50-square mile strippable reserve of about 1 billion tons. The Harmon bed and underlying discontinuous sand deposits in the lower Tongue River and upper Ludlow Members (Fort Union Formation) are the principal shallow aquifers in the area. Varying thicknesses of salt and clay separate the respective aquifers and act as confining units. Hydraulic and potentiometric data indicate that flow velocities are low, recharge is infrequent and of low magnitude, and vertical leakage is a major flux component. Water quality is quite uniform among the three aquifers. Most water is a sodium bicarbonate-sulfate type. Anomalously large sulfate, calcium, magnesium, and iron concentrations are generated by natural geochemical processes at the Harmon bed outcrop, but such concentrations do not persist far into the aquifer. Significant potentiometric declines in the Harmon lignite aquifer will extend for a few miles from active mines. Impact on the deeper aquifers will be minimal. (USGS)
W85-03945

CHEMICAL ANALYSES OF ELUTRIATES, NATIVE WATER, AND BOTTOM MATERIAL FROM CHETCO, ROGUE, AND COLUMBIA RIVERS IN WESTERN OREGON,
Geological Survey, Portland, OR. Water Resources Div.
G. J. Fuhrer.
Available from OFSS, USGS, Box 25425, Fed Ctr., Denver, CO 80225. USGS Open-File Report 84-133, 1984. 57 p, 11 Fig, 29 Tab, 8 Ref.

Descriptors: *Dredging, *Environmental effects, *Bottom sediments, *Water quality, *Elutriates, Chetco River, *Oregon, Cathlamet Bay, Rogue River, Columbia River.

Chemical analyses of elutriates, bottom sediment, and water samples for selected metals, nutrients and organic compounds including insecticides, herbicides, and acid/neutral extractables have been made to provide data to determine short-term water-quality conditions associated with dredging operations in rivers and estuaries. Between April and August 1982, data were collected from the Chetco and Rogue River estuaries in southwestern Oregon, and from the mouth of the Columbia River in the northwestern Oregon to Cathlamet Bay, 18.2 miles upstream. In an elutriation test, bottom materials from a potential dredge site are mixed with native water - collected from either a dredge or disposal site - and the liquid portion of the mixture is removed, filtered, and chemically analyzed. Presented in this report are chemical and physical analyses of elutriates, native water, and bottom material for selected metals, ammonia, organic carbon, pesticides, particle size, and gas chromatographic/mass spectrometric semi-quantitative organic scans. Elutriate and bottom-material samples were screened specifically for phenolic compounds, particularly the chlorinated phenols; phenol was the only compound identified. Elutriate-test results showed variability for selected trace-metal concentrations of dissolved chemicals as follows: in micrograms per liter, arsenic ranged from < 1 to 15, cadmium from 1 to 210, copper from < 1 to 13, chromium from < 1 to 5, and nickel from 2 to 18. Results of computations to determine the amount of a constituent associated with bottom material and interstitial water and subsequently released (dissolved) into the elutriate-test native-mixing water are presented for selected trace metals. The highest elutriate-test release was 35 percent for manganese; the second highest, 5 percent for cadmium. All other computed releases were less than or equal to 1 percent. (USGS)
W85-03947

ATMOSPHERIC DEPOSITION: SAMPLE HANDLING, STORAGE, AND ANALYTICAL PROCEDURES FOR CHEMICAL CHARACTERIZATION OF EVENT-BASED SAMPLES IN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 5A.
W85-03949

COMPUTERIZED SCHEME FOR CHEMICAL CLASSIFICATION OF NATURAL WATERS AND SOIL EXTRACTS,
North Dakota State Univ., Fargo. Dept. of Soil Science.
P. Held, and A. Maianu.
Soil Science Society of America Journal, Vol. 48, No. 6, p 1456-1458, 1984. 2 Fig, 13 Ref.

Descriptors: *Computers, *Chemical properties, *Natural waters, *Soil water, Anions, Cations, Statistical Analysis System, Classification triangle.

The classification triangle is often used to define the chemical classes of water based on anionic and/or cationic composition, but the method is laborious. A SAS (Statistical Analysis System) program was developed to do the work rapidly and with high precision. The SAS program does not plot a graph, but does assign a value to a classification variable according to its chemical class. The variables used for water and soil extract classification according to their chemical composition are the dominant anions (bicarbonate, chloride and sulfate) and the dominant cations (Ca(2+), magnesium and sodium). The method is particular-

ly useful when large amounts of samples need to be classified and summarized. (Moore-IVI)
W85-03970

SPECIFIC-ION ELECTRODE DETERMINATIONS OF SULFIDE PRECONCENTRATED FROM SAN FRANCISCO BAY WATERS,
Geological Survey, Menlo Park, CA. Geologic Div.
D. V. Vivit, J. W. Ball, and E. A. Jenne.
Environmental Geology and Water Science, Vol. 6, No. 2, p 79-80, 1984. 15 Fig, 5 Tab, 23 Ref.

Descriptors: *Sulfides, *Preconcentration, *Specific-ion electrodes, *San Francisco Bay, *California, Estuaries, Water analysis, Copper, Cadmium, Nickel, Silver, Bisulfides.

Measurements of low-level dissolved-sulfide concentrations in estuarine water from San Francisco Bay have been made using the sulfide-specific electrode after preservation, separation, and preconcentration of the sulfide species. The separation and preconcentration were achieved by coprecipitation of ZnS with Zn(OH)2 followed by collection and dissolution of the precipitate, giving concentration factors up to 160-fold. Preconcentration provided sulfide solutions that were adequately measurable within the practical working range of the specific-ion electrode. The sulfide detection limit with the preconcentration step is 0.02 micro-g/l. Spike recoveries in the range of 81 to 101% have been achieved for laboratory-prepared samples having S2- concentrations as low as 0.6 micro-g/l and 84 to 100% for an estuarine sample spiked in the field with 2 micro-g/l S(-II). Positive correlations have been found between dissolved S(-II) concentrations and concentrations of dissolved Cd, Cu, and Ni; negative correlations have been found between bisulfide (HS(-)) activity and activities of Cd(2+), Cu(2+), and Ag(+) species. (Author's abstract)
W85-03978

DISTRIBUTION OF DISSOLVED ORGANIC CARBON AND METAL-BINDING CAPACITY AMONG ULTRAFILTERABLE FRACTIONS ISOLATED FROM SELECTED SURFACE WATERS OF THE SOUTHEASTERN UNITED STATES,
Savannah River Ecology Lab., Aiken, SC.
J. J. Alberts, J. P. Giesy, and D. W. Evans.
Environmental Geology and Water Science, Vol. 6, No. 2, p 91-101, 1984. 5 Fig, 11 Tab, 21 Ref. DOE contract EY-76-C-09-0819.

Descriptors: *Organic carbon, *Heavy metals, *Binding capacity, *Surface waters, *Florida, *Georgia, Dissolved solids, Metals, Copper, Lead, Cadmium, Particulate matter, Swamps, Rivers.

Surface water samples were collected at eight locations from four rivers and two swamps in Georgia and Florida between November 26 and 28, 1979. The variability of metal-binding capacities among locations was studied with respect to dissolved organic carbon, as well as the distribution of organic carbon and metal-binding capacities among ultrafilterable fractions. The binding capacity (BC) ranges of the waters for Cd, Cu, and Pb were: CdBC = 0.04 to 0.79 micro g atm/L; CuBC = 1.0 to 5.4 micro g atm/L; and PbBC = 5.0 to 17.8 micro g atm/L. These binding capacity values are in good agreement with values reported from the northeastern part of the country and northern Europe. The CdBC was due primarily to inorganic ligand binding, while PbBC was predominantly a result of organic matter. The CuBC was due to a complex function of both organic and inorganic binding. Significant portions of the CuBC and PbBC could be removed from the waters by ultrafiltration of particles between 0.45 micro m and 52 A in diameter. Ultrafiltration, even to removing particles > 13 A diameter, did not affect the CdBC. Significant fractions of the dissolved organic carbon are present in the ultrafilterable fraction which contains significant portions of the CuBC and PbBC. The distribution of carbon among various size fractions is considerably different than that observed in the same rivers one year earlier, which emphasizes the need to better understand the seasonal distribution of organic matter within a system before extrapolation resuts between systems. (Moore-IVI)
W85-03979

INTERACTIONS OF SOLUTES AND STREAMBED SEDIMENT; 1. AN EXPERIMENTAL ANALYSIS OF CATION AND ANION TRANSPORT IN A MOUNTAIN STREAM,
Geological Survey, Menlo Park, CA.
K. E. Bencala, V. C. Kennedy, G. W. Zellweger, A. P. Jackman, and R. J. Avanzino.
Water Resources Research, Vol. 20, No. 12, p 1797-1803, December, 1984. 8 Fig, 1 Tab, 19 Ref.

Descriptors: *Solute transport, *Bed load, *Mountain streams, *Cations, *Anions, *California, *Little Lost Man Creek, Chlorides, Strontium, Potassium, Lithium, Sorption, Tracers, Sediments.

An experimental injection was performed to study the transport of stream water solutes under conditions of significant interaction with streambed sediments in a mountain pool-and-riffle stream. Experiments were conducted in Little Lost Man Creek, Humboldt County, California, in a period of low flow during which only a part of the bank-full channel held active surface flow. The injection of chloride and several trace cations lasted 20 days. The results of the first 24 hours of the injection are discussed and the results of the first 10 days surveyed. Solute-streambed interactions of two types were observed. First, the physical transport of the conservative tracer, chloride, was affected by intergravel flow and stagnant water zones created by the bed relief. Second, the transport of the cations (strontium, potassium, and lithium) was appreciably modified by sorption onto streambed sediment. In the stream the readily observable consequence of the solute-streambed interactions was an attenuation of the dissolved concentration of each of the tracers. The attenuation in the stream channel occurred concurrently with the storage of tracers in the streambed via both physical and chemical processes. All tracers were subsequently present in shallow wells dug several meters from the wetted part of the channel. Sediment samples collected approximately 3 weeks after the start of the injection contained increased concentrations of the injected cations. (Author's abstract)
W85-03985

INTERACTIONS OF SOLUTES AND STREAMBED SEDIMENT; 2. A DYNAMIC ANALYSIS OF COUPLED HYDROLOGIC AND CHEMICAL PROCESSES THAT DETERMINE SOLUTE TRANSPORT,
Geological Survey, Menlo Park, CA.
K. E. Bencala.
Water Resources Research, Vol. 20, No. 12, p 1804-1814, December, 1984. 10 Fig, 3 Tab, 16 Ref.

Descriptors: *Solute transport, *Bed load, *Hydrologic properties, *Chemical properties, Chlorides, Strontium, Potassium, Lithium, Mountain streams, Tracers, Sorption, Simulation, Mass transfer.

Solute transport in streams is determined by the interaction of physical and chemical processes. Data from an injection experiment for chloride and several cations indicate significant influence of solute streambed processes on transport in a mountain stream. These data are interpreted in terms of transient storage processes for all tracers and sorption processes for the cations. Process parameter values are estimated with simulations based on coupled quasi-two-dimensional transport and first-order mass transfer sorption. Comparative simulations demonstrate the relative roles of the physical and chemical processes in determining solute transport. During the first 24 hours of the experiment, chloride concentrations were attenuated relative to expected plateau levels. Additional attenuation occurred for the sorbing cation strontium. The simulations account for these storage processes. Parameter values determined by calibration compare favorably with estimates from other studies in mountain streams. Without further calibration the transport of potassium and lithium is adequately simulated using parameters determined in the chloride-strontium simulation and with measured cation distribution coefficients. (Author's abstract)
W85-03986

SOLUTE TRAVEL TIMES DURING TRICKLE IRRIGATION,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
B. E. Clothier.
Water Resources Research, Vol. 20, No. 12, p 1848-1852, December, 1984. 6 Fig, 9 Ref.

Descriptors: *Fertigation, *Solute transport, *Trickle irrigation, Fertilizers, Mathematical models, Tracers, Bromide, Travel time.

Fertigation, the addition of fertilizers to irrigation water, is gaining widespread popularity as an efficient and economic way of supplying soluble plant nutrients to irrigated orchard and field crops. Limiting excessive vertical movement of the fertilizer is necessary to prevent pollution of groundwater. The nutrients applied with the irrigation water should be available to a substantial fraction of the plant root system. A simple theoretical model is developed to predict the travel times for passive transport of a nonreactive solute during three-dimensional water flow from a surface point source (a drip emitter) in the absence of surface evaporation. The solute diffusion-dispersion term in the flow equation is omitted based on experimental evidence. A laboratory trickle irrigation experiment with bromide as a tracer is used to test the model. There is a general accord between the measured bromide fronts and the predicted isochrones. These experiments test reasonably rigorously the solute travel time transfer model in three dimensions. The simple model can be extended to describe the convective transport of absorbed solutes in three dimensions by using, for example, a linear sorption isotherm. (Moore-IVI)
W85-03990

HYDROLOGIC ANALYSES OF ACIDIC AND ALKALINE LAKES,
Systech Engineering, Inc., Lafayette, CA.
For primary bibliographic entry see Field 2H.
W85-03993

INFLUENCE OF STORM CHARACTERISTICS ON SULFATE IN PRECIPITATION,
Atmospheric Environment Service, Downsview (Ontario).
R. M. Bloxam, J. W. Hornbeck, and C. W. Martin.
Water, Air, and Soil Pollution, Vol. 23, No. 4, p 359-374, November, 1984. 5 Fig, 4 Tab, 22 Ref.

Descriptors: *Storms, *Chemistry of precipitation, *Sulfates, *New Hampshire, Hubbard Brook, Precipitation, Storm dynamics, Seasonal variation, Wind.

Effects of storm dynamics on precipitation chemistry were examined using an atmospheric budget for sulfate. Test data were supplied from 100 storms occurring between 1975 and 1978 at Hubbard Brook Experimental Forest in New Hampshire. Concentrations of major ions were usually greater in convective storms than in continuous or layer storms. Stratification of individual storms into either convective or continuous events produced a clearer picture of the relationships of sulfate ion concentrations to such factors as storm type, wind direction, and precipitation amount and intensity. The analysis of a 100-storm data set showed that both storm type and wind direction have seasonal dependence that acts to produce a winter minimum in sulfate ion concentrations. Storm type and wind direction apparently combine with other factors such as seasonal variations in air mass loading to produce the maximum sulfate ion concentrations that occur in summer precipitation at Hubbard Brook. (Baker-IVI)
W85-04010

MASS TRANSFER OF NH3 INTO WATER AT ENVIRONMENTAL CONCENTRATIONS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
T. Ibusuki, and V. P. Aneja.

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Chemical Engineering Science, Vol. 39, No. 7/8, p 1143-1155, 1984. 4 Fig, 4 Tab, 13 Ref.

Descriptors: *Ammonia, *Mass transfer, Temperature, Chemical reactions, Path of pollutants, Gases.

Because of the significant role of NH3 in determining the formation rate of sulfate aerosols, the mass transfer of NH3 into water at environmental concentrations was studied in a two-phase flow reactor. The concentration of NH3 in water ranged from 10 to the minus 6th to 10 to the minus 4th power mole/liter. Temperature changed from 12 to 30 C. At the conditions of the study the overall mass transfer coefficient is more dependent on the hydrodynamics of the gas phase than of the liquid phase. No significant concentration or temperature effects on the value of K were found. The results concerning K were well correlated with the individual mass transfer coefficients of the gas phase and the liquid phase. The small enhancement of the liquid phase mass transfer due to the hydrolysis reaction of NH3 has been confirmed, coinciding with the concentration independence of the overall mass transfer rate. The results of the study confirm some of the theoretical or semiempirical assumptions for estimating the mass transfer coefficient, measurements of mass transfer rates of other atmospheric constituents or pollutants will be required in this connection. (Baker-IVI)
W85-04040

EQUILIBRIUM APPROACHES TO NATURAL WATER SYSTEMS - PART 4; DETERMINATION OF ALKALINITY OF ORGANIC BASES IN AN ANOXIC HYPOLIMNETIC LAKE WATER,
Umea Univ. (Sweden).
J. Liden, and S. Sjoberg.
Schweizerische Zeitschrift fur Hydrologie, Vol. 46, No. 1, p 51-63, October, 1984. 6 Fig, 2 Tab, 19 Ref.

Descriptors: *Lakes, *Hypolimnion, *Alkalinity, *Anoxic conditions, Chemical reactions, Protolyte, Organic compounds, Iron, Organic bases.

The contribution of organic bases to the alkalinity of the anoxic hypolimnetic water of a small lake has been studied. The presence of a protolyte, best described as a one-protonic acid (HL), was demonstrated by potentiometric titrations. The pka of HL was found to be 4.24 + or - 0.08 (3 sigma) and it reached a concentration of 0.4 mM close to the sediment surface. HL was most rapidly formed in the sediment. Because of precipitation reactions, titration experiments could not be performed at pH $>$ 6.8, but indications of additional bases having a pka $>$ 8 were found. The results were interpreted as indicating the presence of low molecular weight carboxylic acids and free amino acids originating from bacterial decomposition of organic material. Polarographicaly measured Fe(2+) concentrations, in situ pH measurements and various model ligands were used to assess the metal speciation in the hypolimnion. Although strong complexing agents such as citrate and glutamine may be present, the total concentration of both Fe(2+) and ligands are too low to bind more than at maximum 20% of the ferrous iron. The total contribution to the alkalinity of organic proton acceptors was up to 30%. This means that the total alkalinity cannot be approximated by HCO3(-) ions alone. The evaluation of the equivalence point in alkalinity titrations of anoxic waters should therefore be performed with allowance for possible interference from carboxylates. (Baker-IVI)
W85-04074

CHEMICAL COMPOSITION OF GROUNDWATER OF THE AZERBAIDZHAN IN CONNECTION WITH THEIR USE FOR DOMESTIC WATER SUPPLY,
V. A. Listengarten.
Water Resources, Vol. 10, No. 2, p 151-158, March-April, 1983. 3 Tab, 4 Ref. Translated from Vodnye Resursy, No. 2, p 86-94, March-April, 1983.

Descriptors: *Groundwater, *Trace elements, *Azerbaidzhan, *USSR, Chemical analysis, Water quality, Drinking water, Brackish water, Saline water, Chlorides, Sulfates.

Low-mineralized groundwaters of piedmont and intermontane plains of the Azerbaidzhan SSR serve as the main source of centralized domestic water supply of the majority of cities of the republic and decentralized water supply of many populated rural areas. Within the plains the groundwaters are primarily fresh of slightly brackish quality and, in the lowlands, the waters are strongly brackish and saline. During the past 10 years the Azerbaidzhan Geological Administration has been conducting investigations related to an evaluation of exploitable groundwater supplies. The chloride and sulfate content in fresh waters was almost always less than 10 meq/liter. The total hardness of fresh waters was usually 5-7 meq/liter, but occasionally reached 10 meq/liter. The trace elements Fe, Cu, Zn, stable Sr, Mo, and U, were present in waters of all plains, and nitrates, As, Se, and Pb, were found in waters of almost all plains. Be and Mn are found in waters of only certain plains. The sources of entry of trace elements in the groundwater of the plains are surface waters, water bearing rocks, and to a lesser extent precipitation and waters of deep circulation. (Baker-IVI)
W85-04093

TRITIUM CONTENT IN USSR SURFACE WATERS IN 1979-1980,
V. V. Romanov, V. I. Ferronskii, S. M. Vakulovskii, I. Yu. Katrich, and E. I. Roslyi.
Water Resources, Vol. 10, No. 3, p 274-279, May-June, 1983. 5 Fig, 4 Tab, 10 Ref. Translated from Vodnye Resursy, No. 3, p 109-115, May-June, 1983.

Descriptors: *Tritium, *Lakes, *Rivers, *Chemistry of precipitation, *USSR, Distribution, Spatial distribution, Seasonal variation, Surface waters, Groundwater recharge, Infiltration.

A study of the regularities of the distribution of tritiated water (HTO) in surface waters was undertaken. Starting in 1973 regular sampling of water from the main rivers of the USSR in the flood and low-water periods was organized. The tritium content in river waters is determined by its concentration in precipitation over the drainage area of the river and the lag time of the infiltrating percipitation in soils through which recharge and discharge of groundwaters into the river channel are accomplished. Thus the tritium content in river waters is subject to temporal and spatial variations. In addition to temporal variations in river waters, spatial variations of the T concentration are also observed. The calculated T concentrations in groundwaters are very high for Siberian rivers and correspond to the T concentration in precipitation that fell only 10-15 years ago. While the T content in river waters is mainly determined by its content in precipitation falling on the drainage area of the river, for lake waters, T content is determined by the hydrologic characteristics of the lake itself. (Baker-IVI)
W85-04108

INVESTIGATION OF THE POSSIBILITY OF USING THE COMPOSITION METHOD FOR DETERMINING MINERALIZATION OF WATER IN A RIVER SYSTEM,
G. Kh. Ismaiylov, and K. Yu. Shatalova.
Water Resources, Vol. 10, No. 4, p 356-369, July-August, 1983. 6 Fig, 2 Tab, 6 Ref. Translated from Vodnye Resursy, No. 4, p 75-88, July-August, 1983.

Descriptors: *Rivers, *Mineralization, Water quality control, Water resources, Water management, Reservoirs, Wastewater pollution, Reservoir storage, Runoff.

Efforts were made to determine mineralization of river waters on two characteristic stretches of a river: a stretch with a regulating reservoir in the presence of an intake and discharge of wastewaters; and an unregulated stretch with an intake and local inflow. The qualitative characterisics of the river runoff are formed under the effect of both natural and anthropogenic factors. For the regulated water source the problem reduces to the following: determine the average mineralization of water in the reservoir at the start and end of the calculated time intervals into which the water management year is divided; establish the relation between mineralization and volume of inflow to the reservoir; and establish the relation between mineralization and reservoir storage. (Baker-IVI)
W85-04120

ANALYSIS OF THE POSSIBILITIES OF USING HYDROCHEMICAL EARTHQUAKE PRECURSORS,
For primary bibliographic entry see Field 2F.
W85-04137

PROJECT SKYWATER, 1982-83 SCPP DATA INVENTORY, SIERRA COOPERATIVE PILOT PROJECT.
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
For primary bibliographic entry see Field 3B.
W85-04212

CLOUD PHYSICS STUDIES IN THE SCPP, 1982-1983,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W85-04214

SEEDING EFFECTS IN NON-CONVECTIVE CLOUDS OF THE SCPP,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W85-04215

INTERFERENCES IN THE DETERMINATION OF TOTAL NITROGEN IN NATURAL WATERS BY PHOTO-OXIDATION TO NITRATE-NITRITE MIXTURE,
Uppsala Univ. (Sweden). Dept. of Analytical Chemistry.
L. Gustafsson.
Talanta, Vol. 31, No. 11, p 979-986, November, 1984. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Nitrites, *Nitrates, *Water analysis, *Photo-oxidation, Brackish water, Natural waters, Organic matter, Salts, Carbon dioxide, Hydrogen ion concentration.

The method proposed by Armstrong, Williams and Strickland for the photo-oxidation of total nitrogen in sea-water to nitrate and nitrite has been studied in some detail, to extend its use to fresh and brackish waters, applying a more accurate method for the determination of the reaction products. Variables influencing the yield of nitrate and nitrite are irradiation time, pH and type of buffer, kind of nitrogen compound and its concentration, and the concentrations of oxygen, carbon dioxide, organic matter and salts, especially bromides, even at the low concentrations found in brackish waters. All these variables interact in a rather complicated way. Interferences from halides, organic matter and carbon dioxide are considerably reduced by ensuring that the pH is kept at 8.5-9 during the irradiation. Because pure solutions of many substances give quantitative yields ($<$ or = 98%) in the pH-range 7-9 usually recommended, whereas others require lower pH for maximal oxidation, a method has been developed involving photo-oxidation first at pH 2.1 and then at pH 8.5-9. In the absence of interfering concentrations of halides the relative increase in yield by an initial irradiation at low pH is especially large (10-36%) for proteins, organic nitrogen in fresh waters, uric acid and urea. A comparison is made between determination of total nitrogen in some natural waters by using photo-oxidation and by a Kjeldahl method modified to give total nitrogen. By making use of the optimal conditions presented in this paper, a negative error of less than 8% is expected in the determination of total nitrogen in fresh waters. For saline water the error will probably be larger, at

least at a high ratio of organic to inorganic nitrogen. (Author's abstract)
W85-04239

EVALUATION OF THE BURNS MODEL FOR NITRATE MOVEMENT IN WET SANDY SOILS,
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
Y. M. Khanif, O. V. Cleemput, and L. Baert.
Journal of Soil Science, Vol. 35, No. 4, p 511-518, December, 1984. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Nitrates, *Solute transport, *Sandy soils, Soil water, Leaching, Model studies, Water table, Capillarity, Nutrients.

Nitrate can be translocated by leaching during the wet season and by upward movement during the dry season. Burns (Journal of Soil Science 25, 165-178, 1974) developed a simple model to predict the distribution of non-adsorbed solutes subject to leaching and upward movement. The model was tested to predict the redistribution of nitrate-N during winter in soil profiles of 1 m depth. The measured and calculated nitrate concentrations in 100 cm wet sandy soil profiles were compared: the results showed reasonably good agreement between the two values. Adjusting the initial conditions and reducing the segment size from 10 to 5 cm did not improve the accuracy of the prediction. Better agreement was, however, obtained when only the samples above the groundwater table were considered. The model gives a satisfactory prediction under free drainage conditions. (Moore-IVI)
W85-04248

DIFFUSION OF UREA, AMMONIUM AND SOIL ALKALINITY FROM SURFACE APPLIED UREA,
Oxford Univ. (England). Soil Science Lab.
Rachhpal-Singh, and P. H. Nye.
Journal of Soil Science, Vol. 35, No. 4, p 529-538, December, 1984. 6 Fig, 15 Ref.

Descriptors: *Urea, *Ammonium, *Alkalinity, *Soil chemistry, Hydrogen ion concentration, Model studies, Hydrolysis, Sorption, Diffusion, Soil solution.

Urea application to the soil triggers a number of physical, chemical and microbiological reactions that are of great interest to both the agricultrualist concerned with maximizing crop yields and to the environmentalist concerned with minimizing nitrogen pollution of surface and groundwaters. A model for predicting the concentration profiles of urea, ammonium and soil pH in a soil column following diffusion from a surface application of urea is developed, using independently derived parameters, and tested experimentally. The rate of urea hydrolysis as a function of substrate concentration and pH in the soil solution, and the sorption of urea and ammonium by the soil from solution were studied separately under the same conditions as those in the diffusion run. A theory for the propagation of changes of pH in soils was applied to describe the diffusion of soil alkalinity arising from urea hydrolysis. There was good agreement between experimental and predicted concentrations of urea and NH4, and soil pH values at the two times tested. The importance of this model is the possibility of its application to actual field conditions where pH changes produced by urea hydrolysis are large enough to alter the physicochemical and microbiological properties of the soil. (Moore-IVI)
W85-04249

RESPONSE OF BACTERIA ISOLATED FROM A PRISTINE PRAIRIE STREAM TO CONCENTRATION AND SOURCE OF SOLUBLE ORGANIC CARBON,
Kansas State Univ., Manhattan. Div. of Biology.
J. V. McArthur, G. R. Marzolf, and J. E. Urban.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 238-241, January, 1985. 4 Fig, 14 Ref.

Descriptors: *Aquatic bacteria, *Organic carbon, *Prairie watersheds, *Streams, *Vegetation, Dissolved solids, Grasses, Oak trees, Leachates.

Streams in tallgrass prairie flow through distinct zones of riparian vegetation. Headwaters of tallgrass prairie watersheds are dominated by grasses. Grasses, shrubs, and small trees dominate the midreaches, and still lower reaches flow through a gallery forest dominated by oak trees. It has been hypothesized that bacterial assemblages in the stream change along the watercourse and that these bacteria vary in their ability to grow on dissolved organic substrates from various terrestrial sources. Responses of native aquatic bacteria to source and concentration of dissolved organic carbon was observed by using gradient plates. Dissolved organic carbon of prairie (grasses) or gallery forest (bur oak) origin was used as the carbon source in these observations. Bacteria isolated from sediments in the grassland reaches of a prairie stream showed growth only on grass leachates. Bacteria isolated from the gallery forest reaches of the same stream were able to grow on plates made from either source of leachate. The differential use of dissolved organic carbon compounds by natural aquatic bacterial species is related to their exposure to these compounds in nature. (Moore-IVI)
W85-04266

NEUTRALIZATION OF ACID RUNOFF BY GROUNDWATER DISCHARGE TO STREAMS IN CANADIAN PRECAMBRIAN SHIELD WATERSHEDS,
National Hydrology Research Inst., Ottawa (Ontario).
D. J. Bottomley, D. Craig, and L. M. Johnston.
Journal of Hydrology, Vol. 75, No. 1/4, p 1-26, 1984/1985. 13 Fig, 2 Tab, 31 Ref.

Descriptors: *Runoff, *Acid rain, *Neutralization, *Precambrian Shield, *Ontario, Harp Lake watershed, Turkey Lakes watershed, Snowmelt, Groundwater, Alkalinity, Acid precipitation, Infiltration, Base flow, Storm runoff.

Application of environmental isotope techniques during storm and snowmelt runoff from the Harp Lake and Turkey Lakes watersheds on the Precambrian Shield of central Ontario, Canada, indicates that subsurface pre-event water is a major component of the runoff hydrograph. Storm runoff from two sub-basins in the Harp Lake watershed is comprised of 40-90% groundwater, depending on rainfall amount and intensity, and antecedent soil-moisture conditions and water-table depth. Because the alkalinity of the groundwater is large compared to the acid precipitation (pH 3.8-4.5) characteristic of this region, groundwater discharge results in significant neutralization of runoff acidity. Snowmelt-runoff studies in the Turkey Lakes watershed indicate that much of the first meltwater from the acidic (pH approximately 4.5) snowpack infiltrates the subsurface, displacing higher-pH groundwater to the stream. Since the first meltwater from an ablating snowpack is more acidic than the snow itself, meltwater infiltration limits the extent of stream acidification during snowmelt runoff. Hence, the physical displacement of near-neutral-pH pre-event subsurface water during storm- and snowmelt-runoff periods partially buffers the alkalinity of baseflow. As long as the acid neutralization capacity of the geologic materials storing the subsurface water is not exhausted, groundwater contributions to runoff will continue to neutralize acid runoff. (Author's abstract)
W85-04268

GEOCHEMICAL EVOLUTION OF GROUNDWATER IN SEQUENCES OF SEDIMENTARY ROCKS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
C. D. Palmer, and J. A. Cherry.
Journal of Hydrology, Vol. 75, No. 1/4, p 27-65, 1984/1985. 9 Fig, 8 Tab, 92 Ref.

Descriptors: *Geochemistry, *Sedimentary rocks, *Groundwater, Chemical reactions, Groundwater movement, Mass transfer, Simulation, Minerals, Limestone, Dolostone, Carbon dioxide, Calcite, Gypsum, Albite, Kaolinite, Sulfates, Pressure, Temperature.

A geochemical mass-transfer model (WATEGM-SE) is used to illustrate the effect of several major processes on the chemical evolution of groundwater flowing through hypothetical sequences of sedimentary rocks. Using chemical reactions prevalent in these rock types, the simulations demonstrate the influence of the initial soil PCO2, temperature, pressure and the sequence of encounter of the mineral phases along the flow path of the groundwater. The evolution of groundwater in different sequences of limestone and dolostone is simulated with a range of initial PCO2 -values typical of natural soils. Temperatures of 10 degrees and 25 C are used. The simulations indicate that appreciable differences in the chemical composition of the groundwater and the spring-discharge water will occur, depending on whether a limestone or dolostone unit is first encountered. The cases of more complex stratigraphy are represented by three hypothetical sequences in which each stratum has only one reactive mineral phase. The reactions used in these simulations include calcite dissolution and precipitation, gypsum dissolution and precipitation, cation exchange, and the weathering of albite to kaolinite. Sulfate reduction occurs in the last stratum in each of these sequences. The strata in the three sequences are identical except for the order in which they are encountered by the groundwater. Considerably different hydrochemistries are calculated for each of these sequences even within the same types of rock units. The effect of increasing total pressure is demonstrated with a water initially saturated with both gypsum and calcite under a pressure of 1 bar. The system is then closed and the pressure is increased to 1 kbar while the temperature remains constant at 25 C. The results indicate that pressure has a significant effect above 50 bar or 500 m hydrostatic head. It is commonly expected that groundwater in sedimentary rocks will exhibit trends in chemistry that are the result of the length of the flow path and the groundwater velocity. The simulated sequences obtained in this study demonstrate that the order in which the various sedimentary strata are encountered by the groundwater and the partial pressure of the CO2 in the soil zone are important factors. For groundwater systems that are near equilibrium with the host rock, these factors may control the chemical evolution of the water. (Author's abstract)
W85-04269

TRANSPORT AND CONCENTRATION CONTROLS FOR CHLORIDE, STRONTIUM, POTASSIUM AND LEAD IN UVAS CREEK, A SMALL COBBLE-BED STREAM IN SANTA CLARA COUNTY, CALIFORNIA, U.S.A.; 1. CONCEPTUAL MODEL,
Geological Survey, Menlo Park, CA.
V. C. Kennedy, A. P. Jackman, S. M. Zand, G. W. Zellweger, and R. J. Avanzino.
Journal of Hydrology, Vol. 75, No. 1/4, p 67-110, 1984/1985. 14 Fig, 9 Tab, 25 Ref.

Descriptors: *Chlorides, *Strontium, *Potassium, *Lead, *Sediments, *Solute transport, *Uvas Creek, *California, Adsorption, Tracers, Model studies, Underflow, Bed load, Stream discharge.

Stream sediments adsorb certain solutes from streams, thereby significantly changing the solute composition; but little is known about the details and rates of these adsorptive processes. To investigate such processes, a 24-hr. injection of a solution containing chloride, strontium, potassium, sodium and lead was made at the head of a 640-m reach of Uvas Creek in west-central Santa Clara County, California. Uvas Creek is a cobble-bed pool-and-riffle stream draining the eastern slopes of the Santa Cruz Mountains. By September 12, 1973, after a long dry season, Uvas Creek had a low (0.0215 cu m/s average) flow which varied diurnally, from 0.018 to 0.025 cu m/s. Because stream discharge varied while the injection rate was constant, the concentration of tracers (injected solutes), after mixing in the stream, varied inversely with discharge. Chloride, a nonreactive solute, served as a tracer of water movement. Analysis of extensive chloride concentration data at five sites below the injection point during and after the injection demonstrated that there was considerable underflow of water through the stream gravels;

however, the extent of underflow varied greatly within the study reach. Pre-injection water, displaced by tracer-laden water percolating through the gravels, diluted tracers in the stream channel, giving the mistaken impression of groundwater inflow at some points. Accurate measurement of total discharge in such streams requires prolonged tracer injection unless a reach can be found where underflow is negligible. Strontium and potassium were adsorbed by the bed sediments to a moderate extent and lead was strongly adsorbed. A high proportion of these metals could be removed by adsorption from percolating underflow because of extensive and intimate contact with bed sediments. After channel clearing following injection cutoff, 51% of the added strontium and 96% of the lead remained in the study reach, whereas only 19% of the chloride remained. Packets of sized sediment, placed in the stream before the experiment and withdrawn during and after the injection, indicated that the strontium absorbed on the 0.42-0.50-mm size sediment appeared to achieve near equilibrium with dissolved strontium within less than 2 hr. whereas 3.4-4.0-mm grains had not reached that stage after 24 hr. The cation-exchange capacity (CEC) of the sediments shows a 'bimodal' distribution with grain size. Largest values are in the finest sizes, lower values in the fine-to-medium sand-size range, intermediate values in the coarse- to very coarse-grained sand, and decreasing values with size above very coarse-grained sand. This considerable exchange capacity in coarse-sand to granule-size particles means that a streambed, that has not been infilled with fines to reduce permeability, can be highly reactive and accessible capacity. As stream discharge increases from low flow, the ratio of underflow to channel flow should decrease rapidly with resultant diminution in percent of solutes sorbed within a particular stream reach. (Author's abstract)
W85-04270

TRANSPORT AND CONCENTRATION CONTROLS FOR CHLORIDE, STRONTIUM, POTASSIUM AND LEAD IN UVAS CREEK, A SMALL COBBLE-BED STREAM IN SANTA CLARA COUNTY, CALIFORNIA, U.S.A.; 2. MATHEMATICAL MODELING,
California Univ., Davis. Dept. of Chemical Engineering.
A. P. Jackman, R. A. Walters, and V. C. Kennedy.
Journal of Hydrology, Vol. 75, No. 1/4, p 111-141, 1984/1985. 10 Fig, 2 Tab, 20 Ref.

Descriptors: *Solute transport, *Adsorption, *Chloride, *Strontium, *Potassium, *Lead, *Uvas Creek, *California, *Mathematical models, Streams, Bed load, Convection, Mixing, Diffusion, Tracers, Patriculate matter.

Three models describing solute transport of conservative ion species and another describing transport of species which adsorb linearly and reversibly on bed sediments are developed and tested. The conservative models are based on three different conceptual models of the transient storage of solute in the bed. One model assumes the bed to be a well-mixed zone with flux of solute into the bed proportional to the difference between stream concentration and bed concentration. The second model assumes solute in the bed is transported by a vertical diffusion process described by Fick's law. The third model assumes that convection occurs in a selected portion of the bed while the mechanism of the first model functions everywhere. The model for adsorbing species assumes that the bed consists of particles of uniform size with the rate of uptake controlled by an intraparticle diffusion process. All models are tested using data collected before, during and after a 24-hr. pulse injection of chloride, strontium, potassium and lead ions into Uvas Creek near Morgan Hill, California. All three conservative models accurately predict chloride ion concentrations in the stream. The model employing the diffusion mechanism for bed transport predicts better than the others. The adsorption model predicts both strontium and potassium ion concentrations well during the injection of the pulse but somewhat overestimated the observed concentrations after the injection ceases. The overestimation may be due to the convection of solute deep into the bed where it is retained longer than the 3-week post-injection observation period. The model, when calibrated for strontium, predicts potassium equally well when the adsorption equilibrium constant for strontium is replaced by that for potassium. (Author's abstract)
W85-04271

GROUNDWATER CHEMISTRY IN SOUTHEAST SUFFOLK (U.K.) AND ITS RELATION TO QUATERNARY GEOLOGY,
Birmingham Univ. (England). Dept. of Geological Sciences.
J. A. Heathcote, and J. W. Lloyd.
Journal of Hydrology, Vol. 75, No. 1/4, p 143-165, 1984. 7 Fig, 5 Tab, 33 Ref.

Descriptors: *Grundwater, *Chemical properties, *Geochemistry, *Suffolk, *England, Saline water intrusion, Strontium, Fluoride, Iodide, Climate, Permafrost, Geological history, Groundwater recharge.

Eastern England is an area of essentially low relief and low rainfall and is consequently very dependent on groundwater for domestic, agricultural and industrial use. Most of the groundwater is obtained from the chalk, a soft white limestone of late Cretaceous age with locally a very high secondary permeability. the sand and gravel deposits are important in localizing recharge to the Chalk, and this influence is reflected in the Chalk Aquifer groundwater chemistry. A detailed study of the chemistry of the Chalk groundwater, including strontium, fluoride and iodide as well as major elements, has shown that this chemistry results from three phases of saline intrusion, early Pleistocene to modern, and at least two periods of freshwater flushing. Climate has been the major influence on groundwater flow since the present rock outcrop pattern was established, the important factors being the restriction of recharge by permafrost, and the deep circulation facilitated by low sea level. In the absence of groundwater flow during permafrost periods, diffusion played an important role in the transfer of solute between the Boulder Clay and the Chalk. (Moore-IVI)
W85-04272

SEDIMENT-WATER EXCHANGE IN LOUGH ENNELL WITH PARTICULAR REFERENCE TO PHOSPHORUS,
Foras Forbartha, Dublin (Ireland).
For primary bibliographic entry see Field 2H.
W85-04294

ANALYTICAL FRACTIONATION OF DISSOLVED ORGANIC MATTER IN WATER USING ON-LINE CARBON DETECTION,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. K. Schneider, R. Gloor, W. Giger, and R. P. Schwarzenbach.
Water Research, Vol. 18, No. 12, p 1515-1522, 1984. 4 Fig, 5 Tab, 29 Ref.

Descriptors: *Dissolved solids, *Organic matter, *On-line carbon detection, *Fractionation, Natural waters, Wastewater analysis, Water analysis, Hydrogen ion concentration, Organic carbon.

A routine method is described for the analytical fractionation of dissolved organic matter (DOM) in natural freshwater and in used waters. The fractionation is based on the different adsorption behaviors of various constituents of the DOM on octadecyl-silica as a function of pH. The DOM is separated into a hydrophilic, an acid and a hydrophobic fraction. The detection is carried out by an on-line carbon detector. The method requires only small water samples (20 ml) with low dissolved organic carbon (DOC) concentrations (1-5 mg C/l). The samples can be analyzed rapidly with no preconcentration. Fractionation of model compounds and mixtures demonstrates the performance of the method. The application of the method is illustrated by an investigation of the changes of the DOC composition occurring in a longitudinal transect of a river and during the infiltration of river water to groundwater. (Author's abstract)
W85-04298

SILICATE DISSOLUTION INFLUENCE ON FILSON CREEK CHEMISTRY, NORTHEASTERN MINNESOTA,
Syracuse Univ., NY. Dept. of Geology.
D. I. Siegel, and H. O. Pfannkuch.
Geological Society of America Bulletin, Vol. 95, No. 12, December, 1984. 4 Fig, 4 Tab, 58 Ref.

Descriptors: *Silicates, *Chemical kinetics, *Solution, *Filson Creek, *Minnesota, Surface water, Groundwater, Precipitation, Bicarbonates, Calcium, Magnesium, Sodium, Potassium, Sulfates, Mafic minerals, Minerals, Troctolite.

The chemistry of surface water, precipitation, and ground water in Filson Creek watershed was studied to evaluate the kinetics of dissolution of silicate minerals in a natural watershed underlain by troctolite. Annual chemical budgets in 1977 showed net losses of dissolved silica, bicarbonate, calcium, magnesium, and sodium of about 31.0, 19.6, 4.8, 3.8, and 2.1 kg per hectare per year, respectively, and net gains of dissolved potassium and sulfate of 0.4 and 8.9 kg/ha/yr. On a molar basis, about 1.5 times as much magnesium was lost as was calcium, even though the amount of mafic minerals in till and bedrock underlying the watershed is about 10 times less than the amount of calcic plagioclase. Molar concentrations of magnesium in base flow and ground water were about the same as concentrations of calcium and sodium. These field data indicate that magnesium loss from the mafic minerals may be faster than either calcium or sodium loss from plagioclase. Stoichiometric 'reconstruction' of primary minerals from base-flow water chemistry and kaolinite was done as a first approximation to evaluate the rates of loss. The calculations indicated that the release of magnesium from mafic minerals would have to be more than ten times faster than the release of calcium and sodium from plagioclase to account for the amount of magnesium in base flow. These calculations compare favorably with experimental linear rates of cation and silica release from forsterite, enstatite, augite, and labradorite. (Author's abstract)
W85-04310

METHOD FOR MEASURING OXYGEN IN AQUATIC MICROZONES,
Chequamegon National Forest, Park Falls, WI.
M. P. Dombeck, R. W. Bachmann, and B. W. Menzel.
Journal of Freshwater Ecology, Vol. 2, No. 6, p 535-540, December, 1984. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Dissolved oxygen, *Water analysis, *Microzones, Lotic environment, Lentic environment, Costs.

A method to obtain accurate dissolved oxygen concentration (DO) measurements within a 16-mm microzone was developed using oxygen-permeable dialysis tubing with a 12-ml water sample and a modification of the micro-Winkler technique. Controlled experiments showed that DO within tubes reached 99% equilibrium with ambient water in less than 3 hours in lotic waters and in less than 5 hours in lentic waters with experimental error of 0.05 mg/liter. A kit to perform the DO measures can be assembled for about $150, and samples can be run in less than 10 minutes. (Author's abstract)
W85-04312

RELATIONSHIPS BETWEEN PHOSPHORUS FUNCTIONAL CLASSES AND ALKALINE PHOSPHATASE ACTIVITY IN RESERVOIR LAKES,
Oklahoma State Univ., Stillwater. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 2H.
W85-04313

ARSENIC AND ANTIMONY IN GEOTHERMAL WATERS OF YELLOWSTONE NATIONAL PARK, WYOMING, USA,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer, and J. M. Thompson.
Geochimica et Cosmochimica Acta, Vol. 48, No. 12, p 2547-2561, December, 1984. 14 Fig, 6 Tab, 55 Ref.

Descriptors: *Arsenic, *Antimony, *Hot springs, *Yellowstone National Park, *Wyoming, *Steamboat Springs, *Nevada, *Morgan Springs, *California, Geothermal studies, Chlorides, Silica, Carbonates, Leaching, Geochemistry, Chemical precipitation.

Samples from the thermal springs of Yellowstone National Park (YNP) (Wyoming), Steamboat Springs (Nevada), and Morgan Springs (Lassen, California) were collected during 1966-75 (principally after 1971). A total of 268 thermal spring samples (from 230 individual YNP springs, and 2 samples from Morgan Springs and 5 samples from Steamboat Springs) were analyzed for total soluble As using reduced molybdenum-blue; 27 of these samples were also analyzed for total Sb using flame atomic absorption spectrometry. At Yellowstone the Cl/As atomic ratio is nearly constant among neutral-alkaline springs with Cl > 100 mg/L, and within restricted geographic areas, indicating no differential effects of adiabatic vs. conductive cooling on arsenic. The Cl/As ratio increased with silica and decreases with decreasing Cl/total-CO3; the latter relationship is best exemplified for springs along the extensively sampled SE-NW trend within the Lone Star-Upper-Midway Basin region. The relationship between Cl/As and Cl/total-CO3 at Yellowstone suggests a possible rock leaching rather than magmatic origin for much of the Park's total As flux. Condensed vapor springs are low in both As and Cl. Very high Cl/As ratios (> 1000) are associated exclusively with highly diluted (Cl < 100 mg/L) mixed springs in the Norris and Shoshone Basins and in the Upper White Creek and Firehole Lake areas of Lower Basin. The high ratios are associated with acidity and/or oxygen and iron; they indicate precipitation of As following massive dilution of the As-bearing high-Cl parent water. Yellowstone Sb ranged from 0.009 at Mammoth to 0.166 mg/L at Joseph's Coat Spring. Within basins, the Cl/Sb ratio increases as the Cl/total-CO3 ratio decreases, in marked contrast to As. Mixed springs also have elevated Cl/Sb ratios. (Collier-IVI)
W85-04370

URANIUM GEOCHEMISTRY IN GROUNDWATER FROM TERTIARY SEDIMENTS,
Nebraska Univ.-Lincoln. Inst. of Agriculture and Natural Resources.
R. F. Spalding, A. D. Druliner, L. S. Whiteside, and A. W. Struempler.
Geochimica et Cosmochimica Acta, Vol. 48, No. 12, p 2679-2692, December, 1984. 10 Fig, 1 Tab, 50 Ref.

Descriptors: *Uranium radioisotopes, *Geochemistry, *Groundwater, *Nebraska, Water quality, Leaching, Dissolved solids, Surface waters, Residence time, Activity ratio, Geohydrology.

Dissolved U concentrations and activity ratios (ARs) of the U isotopes in the U-238 decay series were measured in ground and surface waters as part of an investigation to delineate the water quality in a proposed uranium mining area of northwest Nebraska. In oxidizing groundwaters from 67 wells completed in the Tertiary sediments, increasing U concentrations in the direction of groundwater flow generally were associated with a maturation of the formation water as evidenced by evolutionary trends in major ion character. The increased U levels probably are associated with leaching as shown by the positive correlation between U concentrations and total dissolved solids (TDS) (r = +0.83). The inverse relationships between TDS and U ARs (r = -0.73) and U levels and ARs (r = 0.72) indicate that the decay of excess U-234 is related to maturation of the formation water and to sediment leaching along the flowpath. The data are described by a model which incorporates etching, decay and recoil and suggests that aquifer residence time can be estimated from the TDS level. The levels of soluble U in a reducing uraniferous hydrogeologic unit near Crawford, Nebraska are affected by the proximity of the sample collection to ore. In groundwater samples having similar chemistries (Na-SO4 + Cl type), similar Ehs, and collected from a close-knit pattern, U concentrations ranged from 0.01 to 2,037 micro-g/l and ARs ranged from 0.75 to 12.6. This high variability in U levels and ARs is indicative of uranium ore in small areal studies where low ARs almost always are associated with high U concentrations. (Author's abstract)
W85-04371

VARIATION OF ORGANIC MATTER EXTRACTED FROM PARTICLES ALONG THE GIRONDE ESTUARY (FRANCE),
Bordeaux-3 Univ., Talence (France).
For primary bibliographic entry see Field 2L.
W85-04372

COMPOSITION OF MINERAL FRACTIONS OF THE NARBADA AND TAPTI ESTUARINE PARTICLES AND THE ADJACENT ARABIAN SEA SEDIMENTS OFF WESTERN INDIA,
Physical Research Lab., Ahmedabad (India).
For primary bibliographic entry see Field 2L.
W85-04373

2L. Estuaries

PURGING OF SALINE WEDGES FROM OCEAN OUTFALLS,
New South Wales Univ., Kensington (Australia). Water Research Lab.
D. L. Wilkinson.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1815-1829, 9 Fig, 8 Ref, 1 Append.

Descriptors: *Saline water intrusion, *Sewage outfalls, *Wastewater disposal, Purging, Ocean dumping, Design criteria.

The nature of saline wedge formation is described in tunnelled ocean sewage outfalls. A momentum flux equation is used to determine the sewage discharge required to purge a saline wedge from an outfall tunnel in which the risers leave from the soffit. The purging discharge is generally much greater than the flow required to prevent saline intrusion into the risers. Laboratory experiments are described which confirm the validity of the purging criterion. Means by which the purging flow may be minimized are also considered. It is emphasized that the discharge required to purge an outfall will generally be many times the discharge required to prevent intrusion into the outlet port of a riser. If tunnelled outfalls are to function effectively it is imperative that sea water can be purged from the outfall tunnel. Because the flow required to achieve this would usually be many times the normal operating flow, it is worth considering means by which the purging flow may be reduced. The simplest means of accomplishing this reduction would be to have only a single, large diameter riser connecting the tunnel to a diffuser manifold on the sea floor. Another means by which the purging discharge could be reduced would be to release compressed air beneath each riser. The drag of the bubbles ascending in the risers could overcome the negative buoyance of the sea water thereby assisting to purge the system. Reducing the riser diameter produces a marked reduction in the purging flow. However, this would generally also result in an increase in the system flow resistance. It is noted that riser junctions are best located as close to the tunnel invert as possible. Outfall systems with this geometry are less prone to wedge blocking; however, saline circulation can still develop and impair the performance of the diffuser. (Baker-IVI)
W85-03791

TEMPERATURE DISTRIBUTIONS IN TIDAL FLOW FIELD,
Birmingham Univ. (England). Dept. of Civil Engineering.
R. A. Falconer.
Journal of Environmental Engineering, Vol. 110, No. 6, p 1099-1116, December, 1984. 9 Fig, 17 Ref.

Descriptors: *Tidewater, *Poole Harbour, *England, *Model studies, *Temperature, *Powerplants, Mathematical equations, Heat, Thermal pollution.

A numerical model was developed and applied to Poole Harbour and Holes Bay, in England, in an attempt to predict the tide-induced velocity fields and to make an assessment of the background temperature rises caused by a continuous discharge of warm cooling water from a power station outfall. In the model, the problems associated with nonlinear instabilities, occurring as a result of the narrow harbor entrance in particular, were overcome by time-centering the advective accelerations with respect to the local acceleration. The numerical simulation of large areas of Poole Harbour and Holes Bay, which were dried out and flooded on each ebb and flood tide, was successfully modeled by defining the location of the land-water boundary as being a function of the current value of the fluid depth in each grid square. For the 350-MW capacity power station, the mean temperature rise across the harbor was 0.4 K for spring tides and 0.6 K for neap tides, with the corresponding standard deviation for the temperature fields being 0.6 K and 1.1 K, respectively. The corresponding predictions for the 700-MW capacity power station were exactly double the temperatures predicted for the 350-MW capacity. However, these temperature predictions were thought to be conservative as 14 consecutive neap tides would not occur in practice, and the assumption that 86% of the heat discharged across the open boundary would return on the next flood tide was thought to be too large in the light of subsequent field data on nitrate levels. The shape of Poole Harbour, with its narrow entrance and relatively long tidal path, suggested that the basin might have a poor flushing efficiency. This supposition was reinforced to a certain extent when the tidal prism ratios were calculated and found to be low in comparison with published data for other harbors. The neap tide value for the tidal prism ratio of 0.22 was particularly low. (Baker-IVI)
W85-03804

MARSH PLANT ESTABLISHMENT ON NEWLY FLOODED SALT FLATS,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 4A.
W85-03811

PERSISTENT BLOOMS OF SURF DIATOMS (BACILLARIOPHYCEAE) ALONG THE PACIFIC COAST, USA. III. RELATIONSHIPS BETWEEN DIATOM POPULATIONS AND ENVIRONMENTAL VARIABLES ALONG OREGON AND WASHINGTON BEACHES (1977 AND 1978),
Washington Univ., Seattle. School of Oceanography.
J. G. Juina, and J. Lewin.
Phycologia, Vol. 23, No. 4, p 471-483, December, 1984. 7 Fig, 3 Tab, 22 Ref. DOE contract DE-AT06-76-EV-75026, NSF grant OCE 716-20155.

Descriptors: *Diatoms, *Beaches, *Pacific Coast, *Oregon, *Washington, Population dynamics, Plankton, Temperature effects, Salinity, Rainfall.

The surf diatom populations and environmental conditions at 13 beaches along the Oregon and Washington coasts were studied from June 1977 through August 1978. Spearman rank correlation coefficients were calculated for 14 environmental variables and seven species. Cell numbers of four of the species were positively correlated with rainfall and river discharge and negatively correlated with air temperature, water temperature, salinity, upwelling, daylength, and nitrogen concentrations. These four species are stable members of the surf ecosystem. The remaining three species exhibited weaker correlations that were consistently opposite in direction to the correlation coefficients calculated for the surf diatoms, above. This correlation study has shown that the four surf diatom species responded to environmental variables as a unit, while the three transient species responded to every variable in an opposite way to the response shown by the surf species. This clear-cut division in response of surf species and transient species, in addition to the physical requirements previously described, provide new insights into the surf-zone ecosystem. (Baker-IVI)
W85-03839

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STUDIES ON THE PHYTOPLANKTON IN THE BAY OF BREST (WESTERN EUROPE). SEASONAL VARIATIONS IN COMPOSITION, BIOMASS AND PRODUCTION IN RELATION TO HYDROLOGICAL AND CHEMICAL FEATURES (1981 AND 1982),
Brest Univ. (France). Lab. de Physiologie Vegetale.
B. Queguiner, and P. Treguer.
Botanica Marina, Vol. 27, No. 10, p 449-459, October, 1984. 13 Fig, 2 Tab, 36 Ref.

Descriptors: *Seasonal variation, *Phytoplankton, *Bays, *Bay of Brest, *Biomass, *Species composition, *Productivity, Population dynamics, Chemical reactions, Chemical analysis.

Among the factors influencing the seasonal evolution of phytoplankton communities in the Bay of Brest, river discharge is of particular interest. In spite of strong freshwater inputs during the winter period, the Bay of Brest is a well-mixed marine ecosystem, owing to rapid tidal action seawater renewal. Combined effects of tides and river flows are responsible for great long term and short term variability in the ecosystem. Fertilization by river discharge was the main factor controlling phytoplankton species succession; each increase of this parameter was followed by a bloom during the production period. Primary production which reached the level of 280 g C/sq m/a was relatively low considering the high nutrient concentrations measured during the winter period and can be explained by the effect of tidal action which induced strong exchanges between the Bay of Brest and the adjacent part of the Bay of Biscay. (Baker-IVI)
W85-03840

ROLE OF LEAF LITTER NITROGEN IMMOBILIZATION IN THE NITROGEN BUDGET OF A SWAMP STREAM,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
R. G. Qualls.
Journal of Environmental Quality, Vol. 13, No. 4, p 640-644, 1984. 3 Fig, 3 Tab, 24 Ref. Energy Research and Development Administration grant B0840NC.

Descriptors: *Swamps, *Litter, *Nitrogen, *North Carolina, *Creeping Swamp, *Chicod Creek, Decomposition, Wetlands, Nitrogen cycle, Nutrients.

Attempts were made to determine if immobilization-mobilization of N in the litter layer is of a sufficient magnitude to affect the concentrations of inorganic N in the overlying water, and to determine the effect of concentrations of dissolved nutrients and hydroperiod on litter decomposition, N uptake, and N release by litter. The study was conducted in two blackwater stream swamps in North Carolina: Creeping Swamp (CR) and Chicod Creek (CH). With the low levels of dissolved nutrients in CR, there was little difference in litter decomposition rate along elevation gradients. Decomposition was faster at the inundated sites in CH and the faster decomposition was associated with nutrient enrichment. Exogenous N immobilized in litter reached higher levels in the enriched swamp CH. Despite faster decomposition in CH, no substantial mineralization of litter N had occurred prior to June. A budget of litter N and dissolved inorganic N inflow showed that immobilization by flooded litter over 1 linear km of CR during the sampling period was 87 kg, equivalent to about 25% of the inorganic N inflow. This proportion shows that litter can play a significant role in controlling N concentrations in stream water in small swamp streams. (Baker-IVI)
W85-03862

CONDUCTIVITY-DENSITY-SALINITY-CHLORINITY RELATIONSHIPS FOR ESTUARINE WATERS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
F. J. Millero.
Limnology and Oceanography, Vol. 29, No. 6, p 1317-1321, 1984. 5 Fig, 2 Tab, 22 Ref.

Descriptors: *Estuarine environment, *St. Lawrence Estuary, *Salinity, *Density, *Chlorinity, *Conductivity, Estuaries, Water properties, Chemical properties.

The relative conductivity and density of estuarine waters formed by mixing world river water with standard seawater have been determined. The conductivity-density-salinity-chlorinity relationships of estuarine waters of known composition with seawater diluted with pure water were examined using these results. The maximum difference between the true salinity and the value derived from conductivity was 0.047 in dilute solutions. The maximum density difference between the measured and calculated values was .000035 g/cu cm. A comparison is made between these results and measurements of waters from the St. Lawrence estuary. These results indicate that, although dilute St. Lawrence River waters have a conductivity similar to world river waters, the densities are different. Thus, from careful estuarine work it is necessary to measure both density and conductivity as a function of chlorinity to fully characterize the system. If errors of + or - 0.04 in salinity and + or - .00005 g/cu cm can be tolerated, the Practical Salinity Scale and the International Equation of State of Seawater can be used for estuarine systems without a knowledge of the detailed ionic composition. (Baker-IVI)
W85-03878

FINITE-ELEMENT ANALYSIS OF DISPERSION-AFFECTED SALTWATER UPCONING BELOW A PUMPING WELL,
Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Matematik und Mechanik.
H.-J. Diersch, D. Prochnow, and M. Thiele.
Applied Mathematics Modeling, Vol. 8, No. 5, p 305-312, October, 1984. 8 Fig, 2 Tab, 17 Ref.

Descriptors: *Finite element method, *Upconing, *Saline-freshwater interfaces, Saline water intrusion, Wells, Porosity, Dispersion, Density.

Previous analyses of the upconing problem have failed to predict theoretically the critical upconing condition and the salinity of the pumped water. In the present study the finite-element method is used to overcome these drawbacks. Involving effects of hydrodynamic dispersion, the FEM (finite element method) is able to describe critical or supercritical conditions and to predict the saltwater intrusion into the well in relation to the dispersivities, the saltwater density and the thicknesses of the freshwater and saltwater zones. For subcritical conditions, the numerical results obtained agree with the results of Dagan and Bear for the predicted upconing rise. The breakthrough behavior of the concentration for the pumped water has shown some new effects which result from the coupling between density and dispersion. Depending on their magnitudes, both a lag and a remarkable overshoot of the saltwater breakthrough are possible. Also, depending on the nature of the saltwater source at the base of the aquifer (either a pure dispersive saltwater zone at rest or a free-moving saltwater zone controlled by the thickness S), the rate of saltwater intrusion is inversely related to the saltwater density. The present finite-element method can be used successfully for solving practical upconing problems, and for analyzing several techniques of saltwater interception. (Baker-IVI)
W85-04015

NUMERICAL THREE-DIMENSIONAL FREE SURFACE CIRCULATION MODEL FOR THE SOUTH BISCAYNE BAY, FLORIDA,
United Engineers and Constructors, Inc., Philadelphia, PA.
H. P. Miller.
Applied Mathematics and Modeling, Vol. 8, No. 5, p 313-318, October, 1984. 13 Fig, 17 Ref.

Descriptors: *Model studies, *Water circulation, *Richardson lattice, *South Biscayne Bay, *Florida, Mathematical models, Bays, Tidal effects, Wind, Hydrodynamics, Diffusion.

A three-dimensional, time-dependent free surface model has been developed for predicting circulation and surface height variations in a tidal bay. An explicit finite difference numerical solution is obtained by transforming the vertical coordinate in the governing model equations. The hydrodynamic variables used were obtained using wind and tide data bases for 15 April 1975 for the South Biscayne Bay. Horizontal velocity field calibration yielded a vertical eddy kinematic viscosity Kv = 20.0 sq cm/s which was used for the final computer runs. Agreement with a statistically averaged tide data base, at the ocean exchange area and at several shoreline locations, for the calibrated model is relatively good. Significant computational efficiency was achieved by using the staggered Richardson lattice for horizontal grid variables, whereby the justifiable approximation of neglecting horizontal diffusion for the South Biscayne Bay, reducing the hydrodynamic model from second order in velocity to first order in velocity, resulted in relaxing the slip-condition at the solid surfaces required in second-order diffusion models. Staggering the horizontal hydrodynamic grid variables in a Richardson lattice enabled the open boundary condition to be incorporated into the numerical model without requiring any tidal current phase averaging approximation. This mathematical model for simulating the three dimensional hydrodynamic behavior of the South Biscayne Bay is currently the most economical computationally, and is comparable in accuracy to existing numerical models for circulation in this bay. (Baker-IVI)
W85-04016

WATER FLOW CHARACTERISTICS OF URANOUCHI BAY DURING THE SUMMER STRATIFICATION SEASON (IN JAPANESE),
Kochi Univ. (Japan). Lab. of Fishieres Engineering.
Y. Munekage, and H. Kimura.
Reports of Usa Marine Biological Institute, Kochi University, Vol. 6, p 61-73, September, 1984. 9 Fig, 7 Ref.

Descriptors: *Uranouchi Bay, *Japan, *Bays, *Water current, *Summer, *Stratification, Water temperature, Salinity, Tidal currents.

Continuous measurements were made of water temperatures with the aid of a vertical array of thermal sensors at the locations of ST. 2 and ST. 21 in Uranouchi Bay for 50 days commencing on 17 August, 1982. Temperature, salinity and current were also measured at seven locations in the bay including ST. 2 and ST. 21 at an interval of about one hour on 18 August, 1982 for from 12 to 22 hours. The temperatures observed at ST. 2 were basically the same as in our 1981 study. Temperature in the lower layer rose during flood tide, and fell during the ebb tide. However at ST. 21, the temperature changes were of opposite phase to those at ST. 2. These temperature profiles were generated by standing interfacial waves with one node and one tidal period. Furthermore, the observed currents were separated into constant and changing parts. The changing parts were further divided into the currents caused by tidal action and those caused by interfacial waves. The value and horizontal distribution of each current was investigated. At ST. 3 - in the center of the bay - (the nodal position of the internal waves), the current velocity caused by interfacial waves has about the same values as the tidal current. When the standing interfacial waves have the same period and phase as the tidal waves, the surface current velocity becomes weak and bottom current becomes strong between both of the loop positions. However at the loop positions of the internal waves, such as at the mouth and at the head of the bay (ST. 1 and ST. 21), the internal waves have no effect on the tidal current velocity. (Author's abstract)
W85-04070

NATURE OF PRIMARY PRODUCTION IN A TROPICAL BACKWATER OF THE SOUTH-WEST COAST OF INDIA,
Kerala Univ., Trivandrum (India). Dept. of Aquatic Biology and Fisheries.
N. B. Nair, K. Dharmaraj, P. K. A. Azis, M. Arunachalam, and K. K. Kumar.
Proceedings of the Indian National Science Academy, Vol. 49, Part B, No. 6, p 581-597, December, 1983. 6 Fig, 5 Tab, 40 Ref.

Descriptors: *Primary production, *Kadinamkulam backwater, *India, *Backwater, Seasonal variation, Phytoplankton, Tropical regions, Salinity, Temperature, Dissolved oxygen, Phosphates, Silicates, Nitrates, Nitrites, Hydrogen ion concentration, Physicochemical properties.

Ecology of primary organic production in the surface and bottom waters at two stations of a shallow tropical brackish water body namely the Kadinamkulam backwater (Lat. 8 degrees 35' - 8.40'N; Long. 76 degrees 45' - 76 degrees 52'E) has been investigated at fortnightly intervals for one year. Annual average net production has been 84.28 mg C/cu m/hr and gross production 152.33 mg C/cu m/hr with respective ranges of 0-378.79 and 0-664.65 mg C/cu m/hr. Station 2 has been highly productive than the other with respective annual average net rates of 107.82 and 60.75 mg C/cu m/hr. Average net production rate of the surface water has been 97.10 mg C/cu m/hr and of the bottom water 71.46 mg C/cu m/hr. The backwater maintained a temporary mouth with the adjoining Arabian sea for about nine months. Hydrographical conditions, nutrient contents and standing crop of phytoplankton fluctuated widely with space and time. Almost throughout the year euphotic zone extended up to the bottom of both the stations. Productivity variations with space and time and relationships with physicochemical parameters and nutrients have been statistically determined. The backwater has been most productive during the monsoon season and least productive during the postmonsoon season. This general pattern differed considerably with stations and level of the water column. None of the recorded ecological factors such as salinity, temperature, pH value, dissolved oxygen content, reactive phosphate, silicate, nitrate and nitrite has significant influence on the rates of production. Physical stability of the water masses, and closure of the mouth which leads to obvious organic pollution have profound influence on the productivity of the backwater. (Author's abstract)
W85-04079

DYNAMICS OF A SLOWLY MOVING FRONT IN A SHALLOW WATER BODY,
G. I. Shapiro.
Water Resources, Vol. 10, No. 4, p 330-340, July-August, 1983. 6 Fig, 20 Ref. Translated from Vodnye Resursy, No. 4, p 19-29, July-August, 1983.

Descriptors: *Fluid mechanics, *Dynamics, *Salt wedges, Estuaries, River mouths, Saline water, Saline water intrusion, Density, Stratification, Thermal pollution.

The movement of fronts occurring upon interaction of water masses differing in density is examined. Some examples are the propagation of light fresh water over the surface of heavier salt water in coastal regions of seas, the situation occurring when warm waters are discharged by industrial enterprises and electric power stations, and the intrusion of sea water in the form of a salt wedge into river estuaries. In almost all examined works the front was considered stationary. Since it is often unknown behorehand how the front will move, it is of interest to develop a nonstationary theory which should answer questions about the travel speed of the front, form of the frontal surface, and characteristics of circulation of the fluid in the frontal zone. The present work applies to the more complex case of a shallow water body, when the thickness of the upper and lower layers can be comparable and the bottom and near-surface fluid flows are closely interrelated. (Baker-IVI)
W85-04117

PRODUCTION-DESTRUCTION PROCESSES IN THE BUDAK LIMAN,
V. V. Sapozhnikov, I. A. Naletova, Yu. A. Mikhailovskii, and N. M. Lapina.
Water Resources, Vol. 10, No. 4, p 397-405, July-August, 1983. 2 Fig, 3 Tab, 9 Ref. Translated from Vodnye Resursy, No. 4, p 143-152, July-August, 1983.

Descriptors: *Primary productivity, *Budak liman, *Black Sea, Temperature, Salinity, Lagoons, Nitrates, Phosphates, Dissolved oxygen, Bottom water, Decomposition, Organic matter.

The Budak liman belongs to the liman-lagoons of the Danube-Dnestr interfluve located in the northwestern part of the Black Sea. It is a water body extending from the southwest to the northwest with a volume of 2731 million cu m, length 17 km, maximum width 2.5 km, minimum width 1.0 km, surface area 23-27 sq km, maximum depth 2.2 m, and average depth 111 m. There is a layer 10 cm from the bottom with a lower temperature, higher salinity, and marked decrease of the oxygen constant (not more than 50% of saturation). The existence of such a near bottom layer is a characteristic feature of shallow water bodies, which must be taken into account when evaluting the oxygen regime of the liman, since at night with a general decrease of the oxygen concentration in the near bottom layer, its concentration can drop to zero and hydrogen sulfide appears. Dissolved oxygen content gradually increases from Zatoka to the western end of the liman. The maximum concentrations of nitrates (more than 7.0 microg-at/liter) and organic phosphorus (more than 6.0 microg-at/liter) are observed in the upper part of the Akkembet Bay. To estimate the biological productivity of the Budak liman the production-destruction processes occurring in the liman were investigated. The production processes always predominated over destruction. The study of the daily variation of biogenic elements, especially organic form of nitrogen and phosphorus, showed that the situation with nutrient salts in the ecosystem of the liman is very strained. Processes of destruction of organic matter do not have time to reach complete mineralization but are arrested at the stage of ammonification and release of organic phosphorus compounds. For this reason, more than 50% of phosphorus and nitrogen is in the form of organic compounds. (Baker-IVI)
W85-04125

EFFECT OF RUNOFF DISTRIBUTION ON SPRING PHYTOPLANKTON OF THE NORTH CASPIAN,
V. D. Levshakova.
Water Resources, Vol. 10, No. 4, p 406-411, July-August, 1983. 3 Tab, 18 Ref. Translated from Vodnye Resursy, No. 4, p 153-159, July-August, 1983.

Descriptors: *Runoff, *Phytoplankton, *Caspian Sea, *Volga River, *USSR, Seasonal variation, Algae, Diatoms, Saline lakes, Cyanophyta, Chlorophyta, Biomass, Nutrients.

The phytoplankton of the North Caspian in the spring is water rich and diverse, but it varies markedly by years. In 1974, 258 species, varieties, and forms of algae were recorded in the plankton of the North Caspian. Substantial changes in the composition of the leading groups of spring phytoplankton of the North Caspan were attributed to the increased discharges of river water in the winter. The unusually large diversity of the 1974 spring phytoplankton could also have been promoted by offshore winds transporting powerful flows of fresh waters and algae into the North Caspian. An intense development of spirogyra in waters of the North Caspian in the spring occurred in 1959-1962, in the first years of regulating the Volga runoff at Volgograd. The number of phytoplankton and the biomass in the western part of the North Caspian is higher than in the eastern. The green algae were the most abundant of all groups of phytoplankton. The unusual distribution of blue-green algae over the North Caspian indicates that the main flow from the Volga in 1974 passed along the eastern distributaries, which transported along the main nitrogen concentration that promoted the growth of green algae in this region. In 1974, the redistribution of the Volga runoff due to narrowing of the Volga channel in connection with the construction of the earth dam of the water distributor had an effect on phytoplankton in the spring. The redistribution of the Volga runoff from the western to the eastern regions promoted an enrichment of these regions in phytoplankton. (Baker-IVI)
W85-04126

PRESENT AND PREDICTED CHANGES IN THE HYDROLOGICAL, HYDROCHEMICAL, AND HYDROBIOLOGICAL CONDITIONS OF THE ARAL SEA,
For primary bibliographic entry see Field 6G.
W85-04128

THEORETICAL PRINCIPLES OF MODERN HYDROLOGY OF SWAMPS,
K. E. Ivanov.
Water Resources, Vol. 10, No. 6, p 543-549, November-December, 1983. 21 Ref. Translated from Vodnye Resursy, No. 6, p 65-72, November-December, 1983.

Descriptors: *Swamps, *Hydrology, Stability, Drainage, Wetlands, Peat, Lakes.

Four basic principles underlying modern swamp hydrology are discussed: the hierarchy of elements of the landscape structure of swamp systems, the possibility of constructing from aerial photos of swamps the flow nets of the drainage lines, the division of the stratum of peat deposits of the swamps into active and inert horizons, and the representation of swamp formations as dynamic developing systems with a feedback. Aspects and results of a theoretical analysis of the interrelations of hydrologic factors with the structure and development of swamp systems are discussed including hydrologic equivalence of swamplands, hydromorphologic relations, and the problem of the stability of swamp and swamp-lake systems. (Baker-IVI)
W85-04145

WETLAND REGULATION AND WILDLIFE HABITAT PROTECTION; PROPOSALS FOR FLORIDA,
For primary bibliographic entry see Field 6E.
W85-04181

MARSH ENHANCEMENT BY FRESHWATER DIVERSION,
Espey, Huston and Associates, Inc., Austin, TX.
G. H. Ward, Jr.
Journal of Water Resources Planning and Management, Vol. 111, No. 1, p 1-23, January, 1985. 10 Fig, 5 Tab, 21 Ref.

Descriptors: *Marsh management, *Diversion, *Nueces River Delta, *Texas, *Flooding, Flood frequency, Hydrodynamics, Hydrological models, Environmental effects, Weirs, Diversion channels.

The delta of the Nueces River, Texas, is a low-lying coastal marsh with dendritic distributaries and flats, infrequently inundated by flood events overbanking from the river. This study examines the feasibility of improving the ecological value of the marsh by creation of diversion works to increase the frequency and duration of marsh inundation. To this end, the morphology and statistical occurrence of flood events in the Nueces were examined using long-period gage records on the river. A canonical parameterization of flood events was used as input to a numerical hydrodynamic model of the deltaic system, which predicts the time evolution of flow and water level throughout the delta, and includes provision for simulating distributary confluence and difluence, inundation and dewatering of floodplains and flats, and activation of transient channels. The response of the marsh to specified flood events was computed for various alternative physiographies, including existing conditions and candidate combinations of weirs and diversion channels. Coupled with the statistical frequency of occurrence of the specified flood event, the potential ecological value of each diversion alternative was quantitatively established in terms of total inundation period in key segments of the marsh. (Author's abstract)
W85-04240

VARIATION OF ORGANIC MATTER EXTRACTED FROM PARTICLES ALONG THE GIRONDE ESTUARY (FRANCE),
Bordeaux-3 Univ., Talence (France).
P. Berger, H. Etcheber, M. Ewald, G. Lavaux, and C. Belin.

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Chemical Geology, Vol. 45, No. 1/2, p 1-16, August, 1984. 7 Fig, 3 Tab, 20 Ref.

Descriptors: *Organic matter, *Particulate matter, *Estuarine environment, *Gironde Estuary, *France, Organic carbon, Seasonal variation, Turbidity, Marine environment.

Organic matter was extracted from particles suspended in the Gironde Estuary using a sodium pyrophosphate-sodium hydroxide mixture as extractant. The organic carbon was measured for each fraction obtained during the chemical extraction in order to assess the mass balance. The variation in percentage of the extractible fraction was examined. No significant variations were found either between estuarine zones or with the seasons. The high constancy of the behavior of extractible organic matter in the estuary seems to indicate that this fraction behaves as a chemically stabilized mature material, because neither the passage through the high-turbidity zone nor mixing with marine water change the percentage of this fraction in the particulate organic matter. (Author's abstract)
W85-04372

COMPOSITION OF MINERAL FRACTIONS OF THE NARBADA AND TAPTI ESTUARINE PARTICLES AND THE ADJACENT ARABIAN SEA SEDIMENTS OFF WESTERN INDIA,
Physical Research Lab., Ahmedabad (India).
M. Baskaran, M. M. Sarin, and B. L. K. Somayajulu.
Chemical Geology, Vol. 45, No. 1/2, p 33-51, August, 1984. 10 Fig, 6 Tab, 31 Ref.

Descriptors: *Estuarine environment, *Particulate matter, *Minerals, *Narbada Estuary, *Tapti Estuary, *India, *Arabian sea, Suspended solids, Bottom sediments, Clay, Silt, Aluminum, Iron, Manganese, Zinc, Chromium, Cobalt, Nickel, Copper, Magnetic materials, Metals.

Thirty suspended and bottom sediment samples from the Narbada and Tapti river-estuarine systems of western India were separated into magnetic, clay and silt-sand fractions, the Al, Fe, Mn, Zn, Cr, Co, Ni and Cu concentrations of which have been determined by atomic absorption spectrophotometry. On an average, the silt-sand fraction accounts for > or = 90% of the suspended matter and bottom sediments. Of the rest, clays are more abundant than the magnetic fraction. For all fractions there are no major differences, in the region of investigation, in mineralogy between the estuarine suspended and the bottom sediments. The magnetic fraction is enriched in all metals (except Al) by a factor of 1.2-4 as compared to the other two fractions. The clays, in turn, are enriched in all metals by a factor of 1.4 +/- 0.14 as compared to the silt-sand. The metal/Al ratios in the clay as well as in the silt-sand fractions do not show any variations beyond +/- 25% between the freshwater end-member of the estuaries and the coastal Arabian Sea, thus indicating that the effect of estuarine processes on the inorganic solids are within this limit. In the magnetic fraction the metal/Al ratios vary by as much as an order of magnitude, whereas the corresponding metal/Fe ratios do not vary by more than a factor of 2. The clay and silt-sand fractions of sediments from the open shelf and slope regions of the Arabian Sea are enriched in Ni and Zn and depleted in Mn by a factor of 2 as compared to the estuarine suspended and bottom sediments. These enrichments are attributed to the reducing nature of the open marine environment. The inter-elemental correlations in the silt-sand fractions are good, the correlation coefficients (for 28 observations) ranging form 0.60 to 0.95 (the highest value is for Fe-Al). The suspended fluxes of metals from the Narbada and Tapti Rivers to the adjacent shelf and to the deep sea (via clays) are calculated. On average approximately 5% of the total flux to the shelf region reaches the deep sea. (Author's abstract)
W85-04373

NUTRIENT ASSIMILATIVE CAPACITY OF AN ALLUVIAL FLOODPLAIN SWAMP,
East Carolina Univ., Greenville, NC. Dept. of Biology.
M. M. Brinson, H. D. Bradshaw, and E. S. Kane.
Journal of Applied Ecology, Vol. 21, No. 3, p 1041-1057, December, 1984. 9 Fig, 2 Tab, 45 Ref. OWRT project B-114-NC.

Descriptors: *Nutrient removal, *Swamps, *Alluvial floodplain swamps, Nitrogen, Phosphorus, Ammonium, Denitrification, Nitrification, Flooding, Drydown, Land application, Wastewater treatment, Wetlands.

Nitrate, ammonium, and phosphate were added to the forest floor of an alluvial swamp at a weekly rate of 1 g of nitrogen or phosphorus per sq m for nearly 1 year. The experimental design allowed examination of nutrient assimilation and accumulation under field conditions that cannot be duplicated in the laboratory and produced results relevant to management of these swamps for wastewater treatment. Nitrate loss by denitrification was rapid and persistent; only slight accumulation occurred in surface water, and soil water accumulation was undetectable. Ammonium accumulated on cation exchange sites but was transformed to nitrate during drydown of sediments in summer and autumn. As nitrate did not accumulate, a tight coupling of nitrification and denitrification is inferred. Phosphate accumulated in sediments principally in acid-extractable form with little evidence of loss after the additions ceased. At these high loading rates, uptake of nitrogen and phosphorus by vegetation and accumulation in tree stem-wood was small in comparison with disappearance by denitrification and accumulation in sediments. The capacity of the swamp for nutrient removal was highest for nitrate, intermediate for ammonium, and lowest for phosphate. Annual drydown of sediments would be required for sustained ammonium removal in swamps with prolonged flooding, as in this case. It appears that swamps of this type could be managed for inorganic nitrogen removal from sewage effluent, but their usefulness for tertiary treatment of phosphate is limited by the capacity of sediments for phosphorus storage. Management considerations not evaluated by this study, but deserving further investigation, are possible health impacts related to sewage effluent and competing ecological services such as wildlife production. (Author's abstract)
W85-04386

COMPREHENSIVE ESTUARINE NURSERY STUDY COMPLETED,
Louisiana Agricultural Experiment Station, Baton Rouge.
W. H. Herke, and B. D. Rogers.
Fisheries, Vol. 9, No. 6, p 12-16, November-December, 1984. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Louisiana, *Coastal marshes, *Fish migration, *Estuarine environment, Fish management, Habitats, Larval growth stage, Juvenile growth stage, Crustaceans.

Louisiana coastal marsh is eroding rapidly to open water. Many estuarine-dependent fishes and crustaceans must be able to pass from the Gulf to the marsh, and back again to the Gulf, to complete their life cycle. Water control structures being built to slow the erosion must be compatible with the free passage of these organisms. A four year study was funded by the Louisiana Cooperative Fishery Research Unit to determine the seasonal presence and relative abundance of larval and juvenile estuarine-dependent fishes and economically important crustaceans; to determine the main ingress and egress routes of these organisms, and their depth in the water column when migrating; and to determine the relative amount of use of habitat types (canals, open water, and submerged vegetation) by organisms while in the nursery, and correlate use of the habitat types by selected species with various environmental factors. Most of the organisms migrated in the middle and upper levels of the water column. Large emigrations occurred 1 to 3 days afer the passage of strong cold fronts. Peak diel movement was from dusk until dawn. Organisms did not necessarily use the same routes for ingress and egress. Length-frequency analysis indicated that organisms of similar size moved back and forth with the current in the main migration routes. Catch usually was much higher in traps facing the current and increased with increasing current velocities. (Baker-IVI)
W85-04392

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

FORMATION AND FATE OF BROMOFORM DURING DESALINATION,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
N.-W. Chang, and P. C. Singer.
Journal of Environmental Engineering, Vol. 110, No. 6, p 1189-1193, December, 1984. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Desalination, *Bromoform, *Water treatment, Chlorination, Reverse osmosis, Ultrafiltration, Membranes, Membrane processes.

The formation and fate of bromoform in the pretreatment systems at the Wrightsville Beach Test Facility (WBTF) were evaluated and the capabilities of the various reverse osmosis (RO) units to reject bromoform were assessed. The central pretreatment system consisted of a coagulation, sedimentation and pressure-filtration system. Chlorine was added at the seawater intake by an electrolytic hypochlorite generator for the purpose of controling biological growths through the transmission line and the pretreatment system. An alternative pretreatment system consisting of ultrafiltration was also evaluated. Bromoform was produced in significant quantities at the facility and was the only THM species found when seawater was chlorinated. The bromoform concentration increased through the various pretreatment processes with the exception of the activated carbon columns. The DOW cellulose triacetate hollow fine fiber RO membranes did not reject bromoform, and bromoform concentrations in the RO permeate were higher than those in the feed water to the RO units. However the UOP polyether/ureas and the FilmTec polysulfone thin film RO membranes did reject bromoform effectively. (Baker-IVI)
W85-03809

THERMODYNAMIC PROPERTIES OF R13 (CCLF3), R23 (CHF3), R152A (C2H4F2) AND PROPANE HYDRATES FOR DESALINATION OF SEA WATER,
Kobe Univ. (Japan). Dept. of Chemical Engineering.
H. Kubota, K. Shimizu, Y. Tanaka, and T. Makita.
Journal of Chemical Engineering of Japan, Vol. 17, No. 4, p 423-429, August, 1984. 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Sea water, *Desalination, *Hydrating agents, *Propane, *Chlorotrifluoromethane, *Trifluoromethane, *Difluroethane, Water resources development.

Basic data were sought which are needed to develop a new hydrate process for the desalination of sea water. Three new hydrating agents R13, R23, R152 and propane were selected. The pressure-temperature phase diagrams of each agent for pure water and aqueous NaCl solution were determined in the temperature range from 260 to 295 K and pressures up to 4.4 MPa. Based on the pressure-temperature data obtained, the necessary thermodynamic data, such as hydrate decomposition conditions, invariant points, heat of formation, and hydrate composition were determined. It is felt that the information and data as presented may be useful in developing a new sea water treatment process by use of gas hydrate. (Baker-IVI)
W85-03890

REACTION KINETICS OF SODIUM BISULFITE AND DISSOLVED OXYGEN IN SEA-

WATER AND THEIR APPLICATIONS TO SEA-WATER REVERSE OSMOSIS,
Toray Industries, Inc., Otsu (Japan).
N. Matsuka, Y. Nakagawa, M. Kurihara, and T. Tonomura.
Desalination, Vol. 51, No. 2, p 163-171, August, 1984. 13 Fig, 1 Tab, 10 Ref.

Descriptors: *Desalination, *Reverse osmosis, *Seawater, *Sodium bisulfite, *Dissolved oxygen, Membrane processes, Cupric sulfate, EDTA.

Removal of dissolved oxygen (DO) from seawater feeds extends membrane durability in single-stage seawater reverse osmosis (SWRO). The reaction rate of sodium bisulfite (SBS) and DO in seawater was investigated to apply DO removal system to the SWRO. The reaction in seawater was very fast because the salinity had a positive catalytic effect and the bicarbonate ion kept the pH suitable for the reaction. The positive catalytic effect of cupric sulfate used in SWRO as a sterilizer and the negative catalytic effects of ethylenediaminetetraacetic acid (EDTA) used in SWRO as a cleaning agent were investigated. In SWRO experiments where DO was completely removed by dosing with SBS, Toray's PEC-1000 membrane modules showed excellent performance and long durability. (Moore-IVI)
W85-03973

FIELD TRIAL OF REVERSE OSMOSIS IN THE EL KHANKA DESERT, EGYPT,
National Research Centre, Cairo (Egypt).
M. G. A. Khedr, A. H. Abd El Wahab, J. Kaschemekat, and J. Mohn.
Desalination, Vol. 51, No. 2, p 173-181, August, 1984. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Desalination, *Reverse osmosis, *Egypt, Membrane processes, Industrial water, Scaling, Boiler water.

A reverse osmosis test facility was installed at an automatic poultry slaughterhouse at El Khanka Kaliobia, Egypt. High purity water is needed in the slaughterhouse for the steam-producing high pressure boilers. The test plant, a plate system of nominal output of 45 cu m/d, has been in operation since January 1979. Two prototype reverse osmosis modules, G3 and G4 were tested. The two types of membranes used were a blend cellulose di- and tri-acetate membrane and a bentonite-stabilized cellulose acetate membrane. The results of the first three years of operation are presented. During the initial period of operation, a rapid deterioration of performance was observed. Repeated shutdown of electric power contributed to the problem of scale deposition. This was overcome by the introduction of a control valve which stops the feed stream when the power is shut down. Replacement of the G3 modules by G4 modules in the second phase of operation considerably improved the unit's performance. Bentonite-stabilized cellulose acetate membranes showed superior permeability characteristics compared to the blend membranes. (Moore-IVI)
W85-03974

PERFORMANCE OF MULTIPLE EFFECT DIFFUSION STILLS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Mechanical Engineering.
M. M. Elsayed, K. Fathalah, J. Shams, and J. Sabbagh.
Desalination, Vol. 51, No. 2, p 183-199, August, 1984. 12 Fig, 2 Tab, 7 Ref.

Descriptors: *Desalination, *Solar stills, *Diffusion stills, Mathematical models, Temperature, Distillation, Feed rate.

Experimental testing of a three-effect diffusion still is carried out. The experiment is designed to test the effect of the heating fluid temperature input to the still heating temperature and the feed rate of desalinated water to the still rate of feed on the performance of the still. The results produced several empirical relations to predict the following in terms of the heating temperature and the feed rate: average temperature of each effect, the rate of distillate produced by each effect, and the performance ratio of the still. In addition, a mathematical simulation is given for the n-effect diffusion still. The mathematical model is verified by comparing its results with the experimental results of the three-effect diffusion still. The model is further used to predict the performance of a ten-effect diffusion still at the following parametric conditions: various values of the dimensionless parameters N3 and N4, various heating medium temperatures input to the still, and various feed rates to the still. (Author's abstract)
W85-03975

MARGINAL OPERATION FIELD OF EXISTING MSF DISTILLATION PLANTS,
Shuwaikh Power and Water Production Station (Kuwait).
B. Z. Tanios.
Desalination, Vol. 51, No. 2, p 201-212, August, 1984. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Desalination, *Flash distillation, *Multistage flash distillation, Brine, Temperature, Flow rate.

The capability of existing MSF (multistage flash) distillation desalination plants to increase or decrease production by increase or decrease of top brine temperature and brine recirculating flow rate, is technologically limited. The factors which limit the process were analyzed and compared in a practical test carried out on a 4546 cu m/d production plant. The brine levels in evaporator stages were calculated and measured to avoid the vapor blowthrough between the stages and to insure the dynamic stability of the plant. There was an increase of 20% in production at 94% of the design brine flow rate, and a top brine temperature 16.6 C greater than the design value before reaching the unsealing limit. (Author's abstract)
W85-03976

AUTOMATED PLUGGING FACTOR MONITOR-SPECIFICATIONS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
E. J. Eisenhauer, and S. C. Stitt.
Available from the National Technical Information Service, Springfield, VA 22161. USBR Report REC-ERC-83-4, October, 1983. 44 p, 6 Fig, 2 Ref, 1 Append.

Descriptors: *Plugging factor, *Automation, *Water sampling, *Monitoring, Control systems, *Reverse osmosis, Desalination, Particulate matter, Yuma Desalting Test Facility, *Arizona.

Plugging factor is a measure of water quality that must be monitored for reverse osmosis feedwater. The PFM-EC electronically drives the PFM-T (plugging factor monitored-tester) to obtain the necessary data for calculating a plugging factor for a sample of water. The quality of prefiltered feed water delivered to the membranes of reverse osmosis, membrane-type desalting plant largely determines membrane performance and longevity. The process of making a measurement consists of the following basic steps: measure the amount of time it takes to pass a given volume of water through a specified filter membrane at the regulated pressure; continue to pass water through the filter for the specified cycle time (typically 15 minutes) while maintaining the same pressure; and measuring the time. The PFM-EC interfaces to other computer systems, has battery backups, and magnetic tape storage. The PFM-SPSBP draws continous flow samples of test water from 1 to 6 preselected sources. Each sample of water is pumped to the PFM-tester at a back controlled pressure for the duration of the time required. The PFM-SPSBP is capable of operating in an industrial environment without air conditioning. Engineering drawings include: electronic controller hardware overview, operator interface, flowchart, and schematic diagrams.
W85-04210

CATION EXCHANGE PRETREATMENT STUDIES FOR HIGH RECOVERY - YUMA DESALTING PLANT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. W. Kaakinen, and P. E. Laverty.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-82-11, October, 1983. 295 p, 34 Fig, 15 Tab, 33 Ref, 9 Append.

Descriptors: *Pretreatment of water, *Desalination, Cation exchange, *Water softening, *Desalination wastes, Scaling, Reverse osmosis, Calcium sulfate, Water treatment, Electrodialysis, Calcium sulfate, Yuma Desalting Test Facility, Arizona.

The main purpose of the High Recovery Program was to obtain feasibility design data for cation exchange softening to allow a greater fractional recovery of desalted product water at the YDP (Yuma Desalting Plant). Compared to the original YDP design with 70% desalting recovery, additional removal of calcium in the desalting feed would allow recoveries < 90%. The sole chemical regeneration solution for the IX (ion exchange) process during steady-state operation would be the sodium-rich reject brine from the desalting equipment. Pilot plant equipment to test this process was operated at the YDTF (Yuma Desalting Test Facility) and consisted of an IX unit and an electrodialyzer to supply reject-brine regenerant for the IX experiments. Because the reject-brine contained major concentrations of sulfate, gypsum scale occurred in the resin bed under certain IX operating conditions. Scaling occurred especially when the water temperatures were 30 C in the summer. Scaling did not occur with water temperatures of 15 C in the winter. Gypsum scale buildup in the resin bed could be avoided by regeneration with a high upward flow rate causing a fluidized bed. Multiple regression analysis of the IX data delineated the importance of several control variables in the IX experiments, including regeneration concentration, flow rate, volume, and temperature. Results show that ion exchange high recovery pretreatment process is feasible, and that it is technically possible to achieve high recovery in the YDP.
W85-04223

3B. Water Yield Improvement

EFFECTS OF GEL-FORMING POLYACRYLAMIDES ON MOISTURE STORAGE IN SANDY SOILS,
Liverpool Univ. (England). Dept. of Botany.
M. S. Johnson.
Journal of Science, Food and Agriculture, Vol. 35, No. 11, p 1196-1200, November, 1984. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Soil water, *Plant growth, *Water supply development, *Polyacrylamides, *Sandy soil, Soil properties, Plants, Water supply, Soil engineering, Soil management, Soil moisture deficiency.

Most commercial gel-forming, cross-linked polyacrylamide soil conditioners absorb water to many times their own weight thus improving the water storage properties of porous soils. There is notable variation between products in the binding tension of absorbed moisture, so changes in field capacity are of little diagnostic value for the soil moisture available to plants. Cumulative water loss from mixtures of sand and a polyacrylamide with a water absorption capability of at least 125 x in hard tap water was determined as a function of time. Evaporation losses from untreated sand were rapid, to the extent that the air-dry residual moisture level of <1 g/hg was attained after only 4 days under these experimental conditions. After 4 days the residual water levels of the 1 g/kg polymer treated sand and the 2 g/kg polymer treated sand were 3.9 g/hg and 13.0 g/hg, respectively, illustrating significant improvement in water retention brought about by the polymer. The air-dry equilibrium point was deferred by more than 3 and 6 days, respectively, for these two polymer treatment levels. In the absence of polymer the permanent wilting percentage (PWP) of the sand was 1.4 g/hg. This compares with 2.0 g/hg for the 1 g/k treatment and an estimated 2.6 g/hg for the 2 g/kg

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treatment. All the polymers tested increased the field capacity of coarse sand by between 171 and 402%, but the availability to plants of the moisture reservoir varied greatly. The divergence between products increases in proportion to application rate, but linear regression shows that the performance of any one product is predictable to a high degree across a range of treatment levels. (Baker-IVI)
W85-03797

SOUTHWEST DROUGHT RESEARCH PROGRAM. FINAL REPORT,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
R. L. Eddy, and P. A. Hurley.
Available from the National Technical Information Service, Springfield, VA 22161. USBR Final Report, September 1983. 104 p, 9 Fig, 14 Tab, 21 Ref, 1 Append.

Descriptors: *Drought, *Weather modification, *Cloud seeding, Hydrology, Climatology, Water law, Economic impact, Federal-state cooperation, Water resources development, Soil moisture, Southwest Drought Research Program, Arizona, Colorado, Oklahoma, Texas, Utah.

The Southwest Drought Research Program is a cooperative research effort between the Bureau of Reclamation and State agencies in Arizona, Colorado, Oklahoma, Texas, and Utah to define and plan how the Southwest States can best use cloud seeding technology to mitigate droughts. Institutional studies examined issues of authorization for cloud seeding, organization for decision making and communication, and funding for cloud seeding. Technical studies included climatology of drought and nondrought periods, weather modification potentials, and probable net economic and agricultural benefits and probable social and environmental impacts of cloud seeding for drought mitigation. Results indicate that seedable clouds occur during drought but with less frequency than during nondrought periods; estimated seasonal precipitation increases range from 5 to 20%; additional precipitation in drought periods has a benefical economic effect; weather modification makes its greatest contribution to drought mitigation if it is applied in a long-term program to maintain soil moisture and water storage at near-normal levels; there is no interstate uniformity in laws and procedures governing weather modification.
W85-04195

OKLAHOMA'S REACH TO THE CLOUDS,
Oklahoma Water Resources Board, Oklahoma City.
M. E. Mathis, J. W. Schuelein, H. L. Springer, and R. A. Zipser.
Available from the National Technical Information Service, Springfield, VA 22161. Final Report, February, 1983, 204 p. 78 Fig, 6 Tab, 36 Ref, 3 Append. Contract/Grant No. 0-07-81-V0144.

Descriptors: *Moisture deficiency, *Drought, *Cloud seeding, *Precipitation, *Environmental effects, Social impact, Economic impact, Water resources development, *Oklahoma.

The report summarizes the results of the cooperative research effort between the Bureau of Reclamation and the State of Oklahoma (Oklahoma Water Resources Board) in the development of the scientific and institutional background studies for applying weather modification technology as a drought mitigation tool. The report addresses drought and its effect in Oklahoma, regulation and administration of weather modification on Oklahoma, potential funding sources, state/federal cooperation, project implementation under emergency drought conditions, clouds and their processes, climatologies of rainfall and seeding opportunities, methods of cloud seeding, assessment of the effects of cloud seeding, environmental and social effects of weather modification and economic impact of weather modification. The report also recommends a course of action for weather resources management in Oklahoma. Appendices B and C provide summaries of reports prepared by the Oklahoma Climatological Survey and Aeromet, Inc., subcontracted under the Oklahoma Southwest Drought Research Program contract.
W85-04208

COMPARISON OF THE POTENTIAL OF CLOUD SEEDING TO ENHANCE MOUNTAIN SNOWPACK IN COLORADO DURING DRY, NORMAL AND WET WINTERS,
Colorado Dept. of Natural Resources, Denver. Weather Modification Program.
L. A. Sherretz, R. M. Rauber, and L. D. Nelson.
Available from the National Technical Information Service, Springfield, VA 22161. January, 1983. 51 p, 12 Fig, 8 Tab, 34 Ref, 3 Append. Contract/Grant No. 1-07-81-V0226.

Descriptors: *Cloud seeding, *Weather modification, *Artificial precipitation, *Snowpack, *Snow management, *Water yield improvement, Snow cover, Colorado River Basin, Snow, Precipitation, Snow accumulation, Water supply development, Colorado.

This study compares the potential of cloud seeding to enhance mountain snowpack in Colorado during dry, normal and wet winters. Seedable storms are identified from 13 winters of interpolated rawinsonde observations. While a few more seedable storms are identified in the wet than in the dry winters, this difference is not significant statistically; neither is the difference in percentage increases in the moisture content of snow expected from seeding all eligible storms. Past use of seeding in Colorado for drought relief is discussed. The theory of winter seeding, past field experiments in Colorado and variability in Colorado's snowpack are discussed briefly in the Appendices.
W85-04211

PROJECT SKYWATER, 1982-83 SCPP DATA INVENTORY, SIERRA COOPERATIVE PILOT PROJECT.
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
Available from the National Technical Information Service, Springfield, VA 22161. October, 1983. 205 p, 45 Fig, 34 Tab, 3 Append.

Descriptors: *Weather modification, *Cloud seeding, *Cloud physics, *Meteorological data collections, Rain gages, Chemistry of precipitation, Snow density profile, Sierra Cooperative Pilot Project, Ice crystal data, Cloud physics aircraft, Sierra Nevada, California.

This report contains an inventory of all data collected from October 15, 1982 through April 1983 in association with the SCPP (Sierra Cooperative Pilot Project), a weather modification research project in winter orographic cloud seeding. It is subdivided into an introduction plus 15 sections and appendixes A, B, and C: 1) Foresting, 2) Evaluation Data Matrix, 3) Radar, 4) Satellite, 5) Aircraft, 6) Rawinsondes, 7) Surface Meteorological Observations, 8) Precipitation Gage Network, 9) Ground-Based Microphysical Observations, 10) Ice Detection System, 11) Radiometer, 12) Cooperative and Operational Seeding Activities, 13) Snow Chemistry Measurements, 14) Water Quality Measurements, 15) National Weather Service, Federal Aviation Administration, and National Climatic Center Products, and (app. A) SCPP Operations for 1983, (app. B) Sierra PROBE (portable remote observations of the environment) data availability, and (app. C) 1982-83 SCPP Liquid Water Measurement Summary from N2UW. Most of the sections are subdivided into three main components: 1) a general description of equipment, modes of operation, and types of data available for analyses (both visual products and computer files); 2) samples of primary visual products; and 3) tables of data inventories which list start and stop times, locations, and other pertinent information related to data sampling.
W85-04212

CLOUD PHYSICS STUDIES IN THE SCPP, 1982-1983,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
B. Martner, J. D. Marwitz, A. Rodi, and W. Sand.
Annual Interim Progress Report, October, 1983. p 134, 158 Fig, 3 Tab, 11 Ref, 2 Append. Contract/Grant No. 2-07-81-V0256.

Descriptors: *Weather modification, *Cloud physics, *Cloud seeding, Orographic airflow, Clouds, Chemistry of precipitation, Sierra Cooperative Pilot Project, Sierra Nevada, California.

These articles by University of Wyoming investigators represent some of the scientific contributions to the Sierra Cooperative Pilot Project. The first article presents a summary of the aircraft and radar derived seeding responses of SCPP-2 (stable orographic) type clouds to seeding by dry ice and silver iodide. The second article describes the observed thermodynamic and kinematic structure of two stable orographic storms as documented from aircraft and single Doppler data. The third article describes the precipitation processes in the two stable orographic storms. The theoretical and observed precipitation processes are compared. The remaining articles are reprints of the conference and referred articles on SCPP results by UW personnel.
W85-04214

SEEDING EFFECTS IN NON-CONVECTIVE CLOUDS OF THE SCPP,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
B. E. Martner.
In: Cloud Physics Studies in the SCPP, 1982-1983, p 1-26, October, 1983. 16 Fig, 1 Tab, 9 Ref. Contract/Grant No. 2-07-81-V0256.

Descriptors: *Weather modification, *Cloud physics, *Cloud seeding, Clouds, Chemistry of precipitation, Sierra Cooperative Pilot Project, Sierra Nevada, California.

The Sierra Cooperative Pilot Project (SCPP) is a winter cloud seeding research program sponsored by the Bureau of Reclamation. Field studies of clouds over the American River Basin east of Sacramento were initiated in 1976 by the SCPP. After extensive physical studies and calibration seeding trails, convective clouds (C1, C2 and NE precipitation echo types (PET)), have been selected as the subjects for a fully randomized exploratory seeding experiment. This experiment known as SCPP-1, began in 1983. Studies involving non-convective cloud types, orographic and area wide storms (0 and AW PET), are known as SCPP-2. Typical liquid water contents in SCPP-2 clouds are about 0.05-0.10 g/cu m and typical natural concentrations of ice crystals are about 30/l. Thus, the seedability of these clouds appears to be poor. Airborne calibration seeding tests in SCPP-2 clouds have been conducted in 1979, 1980, 1982 and 1983. This article reviews the evidence for seeding effects in these SCPP-2 calibration seeding tests.
W85-04215

WINTERTIME OROGRAPHIC STORMS OVER THE SIERRA, PART II, THE PRECIPITATION PROCESS,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
J. Marwitz.
In: Cloud Physics Studies in the SCPP, 1982-1983, p 68-94, October, 1983. 6 Fig, 2 Tab, 11 Ref. Contract/Grant No. 2-07-81-V0256.

Descriptors: *Hydrometeors, *Storms, *Orographic precipitation, *Moisture density, Precipitation, Ice, Snow, Rain, Sierra Nevada, California.

This paper describes two aspects of the precipitation process observed in orographic storms, over the Sierra. Described first are the observed hydrometeor characteristics. Below the melting level the droplet spectra contained concentrations of 100 to 200/cu cm and mean droplet diameters less than 10 micrometers. Above the melting level in the ice cloud, the concentrations were less than 100/cu cm and the mean droplet diameter typically exceeded 20 micrometers. The condensation of ice particles consistently indicated a peak of 30 to 200/l near the -5 C level. Since many of the particles

near the -5 C level were needles and the concentration exceeded the expected ice nuclei concentration by several orders of magnitude, the peak ice particle concentration was likely a result of a Hallett-Mossop type secondary ice crystal production (SICP) mechanism. The phrase 'Hallett-Mossop type SICP' is used because neither graupel nor small cloud droplets were observed. Described last in this paper, are the calculations of the precipitation process.
W85-04216

3D. Conservation In Domestic and Municipal Use

LEAKAGE INVESTIGATIONS IN HOUNSLOW,
Thames Water Authority (England). Northern Div.
P. F. Borrows, and M. J. Broomfield.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 5, p 424-434, October, 1984. 5 Fig, 4 Tab, 8 Ref.

Descriptors: *Water distribution, *Leakage, *England, *Hounslow, Monitoring, Economic aspects.

Water lost from distribution systems can represent a significant financial loss. The extent to which losses occur is often uncertain, reflecting the difficulties associated with accurate flow measurement. A detailed study was made of active leakage control in the Hounslow area of West London. The study confirmed that active leak detection programs can be cost effective. Where attention to this aspect of maintenance of the distribution system, or to maintenance generally, has diminished, the early stages of introducing such a program will entail a net cost. However, continuing committment will yield important benefits in the long term. Changes to the ways manpower is used can achieve improved productivity and provide a more satisfying job for those involved. The results of the study were sufficiently encouraging for the Thames Water Authority to embark on a region wide program to improve leakage control and thereby generate significant revenue savings. By concentrating on reducing leakage to levels giving a net benefit other advantages were also noted. These are associated with improved knowledge of, and control over, the distribution system. These should also lead to a cheaper and more reliable service to customers. (Baker-IVI)
W85-03884

HYDROGEOLOGY OF THE VERNA WELLFIELD AREA AND MANAGEMENT ALTERNATIVES FOR IMPROVING YIELD AND QUALITY OF WATER, SARASOTA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03904

RATIONAL WATER USE - GAUGE FOR GROWTH IN ACHIEVEMENT AND EFFECTIVENESS IN WATER MANAGEMENT (DIE RATIONELLE WASSERVERWENDUNG - MASSSTAB FUR DEN LEISTUNGS - UND EFFEKTIVITATSZUWACHS IN DER WASSERWIRTSCHAFT),
Ministerium fuer Umweltschutz und Wasserwirtschaft, Berlin (German D.R.).
E. Clausnitzer.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 11, p 363-364, November, 1984.

Descriptors: *Water management, *Water use efficiency, *Germany (Democratic Republic), Water demand, Industrial water, Domestic water.

The results of rational water use in the German Democratic Republic are described together with goals for the continuation of this policy. Regional seminars held in 1983 showed that significant achievements had been realized in 1982 compared with 1980: industrial absolute water demand has decreased by 3.6% and total absolute water demand had risen by only 0.4% (but the goal of reducing specific water demand by 10% was not realized); the use of drinking water for industrial purposes decreased by 6.7 million cu m/yr, 4.1 million cu m/yr more drinking water for public consumption was contributed by industrial plants, and wastewater was reduced by 1.2 million population equivalents (PE). Goals to be achieved by 1985 include reducing industrial specific water demand by a further 17% over the 1980 level, absolute water demand by at least 2%, and wastewater pollution of natural waters by 3.8 million PE. These goals will be realized through rapid practical application of scientific and technological developments, rapid utilization of currently unused capacity in water facilities, scientifically based complex management of available water by uniform balancing methods and the government concept for water-management development, preventive maintenance of hardware to avoid water losses, introduction of modern methods of planning and management, and continuing automation to stabilize information and control systems. In future, water demand and use will be determined using concrete norms defined by law. The protection of water resources will be achieved through multiple use of water and guaranteeing the self-purification capacity of natural waters. Cooperation between water authorities and the agricultural and mining communities is necessary to overcome conflicts of interest within catchment areas. (Gish-IVI)
W85-04322

3E. Conservation In Industry

PROBLEMS IN ESTIMATING SELF-SUPPLIED INDUSTRIAL WATER USE BY INDIRECT METHODS--THE CALIFORNIA EXAMPLE,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 6D.
W85-03957

CREATION OF CLOSED WATER MANAGEMENT SYSTEMS AT INDUSTRIAL ENTERPRISES,
For primary bibliographic entry see Field 5D.
W85-04141

RATIONAL WATER USE - GAUGE FOR GROWTH IN ACHIEVEMENT AND EFFECTIVENESS IN WATER MANAGEMENT (DIE RATIONELLE WASSERVERWENDUNG - MASSSTAB FUR DEN LEISTUNGS - UND EFFEKTIVITATSZUWACHS IN DER WASSERWIRTSCHAFT),
Ministerium fuer Umweltschutz und Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 3D.
W85-04322

3F. Conservation In Agriculture

INFILTRATION FROM TRICKLE IRRIGATION SOURCE,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W85-03816

ECONOMIC CONSIDERATIONS OF DEFICIT IRRIGATION,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
G. H. Hargreaves, and Z. A. Samani.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 4, p 343-358, December, 1984. 10 Fig, 23 Ref.

Descriptors: *Deficit irrigation, *Irrigation, *Economic aspects, *Crop yield, Productivity, Evapotranspiration, Mathematical models, Rainfall distribution.

The most important factors relating to crop yield are water, fertility, and available energy as measured by the evaporative potential. The upper limit on production for well adapted high yielding varieties of several crops has been demonstrated to be a linear function of Class A pan evaporation from a pan located in a large irrigated area. Mathematical yield models were developed relating crop evapotranspiration and total water available to relative yields. Data relative to irrigation amounts, rainfall, type of irrigation, water costs, costs of applying water, total crop production expenditures, and the range of crop incomes for various California crops were used to determine how various factors relate to the economics of deficit irrigation. The principal considerations in evaluating profit include whether land or water are limiting resources, the value of crop production based on yield and price, the contribution of rainfall to the crop water supply, the costs of irrigation water and its relationship to total crop production costs. A minimum data set recommended for evaluating crop water requirements consists of rainfall and maximum and minimum temperatures. When water is cheap, rainfall is scarce, and yields and prices are favorable, the farmer should usually irrigate for approximately the maximum possible yield. Use of high yielding varieties produced under conditions of adequate fertility significantly reduces the probability that deficit irrigation can produce maximum net benefits. (Collier-IVI)
W85-03817

NORMALIZED GRAPHS OF BORDER-IRRIGATION PERFORMANCE,
T. Strelkoff, and M. R. Shatanawi.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 4, p 359-374, December, 1984. 12 Fig, 12 Ref, 1 Append. USDA Agricultural Research Service contract 53-9AHZ-1-1685.

Descriptors: *Mathematical models, *Border irrigation, *Irrigation practices, Infiltration, Runoff, Graphical methods.

Good irrigation management requires the ability to predict the outcome of any given combination of field and management parameters--soil infiltration characteristics, border length, slope and roughness, and inflow rate and cut-off time in the case of simple border irrigation. While accurate mathematical models of the border-irrigation process have been available for some time, their use requires high-speed digital computing equipment. To eliminate the need for such complicated numerical solutions every time a given combination is to be tested, a set of generalized ultimate-outcome solutions have been generated and the results presented in a series of dimensionless normalized graphs. These allow determination, with a pocket calculator, of the ultimate distribution of infiltrated water in the field after recession is complete and of the total volume of runoff, which result from any given set of field and management parameters. A numerical example illustrating the procedure is included. (Author's abstract)
W85-03818

MODELING EFFECT OF DEPTH ON FURROW INFILTRATION,
T. Strelkoff, and F. Souza.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 4, p 375-387, December, 1984. 17 Fig, 2 Tab, 7 Ref. NIH grant FR-0009.

Descriptors: *Furrow irrigation, *Irrigation, *Infiltration, *Mathematical models, Border irrigation, Wetted perimeter, Model studies, Soil water.

In contrast to borders, water depth in furrows has primary influence on infiltration. If flow depth remains relatively constant everywhere and infiltration parameters are measured at that depth, volume infiltrated per unit length computed in a mathematical model of furrow flow depends only on the time of stream arrival. But, a significant depth gradient results in error unless the variable depth is incorporated into the infiltration computation. Six different schemes are considered. The most complicated assumes that infiltration into every element of wetted perimeter at a section

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depends on the time that element has been wetted. Less complex schemes assume that volume infiltrated per unit length at a station depends on time of stream arrival there and, in order of increasing crudeness, local wetted perimeter, local top width, upstream wetted perimeter, upstream top width, top width at normal depth for the give inflow. Comparisons of computed results with field measurements of upstream depth, advance, and cumulative volume infiltrated with time lead to the tentative conclusion that use of current local wetted perimeter is the most satisfactory approach. (Author's abstract)
W85-03819

4

MANAGEMENT CONTOURS FOR BORDER IRRIGATION,
Jordan Univ., Amman. Dept. of Hydrology and Irrigation Engineering.
M. R. Shatanawi, and T. Strelkoff.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 4, p 393-399, December, 1984. 1 Fig, 11 Ref. USDA Agricultural Research Service contract 53-9AHZ-1-1685.

Descriptors: *Irrigation operations, *Border irrigation, *Mathematical studies, Sloping borders, Infiltration, Percolation losses, Inflow rate.

Analysis of border irrigation is now feasible and accurate, but the corresponding synthesis, design of appropriate inflow rates and cutoff times for a given border are currently not so well-established. Apart from some rough empirical guidelines, no systematic procedure has yet been developed for this selection in sloping borders. A management-design chart was developed for free-flowing (open-ended) borders. This is a plot of average low-quarter infiltration depth resulting from any combination of inflow rate and cutoff time in a border with given infiltration characteristics and of given length, slope, and roughness. To minimize deep percolation losses while ensuring that the field receives sufficient water everywhere, only those irrigations in which the requirement just equals the average low-quarter depth are considered in the design. The chart is thus a plot of requirement contours on axes of inflow rate and cutoff time. Superimposed on the plots are values of water-application efficiency to assist in determining the optimum combination of required depth, inflow rate, and cutoff time. The chart needs to be prepared only once for the management of a given border strip at given moisture conditions. Information from the chart coupled with crop water requirements, labor costs, and availability of water can lead to optimal management of a given border-irrigation system. (Collier-IVI)
W85-03821

CHANNEL DESIGN AND FLOW OPERATION WITHOUT CHOKE,
National Univ. of Singapore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-03822

EFFECT OF IRRIGATION ON WARM SEASON PRECIPITATION IN THE SOUTHERN GREAT PLAINS,
National Weather Service, Washington, DC. Climate Analysis Center.
For primary bibliographic entry see Field 6G.
W85-03844

IRRIGATION OF MONTEREY PINE WITH WASTEWATER: EFFECT ON SOIL CHEMISTRY AND GROUNDWATER COMPOSITION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div of Forest Research.
For primary bibliographic entry see Field 5D.
W85-03855

HYDROGEOLOGY OF PARTS OF THE CENTRAL PLATTE AND LOWER LOUP NATURAL RESOURCES DISTRICTS, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03905

POSSIBILITY OF STABILIZING NONRETURNABLE WATER CONSUMPTION IN THE BASINS OF THE CASPIAN AND AZOV SEAS IN THE REMOTE FUTURE,
A. S. Berezner.
Water Resources, Vol. 10, No. 6, p 563-568, November-December, 1983. 2 Tab, 7 Ref. Translated from Vodnye Resursy, No. 6, p 90-96, November-December, 1983.

Descriptors: *Water use, *Consumptive use, *Irrigation, *Caspian Sea, *Azov Sea, *USSR, Basins, Forecasting, Prediction, River basins, Water conservation.

Nonreturnable water consumption is of greatest interest when examining the problem of water supply to a particular region. Meeting the requirements of water users for many river basins necessitates limiting the demands of consumers for water. Between 1900 and 1970, nonreturnable water consumption in the entire world increased from 270 to 1600 cu km/year and will reach 3000 cu km/year by the end of this century. While river runoff, at 42,000 cu km/yr, suggests there is still plenty of water around, much of this runoff occurs in areas where there is but negligible consumption. In trying to forecast beyond the end of this century, emphasis is placed on the amount of water used for irrigation agriculture, since its proportion in the increase of water consumption amounts from 70% in the European part of the USSR to 80-90% in Central Asia. A forecast of the development of irrigation agriculture includes two main problems: determination of the areas of irrigated lands in the country and its regions with respect to future levels and forecast of specific water consumption per 1 ha. Possible solutions to these problems are considered. To proceed from irrigated areas to the future water consumption of irrigation agriculture, a forecast of numerous factors is needed: the composition of the crops irrigation techniques, and the efficiency of irrigation systems. New, more economical irrigation techniques which require the use of less water to accomplish the same job are described. In the first quarter of the next century, stabilization of water consumption appears to be possible. (Baker-IVI)
W85-04147

OPTIMAL INTRASEASONAL IRRIGATION WATER DISTRIBUTION,
Demokritos Univ. of Thrace, Xanthi (Greece). Dept. of Civil Engineering.
G. Tsakiris, and E. Kiountouzis.
Advances in Water Resources, Vol. 7, No. 2, p 89-92, June, 1984. 2 Fig, 3 Tab, 7 Ref.

Descriptors: *Irrigation requirements, *Optimization, *Water distribution, Crop yield, Dynamic programming, Model studies, Root zone, Irrigation water, Rotational distribution.

A dynamic programming model was developed to optimize the intraseasonal distribution of irrigation water to a single crop growing in a uniform environment under the constraints of limited total water volume available for irrigation and rotational distribution of water which is based on constant irrigation interval and variable application depth. The system underlying the model is characterized by two discrete state variables: the available soil-water in the root zone and the net quantity of water to be transferred to the root zone of the crop. Transition equations from one state to another are used in response to irrigation decisions. Substantial increases in crop yield may be obtained if the method is used. Using the proposed method, optimal policy yield-water curves may be produced to substitute for the single valued yield functions in the economic analysis of irrigation projects. A similar approach taking into account the stochastic nature of irrigation water needs can offer more detailed information on how to use the limited available water. (Moore-IVI)
W85-04166

WATER, SALINITY, AND NITRATE RELATIONS OF A CITRUS WATERSHED UNDER DRIP, FURROW, AND SPRINKLER IRRIGATION,
California Univ., Riverside.
F. T. Bingham, B. A. Glaubig, and E. Shade.
Soil Science, Vol. 138, No. 4, p 306-313, October, 1984. 3 Fig, 6 Tab, 7 Ref. University of California, Water Resources Center project UCAL-WRC-W-596.

Descriptors: *Irrigation management, *Drip irrigation, *Furrow irrigation, *Sprinkler irrigation, *Citrus orchards, *Salinity, *Nitrates, Water use efficiency, Orchards, Leaching.

This 2-year investigation determined the relationships among different irrigation systems, water use, nitrate losses, and soil salinity of a 389-ha citrus watershed in southern California irrigated with a 1.1-dS/m water. Salt balance patterns were typical with salts accumulating during the primary irrigation season (May to October) and leaching during the winter season. Orchards under sprinkler and furrow irrigation received 33 and 35% more water, respectively, than orchards under drip irrigation. Soil sample analysis indicated that sprinkler irrigation provided the best leaching of soluble salts. Nitrate leaching losses from the watershed were significant, with yearly losses averaging 80.2 kg N03-N per ha. Although the irrigation management was changed from predominately furrow and sprinkler irrigation to drip irrigation during the preceding 10 years to reduce water and nitrate losses from the watershed, the resultant leaching fraction remained essentially unchanged, and nitrate losses actually increased under the drip management. (Author's abstract)
W85-04346

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

MARSH PLANT ESTABLISHMENT ON NEWLY FLOODED SALT FLATS,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
J. A. Kadelec, and L. M. Smith.
Wildlife Society Bulletin, Vol. 12, No. 4, p 388-394, 1984. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Marsh management, *Salt flats, *Flood irrigation, *Marsh plants, *Bear River National Wildlife Refuge, *Utah, Wildlife management, Marshes, Irrigation effects, Saline soils, Seeds, Vegetation establishment, Irrigation scheduling.

One approach to the management of closed basins in arid and semiarid regions for aquatic and marsh birds is flood-irrigation. The early stages of marsh plant establishment after initiation of a flood-irrigation scheme were studied in the Bear River National Wildlife Refuge in Utah. The development program resulted in flooded areas in the storage reservoir, ditches, ridges, and undisturbed level areas between ditches. Continuous flooding during the growing season rapidly reduced salinity; a high rate of flushing was not required. Intermittent flooding reduced salinity slightly, compared to unflooded ridge sites. Managers can take advantage of this to favor more salt tolerant species and discourage less tolerant species. Seed-bank tests correctly indicated few seeds of emergents in areas not previously occupied by emergents. Managers desiring to establish emergent vegetation might profitably test for the presence of seeds of emergents, and if few or none are found, adjust management techniques to insure a source of seed of desired species. Species having wind disseminated seed are likely to be early invaders. Waterborne seeds depend on water movement and an upstream source. Marsh managers can control, at least in part, the emergent vegetation established in flood-irrigated areas by managing irrigation schedules to

produce sediment salinities favoring desired species and by careful attention to seed sources. (Moore-IVI)
W85-03811

DESIGN AND DEVELOPMENT OF THE FLOOD STORAGE AND AMENITY RESERVOIRS OF THE ROTHER VALLEY COUNTRY PARK,
Yorkshire Water Authority (England).
J. A. Carter, P. J. Cresswell, P. T. Moore, and J. P. Woolnough.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 3, p 403-423, October, 1984. 4 Fig, 1 Append.

Descriptors: *Flood storage, *Rother Valley Country Park, *England, *Resources development, *Reservoirs, Mine wastes, Flood control, Planning, Land reclamation, Restoration.

An area of the Rother Valley some 10 km south east of Sheffield on the border between South Yorkshire and Derbyshire has recently been opencast mined for the extraction of coal. The site was progressively restored and developed as a recreation park in which the principal features are a 2 km long lake and two smaller washland ponds serving the dual function of amenity and flood alleviation. The paper outlines the background to the development of this scheme, its design and construction and also describes its operational, environmental and amenity aspects. Coal was extracted between 1975 and 1981 and the restoration works were completed in 1983. The restored area was designed to fulfil two important main functions: to maintain existing flood storage and food attenuation in the river downstream allowing for additional runoff from urbanization upstream and to provide a public amenity based on a sizeable lake. Specific problems discussed include flood control, temporary river diversion, lake and reservoirs, opencast coaling operations, hydraulic structures, environmental, recreational and amenity aspects. (Baker-IVI)
W85-03883

TIME OF TRAVEL AND DISPERSION STUDY IN THE ANDROSCOGGIN RIVER BASIN, MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03911

FLOW-DURATION HYDROGRAPHS FOR SELECTED STREAMFLOW STATIONS ON SOUTH DAKOTA STREAMS,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03923

HYDROLOGIC CONDITION OF THE CHICOD CREEK BASIN, NORTH CAROLINA, BEFORE AND DURING CHANNEL MODIFICATIONS, 1975-81,
Geological Survey, Raleigh, NC. Water Resources Div.
S. A. Watkins, and C. E. Simmons.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4025, 1984. 36 p, 8 Fig, 13 Tab, 16 Ref.

Descriptors: *Channel improvement, *Surface-groundwater relationships, Groundwater, Nutrients, Water quality, Pesticides, *Sediment transport, Surface runoff, Chicod Creek basin, *North Carolina, Pitt County.

Beginning in late 1978, stream channels throughout the 60-square-mile Chicod Creek basin underwent extensive modification to increase drainage efficiency and reduce flooding potential. The modifications of this Coastal Plain basin, consisting primarily of channel excavation and clearing channel blockages, were completed in December 1981. The hydrologic conditon of the basin before and during modification was determined by observed data. These data indicate hydrologic changes occurred in selected basin characteristics. For example, water levels in the surficial aquifer within 250 feet of Juniper Branch declined as much as 0.4 foot during modifications; at distances greater than 250 feet from the stream ground-water levels did not change. Base flows increased, and suspended sediment concentrations for high flows were several time greater during than before channel modifications. Increases in selected chemical constituent concentrations during modifications are as follows: calcium, 12 percent; sodium, 18 percent; biocarbonate, 84 percent, and phosphorus, 80 percent. Significant changes were not found in either pesticide concentrations or coliform bacteria counts. (USGS)
W85-03928

DIGITAL MODEL FOR STREAMFLOW ROUTING BY CONVOLUTION METHODS,
Geological Survey, Bay Saint Louis, MS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03942

REPORT OF THE ANNUAL YIELD OF THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS-OKLAHOMA, 1983 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03951

REGIONAL FLOOD RELATIONS FOR UNREGULATED LAKES IN WEST CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03960

CONTROL OF NUISANCE AQUATIC PLANTS WITH BURLAP SCREEN,
Burgess and Niple Ltd., Columbus, OH.
G. B. Jones, and G. D. Cooke.
Ohio Journal of Science, Vol. 84, No. 5, p 248-251, December, 1984. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Aquatic weed control, *Reservoir operation, *Burlap, *Screens, *Lake Rockwell, *Ohio, *Portage County, Sedimentation, Lakes, Plant growth.

Techniques to control aquatic plants in reservoirs include substrate disruption, winter water level drawdown, harvesting, and herbicides; a very successful technique is the use of sediment screens. Ten-ounce burlap - an inexpensive alternative to fiberglass screening - was applied as a sediment cover in June 1982 to two plots on Lake Rockwell (Portage Co., Ohio). The burlap at one of the plots was treated with a rot-retarding material, Netset. Plant biomass on treated plots was compared to adjacent plots. The application of burlap was effective for seasonal control of aquatic plant growth on a site where material could be tautly secured to the reservoir sediments. Biomass reduction was as much as 99% during the first month of application and progressively declined during the second and third months of evaluation. It was less effective at a site with highly unconsolidated sediments. A thin layer of sediment accumulated on the burlap at one site in September; this permitted the growth of Najas flexilis, a nuisance aquatic plant common in Ohio, on and through the burlap. Burlap would have to be applied annually since it rotted during the summer even with preservative treatment. Treatment with the preservative did not enhance the useful life or effectiveness of burlap; heavier applications might be more effective. The material cost of burlap is about 15-50% of commercial screening products. Where annual maintenance is required for sediment screens, due to heavy sedimentation rates, the same degree of weed control might be achieved with burlap at a lower cost. (Collier-IVI)
W85-04053

MARSH ENHANCEMENT BY FRESHWATER DIVERSION,
Espey, Huston and Associates, Inc., Austin, TX.
For primary bibliographic entry see Field 2L.
W85-04240

RESEARCH AGENDA FOR FLOODS TO SOLVE POLICY FAILURE,
Illinois State Water Survey Div., Champaign.
S. A. Changon, Jr.
Journal of Water Resources Planning and Management, Vol. 111, No. 1, p 54-64, January, 1985. 1 Fig, 12 Ref. NSF grant PAG-81-17027.

Descriptors: *Research priorities, *Flood control, *Flood hazard mitigation, *Policy making, Nonstructural alternatives, Insurance, Flood plain management, Economic aspects, Social aspects, Political aspects.

For the first 60 yr of the 20th Century, the U.S. policy regarding floods was aimed at flood control. In the past 15 yr, policy has shifted to a goal of flood hazard mitigation. However, flood losses continue to rise and the Congress and others have raised questions about the causes of policy failure. The answer is complicated because flood policy involves 4 currently changing issues, including the shift from federal to local-state responsibilities; the National Flood Insurance Program; the shift to nonstructural approaches for flood mitigation; and developing programs for emergency assistance. A comprehensive assessment of flood research needs reveals that policy must have a view of efficient use of flood plains, not just loss reduction. The socioeconomic data base is considered inadequate for many policy decisions, and our knowledge of floods is uneven, with much more known in the physical sciences than in the social sciences. Attention to interdisciplinary research involving economists, sociologists, political scientists, and geographers is needed if better policy making and flood hazard mitigation are to be achieved. (Author's abstract)
W85-04243

MODELING THE CALIFORNIA STATE WATER PROJECT,
California State Dept. of Water Resources, Sacramento.
I. Chung, and O. Helweg.
Journal of Water Resources Planning and Management, Vol. 111, No. 1, p 82-97, January, 1985. 9 Fig, 6 Tab, 11 Ref.

Descriptors: *Model studies, *California State Water Project, *Lake Oroville, *San Luis Reservoir, Simulation, Optimization, Multireservoir networks, Multipurpose reservoirs, Dynamic programming, Reservoir operation.

Two disadvantages of optimization models in water resources planning and management are the simplifications often required to construct the model and user reluctance to rely on optimization models alone. Both of these disadvantages may be overcome by combining a simulation model with an optimization model. In this study, a popular multipurpose, multireservoir system simulation model, HEC-3, developed by the Hydrologic Engineering Center (HEC) of the Corps of Engineers, is combined with a dynamic programming model. One problem in using discrete differential dynamic programming (DDDP) is determining the initial trajectory. In this project, conventional dynamic programming was used to estimate the initial trajectory, and then a DDDP model was used. Consequently, the optimization model combines conventional dynamic programming and discrete differential dynamic programming to solve the complex problem of operating the California State Water Project's (SWP) Lake Oroville and San Luis Reservoir, given the constraints of the Federal Central Valley Project (CVP) and delta flow requirements. Preliminary results suggest that SWP revenue may be almost doubled by adopting the suggested optimal operation. (Author's abstract)
W85-04245

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Group 4A—Control Of Water On The Surface

OPTIMAL DESIGN OF DETENTION AND DRAINAGE CHANNEL SYSTEMS,
Freese and Nichols, Inc., Fort Worth, TX.
M. S. Bennett, and L. W. Mays.
Journal of Water Resources Planning and Management, Vol. 111, No. 1, p 99-112, January, 1985. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Optimization, *Detention basins, *Drainage channels, Design criteria, Model studies, Urban watersheds, Stormwater, Dynamic programming, Brays Bayou watershed, Texas.

Regional or at least watershed level evaluation of detention facility design, as opposed to on-site detention, is necessary to effectively satisfy the requirements of a given stormwater management policy. An optimization model for a minimum cost detention and drainage channel system for a watershed determines the location and size of detention basins, the size, type, and number of outlet structures in addition to the design of downstream channel modifications. The model is based upon dynamic programming for nonserial systems. The model is applied to Brays Bayou watershed in Harris County, Texas for the purpose of illustrating its capabilities. The model is only partially successful in meeting the goals. The model is capable of considering the cost interactions of the detention basins, the outlet structures, and the channels connecting the basins. The hydraulic constraints of a given system can be satisfied, and first order approximations of land and facility costs can be calculated. The model cannot evaluate the costs of flood damages without which the solutions may be incomplete. (Moore-IVI)
W85-04246

4B. Groundwater Management

GROUNDWATER YIELDS FROM BOREHOLES IN THE MIDLANDS,
British Geological Survey, Wallingford (England). Hydrogeology Research Group.
For primary bibliographic entry see Field 2F.
W85-03800

AVAILABILITY OF GROUND WATER FROM THE ALLUVIAL AQUIFER ON THE NISQUALLY INDIAN RESERVATION, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03891

TWO-DIMENSIONAL, STEADY-STATE MODEL OF GROUND-WATER FLOW, NEVADA TEST SITE AND VICINITY, NEVADA-CALIFORNIA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03893

STRATIFIED-DRIFT AQUIFERS IN THE SUSQUEHANNA RIVER BASIN, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03896

GEOHYDROLOGY, AQUEOUS GEOCHEMISTRY, AND THERMAL REGIME OF THE SODA LAKES AND UPSAL HOGBACK GEOTHERMAL SYSTEMS, CHURCHILL COUNTY, NEVADA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03898

NUMERICAL SIMULATION OF THE HIGH PLAINS REGIONAL AQUIFER, NORTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03899

SUBSURFACE STORAGE OF FRESHWATER IN SOUTH FLORIDA: EVALUATION OF SURFACE-WATER DISCHARGE DATA AT SELECTED SITES,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. H. Sonntag.
Available from the OFSS, USGS, Box, 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4008, 1984. 75 p, 62 Fig, 5 Tab, 20 Ref.

Descriptors: Discharge, *Duration curves, Frequency analysis, *Subsurface storage, *Florida, Canals, Regulated flow, *Canal discharge, Injection.

Canal discharge in south Florida may consist of a potential source of freshwater for deep-well injection. Discharge data for the 1970-81 water years at 27 canal and river sites were analyzed. Flow was analyzed for 30-, 60-, 90-, 120-, and 183-consecutive-day low-mean discharges during the periods of highest flow to define minimum high-flow-period fresh surface-water discharges at the 27 sites. Curves show the magnitude and frequency of average minimum flows for consecutive-day periods during high-flow periods, and duration curves and tables show the percentage of time that selected discharges were equaled or exceeded. Canal discharge as high as 660 cubic feet per second occurred 70 percent of the time during the high-flow period at one site (Tamiami Canal Outlets, Levee 67A to 40-Mile Bend). At 11 sites, discharges of 110 to 370 cubic feet per second occurred 70 percent of the high-flow periods, while at 9 sites, discharges of 21 to 100 cubic feet per second occurred 70 percent of the time during the high-flow periods. At other sites (those in the Biscayne, Plantation Road, Middle River, C-111, and Cypress Creek Canals), discharges as low as 0.1 cubic foot per second occurred 70 percent of the time during the high-flow periods. Criteria for amounts of surplus freshwater considered adequate to support injection systems cannot be established, as they would vary greatly with water needs to be satisfied and with the efficiency of a particular injection system. However, based upon this analysis of discharge at 27 canal and river sites throughout south Florida, it appears that substantial amounts of water are available for surface injection and storage. (USGS)
W85-03900

GEOHYDROLOGIC AND DRILL-HOLE DATA FOR TEST WELL USW H-3, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03901

GROUND-WATER RESOURCES OF THE WHITE RIVER BASIN, RANDOLPH COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03902

GROUND-WATER RESOURCES OF ST. JOHNS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03903

HYDROGEOLOGY OF THE VERNA WELLFIELD AREA AND MANAGEMENT ALTERNATIVES FOR IMPROVING YIELD AND QUALITY OF WATER, SARASOTA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03904

RECONNAISSANCE OF THE WATER RESOURCES OF THE SHOALWATER BAY INDIAN RESERVATION AND ADJACENT AREAS, PACIFIC COUNTY, WASHINGTON, 1978-79,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03906

WATER IN SAND AND GRAVEL DEPOSITS IN MCHENRY COUNTY, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2K.
W85-03907

HYDROLOGIC ANALYSIS OF THE HIGH PLAINS AQUIFER SYSTEM IN BOX BUTTE COUNTY, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03915

GEOHYDROLOGY AND WATER RESOURCES OF THE PAPAGO FARMS-GREAT PLAIN AREA, ARIZONA, PAPAGO INDIAN RESERVATION ARIZONA, AND THE UPPER RIO SONOYTA, SONORA, MEXICO,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03920

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACES OF THE MAGOTHY AQUIFER OF SEPTEMBER 1975 DIFFERED FROM THE POTENTIOMETRIC SURFACE OF SEPTEMBER 1981 IN SOUTHERN MARYLAND,
Geological Survey, Annapolis, MD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03931

EVALUATION OF THE POTENTIAL FOR ARTIFICIAL GROUND-WATER RECHARGE IN EASTERN SAN JOAQUIN COUNTY, CALIFORNIA--PHASE 2,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03933

CHANGES ON THE SHALLOW GROUND-WATER RESOURCES OF THE YELLOWSTONE RIVER VALLEY NEAR BILLINGS, MONTANA, AUGUST 1968-1978,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03938

GROUND-WATER RECONNAISSANCE OF THE CENTRAL WEBER RIVER AREA, MORGAN AND SUMMIT COUNTIES, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03939

POTENTIOMETRIC MAP OF THE GORDO AQUIFER IN NORTHEASTERN MISSISSIPPI, NOVEMBER AND DECEMBER 1982,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03943

WATER LEVELS AND WATER-LEVEL CHANGES IN THE PRAIRIE DU CHIEN-JORDAN AND MOUNT SIMON-HINCKLEY AQUIFERS, TWIN CITIES METROPOLITAN AREA, MINNESOTA, 1971-80,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03946

HYDROGEOLOGIC DATA FOR SELECTED TEST WELLS DRILLED IN THE FORT UNION COAL REGION, EASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03952

GROUND WATER IN THE FRESNO AREA, CALIFORNIA--A PROGRESS REPORT,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03954

GEOHYDROLOGIC RECONNAISSANCE OF DRAINAGE WELLS IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03959

CENTRALIZED DECISIONMAKING IN THE ADMINISTRATION OF GROUNDWATER RIGHTS: THE EXPERIENCE OF ARIZONA, CALIFORNIA AND NEW MEXICO AND SUGGESTIONS FOR THE FUTURE,
Hawaii Univ. at Hilo. Social Sciences Div.
Z. A. Smith.
Natural Resources Journal, Vol. 24, No. 3, p 641-688, July, 1984. 321 Ref.

Descriptors: *Groundwater management, *New Mexico, *California, *Arizona, Decision making, Legal aspects, Planning, Water demand.

The attitudes of groundwater pumpers toward the centralized administration of groundwater rights on the state level is examined. The question is whether it is centralized administration some groundwater pumpers fear or the possibility of losing present and possibily future rights to pump groundwater. The groundwater law and administrative systems in Arizona, California and New Mexico are reviewed in an attempt to answer this question. Specifics addressed concerning Arizona groundwater law include creation of the 1980 groundwater management act, major provisions, administration, active management areas (AMA) goals and plans, scope of the act, rights within AMA's, irrigation grandfather rights, irrigation water available, well regulations, municipal and private water company pumping in an AMA, permits, mine dewatering permits, mineral extraction and processing permit, general industrial use permits, poor quality permits, temporary permits for generation of electricity, temporary dewatering permits, drainage permits, and enforcement and appeal provisions. California groundwater law is considered with emphasis on correlative rights doctrine, non-overlying use, prescription, physical solutions, mutual prescription after San Fernando, Pueblo rights, conjunctive use, statutory provisions in California groundwater law, Porter-Dolwig, Porter-Cologne, and the Recordation Act. New Mexico groundwater law is viewed in light of the permit procedure, minor apropriations, loss of right, artesian wells, mine dewatering, groundwater mining, relationship between ground and surface water rights, Pueblo water rights, and interest group leaders' attitudes. (Baker-IVI)
W85-04191

INTERCONNECTED GROUNDWATER SYSTEMS SIMULATION (IGROSS) - DESCRIPTION OF THE SYSTEM AND A CASE HISTORY APPLICATION,
Aquater S.p.A., San Lorenzo in Campo (Italy).
For primary bibliographic entry see Field 2F.
W85-04277

4C. Effects On Water Of Man's Non-Water Activities

ECOTOXICOLOGICAL MODEL FOR ENERGY DEVELOPMENT AND THE SALTON SEA, CALIFORNIA,
California Univ., Los Angeles. Office of Environmental Science and Engineering.
W. Dritschilo, and D. V. Pluym.
Journal of Environmental Management, Vol. 19, No. 1, p 15-30, July, 1984. 7 Fig, 3 Tab, 35 Ref. Southern California Edison Company Contract No. C0991901.

Descriptors: *Model studies, *Salton Sea, *California, *Energy, *Environmental effects, *Water resources development, Salinity, Fish population, Population dynamics, Ecosystems.

A case study is presented of how ecological and toxicological principles may be combined to provide a predictive model of the effect of energy development on the Salton Sea ecosystem. The approach was to analyze the possible changes in salinity that energy development could pose through a number of development scenarios, and then combine as yet incomplete data on lab saline toxicity with population and ecosystem dynamics interactions to predict the relative changes in fish numbers for each development scenario at some time in the future. Energy development is expected to change the water budget of the Salton Sea and thereby modify the salinity of the sea. The modeling approach is a useful case study of the development of a predictive preliminary ecological model in the absence of substantial empirical data. Full predictive capability will require validation and calibration against data currently being collected. Even without predictive ability, the model functions in organizing the necessary data collection. (Baker-IVI)
W85-03823

ENVIRONMENTAL IMPACT OF AN OPENCAST OPERATION IN THE FOREST OF DEAN, ENGLAND,
College of St. Paul and St. Mary, Cheltenham (England).
M. C. Addis, I. G. Simmons, and P. L. Smart.
Journal of Environmental Management, Vol. 19, No. 1, p 79-95, July, 1984. 9 Fig, 31 Ref.

Descriptors: *Water quality, *Environmental effects, *England, *Forest of Dean, *Opencast mining, Mining wastes, Coal, Water pollution sources.

An inexpensive method of monitoring the water quality and quantity of the discharge from an opencast coal site in the United Kingdom during 1978-79 is described. The data are discussed and their limitations evaluated. It was possible to attribute impacts upon discharge and suspended sediment levels directly to opencast activities. The results were used to produce simple predictive models and to evaluate the effectiveness of current legislation in controlling adverse impacts of opencast coal working. The introduction of an Environmental Impact Assessment procedure is advocated. Legislation for the control of opencast operations at Woorgreens was generally effective, but only as a retributive measure. Too many loopholes in interpretation were discovered in the relevant laws, but it was at the local level of implementation and consultation that major problems occurred. (Baker-IVI)
W85-03824

ANALYSIS AND CHARACTERISTICS OF SIMULATED FLOWS FROM SMALL SURFACE-MINED AND UNDISTURBED APPALACHIAN WATERSHEDS IN THE TUG FORK BASIN OF KENTUCKY, VIRGINIA, AND WEST VIRGINIA,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03918

PRECONSTRUCTION AND SIMULATED POSTCONSTRUCTION GROUND-WATER LEVELS AT URBAN CENTERS IN THE RED RIVER NAVIGATON PROJECT AREA, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03929

ATTENUATION OF STORMWATER CONTAMINANTS FROM HIGHWAY RUNOFF WITHIN UNSATURATED LIMESTONE, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W85-03944

EARLY BIOTIC RESPONSES TO ADVANCING LAKE ACIDIFICATION,
For primary bibliographic entry see Field 5C.
W85-04198

CHANGES IN THE TEMPORAL BEHAVIOR AND SIZE STRUCTURE OF PLANKTON SYSTEMS IN ACID LAKES,
Environmental and Social Systems Analysts Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 5C.
W85-04199

AQUATIC MACROPHYTES AND PH AS CONTROLS OF DIVERSITY FOR LITTORAL CLADOCERANS,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 5C.
W85-04202

ACIDIFICATION AND CHANGES OVER TIME IN THE CHYDORID CLADOCERA ASSEMBLAGE OF NEW ENGLAND LAKES,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 5C.
W85-04203

RESPONSES OF FISH COMMUNITIES TO ACIDIC WATERS IN ONTARIO,
Fisheries and Marine Service, Sault Ste. Marie (Ontario). Great Lakes Biolimnology Lab.
For primary bibliographic entry see Field 5C.
W85-04204

FISH POPULATION RESPONSES TO EXPERIMENTAL ACIDIFICATION OF A SMALL ONTARIO LAKE,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W85-04205

SPECIES COMPOSITION OF FISH COMMUNITIES IN NORTHERN WISCONSIN LAKES: RELATION TO PH,
Columbia National Fisheries Research Lab., La Crosse, WI. Field Research Station
For primary bibliographic entry see Field 5C.
W85-04206

POTENTIAL FOR AQUATIC ECOSYSTEMS ACIDIFICATION IN THE SIERRA NEVADA, CALIFORNIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5C.
W85-04207

STATUS OF HEALTH AND ENVIRONMENTAL RESEARCH RELATIVE TO COAL GASIFICATION 1976 TO THE PRESENT.
Argonne National Lab., IL.

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For primary bibliographic entry see Field 5C.
W85-04227

PREDICTING HYDROLOGIC EFFECTS OF URBANIZATION BY USING SOIL CONSERVATION SERVICE METHODS,
R. H. McCuen, and N. Miller.
Transportation Research Record 922, p 40-46, 1984. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Urbanization, *Environmental effects, *Hydrology, Urban runoff, Storm runoff, Hydrographs, Land use.

Urbanization is a process that affects a number of components of the hydrologic cycle. The manner in which the Soil Conservation Service (SCS) methods can be used to evaluate the hydrologic effects of urbanization are evaluated and a comparison is made of the predicted effects with the results of other studies. The TR-55 graphical and chart methods are used to predict peak discharge. The TR-55 tabular method and the TR-20 computer package can be used to generate entire storm hydrographs. Because the methods are widely used for design in urban areas, it is important to understand exactly how the effects of urbanization should be assessed by using the SCS methods. Changes in land use affect the flood runoff through both the time of concentration and the SCS runoff curve number. The effect of urbanization on peak discharges indicated by SCS methods is compared with the effect indicated by other peak-discharge methods. (Baker-IVI)
W85-04332

SIMPLE METHODS TO EVALUATE RELATIVE EFFECTS OF LONGITUDINAL ENCROACHMENTS,
For primary bibliographic entry see Field 8B.
W85-04333

SIMPLE METHODS FOR ESTIMATING BACKWATER AND CONSTRICTION SCOUR AT BRIDGES AND ABRUPT ENCROACHMENTS,
For primary bibliographic entry see Field 8B.
W85-04334

4D. Watershed Protection

FLUVIAL SEDIMENTATION OF KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 2J.
W85-03897

CHANNEL CHANGES OF POWDER RIVER BETWEEN MOORHEAD AND BROADUS, MONTANA, 1939-1978,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2J.
W85-03910

GULLY REHABILITATION - A THREE-STAGE PROCESS IN A SODIC SOIL,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
B. H. Heede, and L. F. DeBano.
Soil Science Society of America Journal, Vol. 48, No. 6, p 1416-1422, November/December, 1984. 5 Fig, 6 Tab, 16 Ref.

Descriptors: *Gully rehabilitation, *Sodic soils, *Colorado, Gully erosion, Sedimentation, Vegetation, Sodium, Calcium, Magnesium, Soil chemistry, Leaching, Gullies, Suspended sediments, Peak flow.

The geomorphic, edaphic, and vegetation changes occurring in sodic soils were studied during a gully rehabilitation project in western Colorado. Soil material was collected along transects which traversed individual gullies in the network. A topographic survey was also made of each transect to determine areas of erosion and deposition. Along each transect samples were collected on exposed sodium banks, recent and old gully bank colluvium, sediment deposited in the channel, partially stable gully banks, and stable gully banks. The six sample locations were samples in 1962, 1965, 1967, and 1981. The samples collected at the six locations were analyzed for pH; soluble calcium, magnesium, and sodium in a saturated extract; total calcium, magnesium, and sodium; water soluble sodium; cation exchange capacity; and soil texture. Exchangeable sodium percentage (ESP) and sodium adsorption ratio (SAR) were calculated. The analysis of the data showed that gully rehabilitation occurred in three stages; nonvegetated sodium banks disintegrated; the colluvial material from these eroded banks was weathered and leached; and, finally when enough sodium had been leached from the eroded material, it was stabilized and vegetated as older colluvial material at the base of high sodium gully banks or as channel alluvium deposited behind gully structures. These changes led to an overall stabilization of the gullies and reduced suspended sediment and peak flows. (Author's abstract)
W85-03967

USING CLAY MINERALOGY TO INFER SOURCES OF SUSPENDED CLAY AND SILT IN A WATERSHED: QUANTITATIVE APPROACH,
Florida A and M Univ., Tallahassee, FL. Div. of Agricultural Science.
For primary bibliographic entry see Field 2J.
W85-03969

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

CALCULATOR SMOOTHS COLOR MEASUREMENT PATH,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W85-03799

WATER QUALITY INDEX FOR CHAO PHRAYA RIVER,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
B. N. Lohani, and G. Todino.
Journal of Environmental Engineering, Vol. 110, No. 6, p 1163-1176, December, 1984. 6 Fig, 5 Tab, 17 Ref.

Descriptors: *Water quality control, *Statistical analysis, *Chao Phraya River, *Thailand, *Evaluation, Mathematical studies, Cluster analysis, Factor analysis, Multiple regression.

Statistical approaches to water quality evaluation and parameter estimation are investigated. Water quality indices for the Chao Phraya River in Thailand are developed using the techniques of cluster type analysis, factor analysis, and multiple regression. Results of the factor analysis are also used to assess the possible reduction in the number of variables measured, adequacy of sampling locations, and the underlying causes of pollution. With the availability of statistical packages factor analysis provides a quick, simple and analytical method of quality evaluation. In conjunction with cluster analysis, results of factor analysis per se may be used to determine any redundancy in the number of variables measured, the adequacy of sampling stations, and to pinpoint sources of pollution through factor scores. The factor scores may be further utilized for developing a composite index for water quality assessment. Further, different indices representing different underlying processes may be calculated. For the Chao Phraya River in Thailand, the development of the index may be summarized in the following steps: data collection, test for normality, missing value estimation, cluster analysis, factor analysis, stepwise regression, and transformation to normal curve index values. A limitation in this type of statistical index is the data-specific nature of the index. Thus the formulations have to be reviewed from time to time. Evaluation of the range of sensitivity and determination of levels of acceptance should be investigated following river water quality standards setting. (Baker-IVI)
W85-03807

SPECIATION OF ARSENIC AND CADIUM COMPOUNDS BY REVERSED-PHASE IONPAIR LC WITH SINGLE-WAVELENGTH INDUCTIVELY COUPLED PLASMA DETECTION,
Cincinnati Univ., OH. Dept. of Chemistry.
W. Nisamaneepong, M. Ibrahim, T. W. Gilbert, and J. A. Caruso.
Journal of Chromatographic Science, Vol. 22, No. 11, p 473-477, November, 1984. 5 Fig, 5 Tab, 23 Ref.

Descriptors: *Arsenic, *Cadmium, *Pollutant identification, *Spectrography, *Liquid chromatography, Inductively coupled plasma detection, Speciation, Water analysis.

The usefulness of high pressure liquid chromatography-inductively coupled plasma (HPLC-ICP) for the determination of both As and Cd compounds at the As line of 228.812 nm is demonstrated. The successful performance of the HLPC-ICP technique poses attractive possibilities for trace analysis of metal-containing species. The HPLC-ICP single channel technique allows two elemental species to be separated at one detector wavelength setting. No spectral overlap is observed by time sequencing the analytes. The ionpair method allows rapid and selective separation of charged moieties. A better understanding of the fundamental principles of reversed-phase ionpair chromatography is required to fully explain the separation. Further nebulizer modifications should reduce the peak broadening and improve the sensitivity. In addition a hydride generation technique may be applied to impove the sensitivity for the As compounds. (Baker-IVI)
W85-03865

INWASH OF CATCHMENT DIATOMS AS A SOURCE OF ERROR IN THE SEDIMENT-BASED RECONSTRUCTION OF PH IN AN ACID LAKE,
University Coll., London (England). Dept. of Geography.
R. W. Battarbee, and R. J. Flower.
Limnology and Oceanography, Vol. 29, No. 6, p 1325-1329, 1984. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Acid lakes, *Diatoms, *Lake sediments, Catchments, Soil erosion.

An increase in lake water pH following the ploughing of catchment soils in 1961 before conifer plantation is suggested from a diatom analysis of the recent sediments of an acid lake in Galloway, southwest Scotland. The increase is apparently an artifact resulting from the erosion and transfer of soils containing mainly nonacidobiontic diatoms to the sediments and the consequent depression of autochthonous acidobiontic taxa in the percentage diatom counts. Data for diatom accumulation rates which indicate no decrease in the accumulation rates of the acidobiontic taxa over this period support this interpretation. The study indicates that in oligotrophic acid lakes with extensive peatlands in their catchments, a large portion of the diatoms found in the lake sediment may be derived from the catchment if the peatlands have been disturbed by ploughing. Errors in pH inference of lake water are likely to ensue. This study underlines the importance of calculating diatom concentrations and diatom accumulation rates to aid in interpreting percentage data. (Baker-IVI)
W85-03880

DETERMINATION OF NITRILOTRIACETIC ACID IN WATER BY HIGH RESOLUTION GAS CHROMATOGRAPHY,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
C. Schaffner, and W. Giger.
Journal of Chromatography, Vol. 312, No. 16, p 413-421, 1984. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Chromatography, *Nitrilotriacetic acid, *Water analysis, Wastewater analysis, Pollutant identification.

Nitrilotriacetic acid was determined in waters and waste-waters by high resolution gas chromtography of the butylated acids isolated on an anion-exchange resin. The presented method is applicable to heavily loaded waste waters and natural waters. The method allowed rapid, precise and reliable quantitation of NTA in waters and wastewaters down to 0.2 microg/l. Below 2 microg NTA/liter it is recommended to carry out duplicate determinations and frequently to analyze blank samples. No interferences could be detected in heavily loaded wastewaters. The method is highly suitable for routine monitoring programs and investigations of dynamic environmental systems such as wastewater treatment plants and rivers which require the analysis of large numbers of samples. (Baker-IVI)
W85-03887

RECONNAISSANCE OF THE WATER RESOURCES OF THE SHOALWATER BAY INDIAN RESERVATION AND ADJACENT AREAS, PACIFIC COUNTY, WASHINGTON, 1978-79,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03906

ATTENUATION OF STORMWATER CONTAMINANTS FROM HIGHWAY RUNOFF WITHIN UNSATURATED LIMESTONE, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W85-03912

EFFECTS OF STORM-WATER RUNOFF ON WATER QUALITY OF THE EDWARDS AQUIFER NEAR AUSTIN, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5B.
W85-03914

GEOCHEMISTRY OF GROUND WATER IN THE SACRAMENTO VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W85-03926

TRACE METALS IN SAN FRANCISCO BAY, CALIFORNIA, NEAR THE PROPOSED SAN LUIS DRAIN DISCHARGE SITE: A PRELIMINARY REPORT,
Geological Survey, Sacramento, CA. Water Resources Div.
S. N. Luoma, P. V. Cascos, and R. Dagovitz.
Available from the OFSS, USGS, Box, 25425, Fed. Ctr. Denver, CO 80225. USGS Water Resources Investigatons Report 84-4170, 1984. 35 p, 7 Fig, 6 Tab, 55 Ref.

Descriptors: Water quality, *Heavy metals, *Estuaries, Water pollution, Sediment, Mollusks, *California, *Trace metals, *San Francisco Bay, San Luis Drain, Corbicula, Suisun Bay.

A 5-month partial study (February to July 1983) was completed in Suisun Bay, a shallow embayment of San Francisco Bay, Calif., to determine characteristic heavy metal concentrations present in sediments and organisms (Corbicula clams) prior to possible discharge of San Luis Drain irrigation tile return water. Preliminary results show sediments are typical of other San Francisco Bay study sites, ranging from coarse sands to fine silt-clays. The sediments are enriched in manganese and low in organic carbon; iron is moderately enriched, with acid-extractable iron concentrations of 162-3,521 micro-g/g. Sediment concentrations of silver, zinc, lead, and cadmium measured between April and July are reported. Previous area studies have shown increased concentrations during autumn and winter, a period not covered in this data set. Due to insufficient data, interpretations are incomplete. Clam-tissue burdens for silver and zinc are similar to those found in Corbicula from pristine areas. Lead concentrations are typically below the 2-micrograms-per-gram detection level. Corbicula do show indications of more tissue enrichment for cadmium and copper at estuarine stations than at riverine stations.
W85-03927

RECONNAISSANCE OF THE QUALITY OF SURFACE WATER IN THE WEBER RIVER BASIN, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2K.
W85-03930

QUALITY OF WATER RECOVERED FROM A MUNICIPAL EFFLUENT INJECTION WELL IN THE FLORIDAN AQUIFER SYSTEM, POMPANO BEACH, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5E.
W85-03932

CHEMICAL ANALYSES OF ELUTRIATES, NATIVE WATER, AND BOTTOM MATERIAL FROM CHETCO, ROGUE, AND COLUMBIA RIVERS IN WESTERN OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2K.
W85-03947

ATMOSPHERIC DEPOSITION: SAMPLE HANDLING, STORAGE, AND ANALYTICAL PROCEDURES FOR CHEMICAL CHARACTERIZATION OF EVENT-BASED SAMPLES IN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
R. L. Houghton, M. Berger, N. Zander, and S. K. Dutchek.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 83-4205, 1983. 71 p, 3 Fig, 13 Tab, 44 Ref.

Descriptors: *Acid rain, *Precipitation, *Chemistry of precipitation, *Sample preparation, Water sampling, *North Dakota, Precipitation collection.

The North Dakota atmospheric-deposition network uses HASL-type collectors to sample wet and dry deposition on an event basis for analysis of 8 principal mineral, 3 nutrient, and 15 trace constituents. Comparison of the compositions of wet deposition collected in adjacent collectors sampled on weekly and event bases indicates that nonevent sampling leads to significant contamination of wet-deposition samples with dry deposition. Elevation of the collectors 10 feet above ground surface may decrease wind-blown soil contamination significantly. This manual presents a summary of the research procedures adopted by the North Dakota District of the U.S. Geological Survey to investigate the consequences of increased fossil-fuel combustion on the quality of atmospheric deposition. The manual has been tested by field operatives for 3 years and shown to be an effective field guide and management tool. (USGS)
W85-03949

STATISTICAL CONSIDERATIONS IN THE EVALUATION OF CHRONIC AQUATIC TOXICITY STUDIES,
Government of the Northwest Territories, Yellowknife.
T. Capizzi, L. Oppenheimer, H. Mehta, H. Naimie, and J. L. Fair.
Environmental Science and Technology, Vol. 19, No. 1, p 35-43, January, 1985. 7 Tab, 23 Ref.

Descriptors: *Toxicity, *Statistical methods, *No observable effects concentration, Survival, Evaluation, Chronic toxicity.

Statistical methodological issues for estimating the no observable effects concentration (NOEC) in chronic aquatic toxicity tests are addressed. The proposed approach utilizes a two-stage estimation procedure which first examines survival and then evaluates sublethal effects on those concentrations which do not affect survival. At each stage, a one-sided stepwise trend test is employed to test for progressiveness of response with increasing concentration. The log rank test is employed for the analysis of censored survival and time to maturation variables. Adjustments are made for the period of reproductive potential, and transformations are applied to the reproductive variables. Theoretical arguments and empirical results from four previously described Daphnia magna assays show that the proposed procedure should provide more meaningful and sensitive NOEC estimates than presently used methods. The necessity of providing some statement on the sensitivity of the study design and estimation procedure to detect environmentally important differences is also discussed. (Author's abstract)
W85-03971

TRACE DETERMINATION OF INORGANIC AND ORGANIC TIN IN WATER BY HYDRIDE ATOMIC ABSORPTION SPECTROMETRY (DOSAGE DE L'ETAIN MINERAL ET ORGANIQUE EN TRACES DANS LES EAUX PAR SPECTROPHOTOMETRIE D'ABSORPTION ATOMIQUE AVEC GENERATION-DECOMPOSITION D'HYDRURES),
Pau Univ. (France). Lab. de Chimie Analytique.
R. Pinel, I. G. Gandjar, M. Z. Benabdallah, A. Astruc, and M. Astruc.
Analusis, Vol. 12, No. 8, p 404-408, October, 1984. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Tin, *Chemical analysis, *Atomic absorption spectrometry, Spectrometry, Metals, Sea water, Organotin compounds, Oxidation.

Determination of total tin in water by atomic absorption was optimized with hydride generation-decomposition. The detection limit is 1.4 ng (IUPAC confidence level 99.86%) or 1 ng (confidence level 97%). This detection limit is low enough to obtain direct tin determinations in sea water. The combination of two determinations (with and without HNO3-H2O2 wet oxidation of the sample) allows a separate evaluation of 'heavy' organotin compounds. (Author's abstract)
W85-04000

ALUM SLUDGE: A SAMPLING METHOD FOR THE RADIOACTIVITY IN WATERS (LES BOUES D'ALUN: UNE METHODE D'ECHANTILLONNAGE DES COURS D'EAU POUR L'ETUDE DES RADIONUCLEIDES),
Laval Univ., Quebec. Dept. de Genie Chimique.
J. Turcotte, P. Doddridge, P. Beaulieu, J.-C. Roy, and J. E. Cote.
Analusis, Vol. 12, No. 9, p 448-461, November, 1984. 4 Fig, 8 Tab, 25 Ref.

Descriptors: *Radioisotopes, *Chemical analysis, *Alum sludge, Cesium radioisotopes, Beryllium radioisotopes, Suspended solids, Flocculation.

The alum coagulation and settling steps used in water treatment plants can be the basis of a method to concentrate radionuclides present in very small amounts in soft waters. Indeed, the gamma spectrum of a dried alum sludge shows the presence of a number of naturally occurring radionuclides, of fission and activation products unobservable unless a preconcentration step is carried out. The floc sampling technique is described. The different methods developed to relate the amount of floc to

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the volume of water, are presented; they are based either on the chemical characterization of the suspended matter or on the use of internal standards like Cs-137 and Be-7. The question of the distribution of some radionuclides between the liquid and the solid phases in the rivers and that of their retention by the floc is discussed: the results show clearly the importance of the suspended matter as a carrier for the radioactivity. (Author's abstract)
W85-04017

BACTERIOLOGICAL AND CHEMICAL VARIATIONS AND THEIR INTER-RELATIONSHIPS IN A SLIGHTLY POLLUTED WATERBODY,
Perugia Univ. (Italy). Cattedra di Igiene.
G. Morozzi, G. Cenci, and P. Scarabattoli.
International Journal of Environmental Studies, Vol. 23, p 121-129, 1984. 1 Fig, 5 Tab, 20 Ref.

Descriptors: *Bacteria, *Chemical analysis, *Pollutant identification, *Lago di Piediluco, *Italy, Recreation, Reservoirs, Monitoring, Water quality control.

The statistical methods used in the analysis of the data from a 1 year survey of the water of the Lago di Piediluco, Italy yielded useful points for the planning of a better scheme of surveillance for the continuous gathering of information on the quality of the waters from the public health point of view. Lago di Piediluco is a small lake which acts as a reservoir for a hydroelectric station, but which is also used for recreation. Fluctuating demand for power causes changes in water level and both chemical and bacteriological parameters must be monitored to ensure that the water quality does not fall below the standards for recreational use. The high correlations between the bacteriological indices and total inorganic nitrogen, phosphate, chloride, dissolved solids and conductivity make it possible to use the bacteriological parameters as the basic criteria for determining the quality of the surface water. (Baker-IVI)
W85-04034

SPRUCE DECLINE IN THE NORTHERN APPALACHIANS: EVALUATING ACID DEPOSITION AS A POSSIBLE CAUSE,
Pennsylvania Univ., Philadelphia.
A. H. Johnson, and T. G. Siccama.
In: Proceedings of the 1983 Annual Meeting of the Technical Association of the Pulp and Paper Industry, Atlanta, GA, March, 2-4. p 301-310, 14 Fig, 3 Tab, 29 Ref.

Descriptors: *Acid Rain, *Forests, Drought, Spruce trees.

High elevation spruce-fir forests of the eastern U. S. receive particularly high rates of H(+) deposition (up to 4 Keq/ha/yr) and vegetation is exposed to highly acidic cloud moisture for up to 2000 hours per year. Red spruce in the northern Appalachians have died in abnormally large numbers during the last decade while the stands of the southern Appalachians remain healthy. There are no primary pathogens or insect pests involved and the decline appears to be stress related. Analysis of the tree rings suggests that the drought of the early 1960's probably triggered the decline. Although acid deposition is only speculatively linked to the decline at present, it could be a contributing stress if acid deposition and drought stress interact syngergistically.
W85-04236

NEW MEDIUM FOR THE ENUMERATION AND SUBCULTURE OF BACTERIA FROM POTABLE WATER,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
D. J. Reasoner, and E. E. Geldreich.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 1-7, January, 1985. 3 Fig, 5 Tab, 13 Ref.

Descriptors: *Potable water, *Bacterial analysis, *Culture media, Water analysis, R2A medium, Water treatment, Incubation, Temperature effects.

Plate count agar is presently the recommended medium for the standard bacterial plate count (35 C, 48-h incubation) of water and wastewater. However, plate count agar does not permit the growth of many bacteria that may be present in treated potable water supplies. A new medium was developed for use in heterotrophic plate count analyses and for subculture of bacteria isolated from potable water samples. The new medium, designated R2A, contains 0.5 g of yeast extract, 0.5 g of Difco Proteose Peptone no. 3 (Difco Laboratories), 0.5 g of Casamino Acids (Difco), 0.5 g of glucose, 0.5 g of soluble starch, 0.3 g of K2HPO4, 0.05 g of MgSO4 . 7H2O, 0.3 g of sodium pyruvate, and 15 g of agar per liter of laboratory quality. Adjust the pH to 7.2 with crystalline K2HPO4 or KH2PO4 and sterilize at 121 C for 15 min. Results from parallel studies with spread, membrane filter, and pour plate procedures showed that R2A medium yielded significantly higher bacterial counts than did plate count agar. Studies of the effect of incubation temperature showed that the magnitude of the count was inversely proportional to the incubation temperature. Longer incubation time, up to 14 days, yielded higher counts and increased detection of pigmented bacteria. Maximum bacterial counts were obtained after incubation at 20 C for 14 days. As a tool to monitor heterotrophic bacterial populations in water treatment processes and in treated distribution water, R2A spread or membrane filter plates incubated at 28 C for 5 to 7 days is recommended. These conditions provide adequate time for pigment development and for growth of slow-growing bacteria. For isolation and subculture of aquatic bacteria which would not grow on subculture to fresh plate count agar, a modified R2A medium (essentially double strength) designated R3A was found to be very useful. R2A medium has also been used to enumerate bacteria associated with granular activated carbon and in effluents from granular activated carbon water treatment filters. (Author's abstract)
W85-04255

COMPARISON OF SELECTIVE MEDIA FOR ASSAY OF COLIPHAGES IN SEWAGE EFFLUENT AND LAKE WATER,
Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
J. E. Kennedy, Jr., G. Bitton, and J. L. Oblinger.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 33-36, January, 1985. 3 Tab, 18 Ref.

Descriptors: *Effluents, *Coliphages, *Water analysis, Bacteriophages, Wastewater analysis, Culture media, Eutrophic lakes.

Selective media, including EC medium, gram-negative broth, nutrient broth (with 0.05% sodium deoxycholate), and lactose broth (with 0.05% sodium deoxycholate), as well as nonselective nutrient and lactose broths, were compared for the enumeration of coliphages by the agar layer method from activated-sludge effluent and eutrophic-lake water from a lake receiving treated sewage effluent. Samples were plated directly or after chloroform treatment with Escherichia coli B, E. coli C, or a mixed host of both E. coli B and C. With the exception of gram-negative broth, direct assays of all samples with the selective media generally resulted in significantly higher ($P < 0.05$) recoveries of coliphages than did assays of chloroform-treated samples with nutrient broth medium regardless of the host used. In addition, chloroform pretreatment resulted in decreased recovery of coliphages with each selective medium in most analyses. The highest recoveries of coliphages from all samples with each host, except lake water with E. coli C, were obtained by direct assay on EC medium. The selectivity of the EC and gram-negative media resulted in suppression of bacterial interference on direct assay plates comparable to that observed in nutrient agar medium with chloroform-treated samples. The use of certain selective media for the direct assay of environmental materials for coliphage may enhance the recovery of coliphages and obviate bacterial decontamination procedures. (Author's abstract)
W85-04258

SURVIVAL AND DETECTION OF BACTEROIDES SPP., PROSPECTIVE INDICATOR BACTERIA,
Trondheim Univ. (Norway). Div. of Hydraulic and Sanitary Engineering.
L. Fiksdal, J. S. Maki, S. J. LaCroix, and J. T. Staley.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 148-150, January, 1985. 3 Tab, 12 Ref.

Descriptors: *Bioindicators, *Bacteroides, *Bacterial analysis, Escherichia, Streptococcus, Fecal coliforms, Fluorescent antibody method, Feces.

Preliminary experiments were performed to assess the use of intestinal Bacteroides spp. as indicators of fecal contamination of water. Viable counts of Bacteroides fragilis, an anaerobic bacterium, declined more rapidly than those of Escherichia coli and Streptococcus faecalis. However, a fluorescent antiserum prepared against B. fragilis successfully detected high proportions (18 to > 50%) of B. fragilis cells suspended for 8 days in aerobic water in dialysis bags at the ambient temperature. These percentages were higher than the percent viable recoveries of the two indicator bacteria used for comparison. Thus, the fluorescent antiserum test for B. fragilis might serve as a useful indicator of fecal contamination of water. An advantage of this approach over coliform analysis is the rapidity at which the test can be performed. (Author's abstract)
W85-04262

DETECTION OF FALSE-POSITIVES AMONG TOTAL AND FECAL COLIFORM COUNTS BY FACTORIAL ANALYSIS OF CORRESPONDENCE,
Laval Univ., Quebec. Dept. de Mathematiques.
M. Joncas, S. Michaud, J. P. Carmichael, and M. C. Lavoie.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 229-231, January, 1985. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Coliforms, *Fecal coliforms, *Ivory Coast, *Factorial analysis, Bacterial analysis, Bioindicators, Citrate, Indole, Amygdaline, Inositol.

Application of an analysis of correspondence to the biochemical characteristics of total and fecal coliforms isolated in the Ivory Coast permitted the separation of two small clusters of isolates different from the main clusters, which included isolates from human and animal feces. The isolates grouped in the small clusters were from water samples. An analysis of the biochemical characteristics which permitted the segregation of the 'water-specific' isolates from the main clusters indicates that water-specific total coliforms were citrate positive, indole negative, and amygdaline positive. Water-specific fecal coliforms were either citrate positive, indole negative, amygdaline positive, and inositol negative or indole negative, amygdaline positive, and inositol positive. Any isolates not fitting the above patterns could be considered of fecal origin. If this observation is confirmed under temperate climates and for a greater number of isolates, these simple tests could be used to confirm the fecal origin of coliforms. (Author's abstract)
W85-04265

ANALYTICAL FRACTIONATION OF DISSOLVED ORGANIC MATTER IN WATER USING ON-LINE CARBON DETECTION,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 2K.
W85-04298

DETERMINATION OF TRIALKYLTIN, DIALKYLTIN, AND TRIPHENYLTIN COMPOUNDS IN ENVIRONMENTAL WATER AND SEDIMENTS,
Erm-Midwest, Inc., Columbus, OH.
Y. Hattori, A. Kobayashi, S. Takemoto, K. Takami, and Y. Kuge.

Journal of Chromatography, Vol. 315, p 341-349, 1984. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Organotin, *Trialkyltin, *Dialkyltin, *Triphenyltin, *Chemical analysis, Extraction, Electron capture gas chromatography.

An analytical procedure for the determination of trialkyltin (tributyltin, tripropyltin), triphenyltin and dialkyltin (dibutyltin) compounds in environmental water and sediment was studied. Water samples were extracted into benzene with hydrochloric acid and sodium chloride. Sediment samples were extracted into methanolic hydrochloric acid and converted into benzene. Silica gel, which was impregnated with hydrochloric acid and activated, was used for clean-up of these compounds. These extracts of organotin chlorides were hydrogenated with an ethanol solution of sodium borohydride. Organotin hydrides were measured by gas chromatography with electron-capture detection. Recoveries of these compounds were ca. 70-95% from the river water and sediment samples. The detection limits were 0.4-0.8 micro g/l in water and 0.02-0.04 micro g/g in sediment samples. (Author's abstract)
W85-04340

RAPID ASSESSMENT OF EFFLUENT TOXICITIES USING E. COLI AS A BIOINDICATOR,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
G. A. Thompson, and R. J. Watling.
Bulletin of Environmental Contamination and Toxicology, Vol. 43, No. 1, p 75-79, January, 1985. 3 Tab, 4 Ref.

Descriptors: *Pollutant identification, *Bioindicators, *Escherichia coli, *Effluents, *Toxicity, Bacteria, Metals.

A method involving an agar-diffusion technique to determine the relative toxicities of selected metal-rich effluents is described. A pure culture of Escherischia coli was used. Effluent toxicities were assessed using the agar diffusion method for the determination of the toxicities of metals. Ten effluent samples were tested and they were also analyzed for selected metals. Optimum results were obtained when 0.1% tryptone and 0.5% sodium chloride were added to Noble agar or Biolab High Purity agar and the inoculum was 0.5 ml of an overnight culture of E. coli in 5 ml of 1% tryptone water per 100 ml media. Test results indicate the main application of this test to be in the quality control screening of metal-rich effluents over a prolonged period of time. Samples of effluent, taken at different periods, can be tested and the resulting zone sizes will indicate a relative increase or decrease in toxicity. If a quantitative result is required, then diffusion gradient curves can be produced for the specific toxic component of the effluent. The zone sizes can then be compared with the diffusion curve to give toxicant concentration in micrograms/liter. A further application of the test is in the determination of synergistic and antagonistic effects of combined effluents. The use of a bacterial effluent testing system lends itself to rapid routine testing of metal containing effluents. (Baker-IVI)
W85-04347

PCB CONGENER ANALYSIS OF WATER AND CADDISFLY LARVAE (INSECTA: TRICHOPTERA) IN THE UPPER HUDSON RIVER BY GLASS CAPILLARY CHROMATOGRAPHY,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
B. Bush, K. W. Simpson, L. Shane, and R. R. Koblintz.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 1, p 96-105, January, 1985. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Caddisflies, Invertebrates, Bioindicators, Organic compounds, Bioaccumulation, Aquatic insects, Water pollution effects.

The presence and relative concentration of 74 congeners in water and caddisfly larvae collected from 3 sites in the Hudson River were examined. The concentration of the lower chlorinated congeners were much enhanced in the water sampled compared with the mixture of Aroclors 1221, 1016, 1254 and 1260. A high variance in sample findings at Rogers Island was attributed to the turbulence of the riffle areas at that site and possibly the heterogeneity and instability of remnant deposits containing PCB's directly upstream. The majority of the PCB in the river was contained by an earth dam near Roger's Island until that dam was taken out in 1973. Large quantities of the retained sediment were then shifted down into the reach ending at the dam just above the riffle area at Thompson's Island due to the 100 year flood in 1974. Aroclors 1221 and 1242 are the major constituents of this sediment. Eighteen species of macroinvertebrates were collected from the three sites. The bioaccumulation factors demonstrate selective uptake of different congeners by the various species. Monitoring PCB by collecting and analyzing macroinvertebrate species in a stream appears a viable and relatively simple process. (Baker-IVI)
W85-04350

POLLUTION ON THE RIVER RHINE WITH HALOGENATED ORGANIC COMPOUNDS; AN INVESTIGATION DURING A 'FLIESSENDE WELLE',
Bremen Univ. (Germany, F.R.). Fachbereich Chemie/Biologie.
B. Stachel, U. Lahl, and B. Zeschmar.
Science of the Total Environment, Vol. 40, p 103-113, 1984. 5 Fig, 6 Tab, 17 Ref.

Descriptors: *Rhine, *Germany (Federal Republic), *Halogenated hydrocarbons, *Chlorinated hydrocarbons, *Chemical analysis, Extraction, Adsorption, Mineralization, Industrial wastewater, Rivers.

The sensitivity of analytical methods for the determination of halogenated organics in river water was compared using 200 Rhine water samples; 400 samples were collected in August 1982 and between 13 September-1 October 1982, during two 'Fliessende Welle' surveys. In the extraction method (EOX) a non-polar and a polar solvent are used, but strongly polar and ionic water pollutants are only partly extracted from the water sample. The adsorption method (AOX) seems much more efficient; the eluates were mineralized using two methods. The total amount of organohalogen compunds measured by the AOX method is distinctly higher than that of the EOX method. Concentrations found midstream using AOX and one of the mineralization methods are six times greater than the EOX-values. The combination of the adsorption with the mineralization indicates that Rhine water contains an average of nearly 250 micro g/l organohalogenic compounds, calculated as Cl. Assuming that Cl accounts for 20-30% of the weight of these pollutants, one may estimate a daily load of organochlorine compounds of approximately 100 tons at the German/Dutch border. The main discharge sources seem to be the paper/cellulose industry and chemical industry plants. The portion of polar and acid organochlorine compounds in the wastewater which is missed by the EOX method is substantial. (Collier-IVI)
W85-04360

5B. Sources Of Pollution

CONTROLS ON CONTAMINANT MIGRATION AT THE VILLA FARM LAGOONS,
Institute of Geological Sciences, Nottingham (England). Fluid Processes Unit.
For primary bibliographic entry see Field 5D.
W85-03770

CHANGES IN THE ORGANIC FRACTION OF LEACHATE FROM TWO DOMESTIC REFUSE SITES ON THE SHERWOOD SANDSTONE, NOTTINGHAMSHIRE,
Severn-Trent Water Authority, Birmingham (England).
R. C. Harris, and D. R. Lowe.
Quarterly Journal of Geology, London, England, Vol. 17, No. 1, p 57-69, 13 Fig, 3 Tab, 15 Ref.

Descriptors: *Landfills, *Groundwater pollution, *Leachates, *Nottinghamshire, *England, Organic compounds, Waste disposal, Attenuation, Groundwater, Water pollution sources, Path of pollutants.

The Sherwood Sandstone formation outcrops in several locations and is the Severn Trent Water Authority's major aquifer. A detailed study was undertaken at two existing waste disposal sites situated on the Sherwood Sandstone in order that field evidence could be used to formulate an objective policy toward domestic water disposal on the exposed aquifer. The two sites selected were at Burntstump and Gorsethorpe. Anaerobic metabolism in the two domestic landfill environments gives rise to a polluting leachate with a high organic strength, dominated by volatile fatty acids. The range of compounds identified correlates with a theoretical treatment. At both sites leachate has percolated from the base of the landfill and is demonstrably advancing into the unsaturated zone at a rate on the order of 2 m/year. There is little evidence for the existence of attenuation mechanisms within the unsaturated zone of the Sherwood Sandstones at the two sites under study. There is some evidence for the recent onset of attenuation within the Gorsethorpe landfill sites and the mechanism of attenuation is postulated to be methanogenesis. (Baker-IVI)
W85-03771

GROUND-WATER CONTAMINATION DUE TO TRANSIENT SOURCES OF POLLUTION,
Dames and Moore, Golden, CO.
A. Prakash.
Journal of Hydraulic Engineering, Vol. 110, No. 11, p 1642-1658, November, 1984. 4 Fig, 2 Tab, 37 Ref, 2 Append.

Descriptors: *Path of pollutants, *Groundwater pollution, *Groundwater flow, Spatial distribution, Temporal distribution, Aquifers, Model studies.

Simple analytical solutions are presented to predict the propagation of contaminant concentrations with time resulting from the instantaneous and finite-time release of contaminants from a point, vertical and horizontal line or plane, or parallelepiped source in an isotropic porous medium with uniform ground-water flow. The formulation includes the contribution of soil adsorption and radioactive decay. An adaptation of the method to compute the concentrations in a stream-aquifer system is described. Approximate methods are presented to simultate the propagation of concentrations in a two or three-dimensional uniform flow field. The contributions of the nonflux boundaries formed by the bedrock, water table or upper confining layer, and ground-water divides in the lateral direction are accounted for by the method of images. Sensitivity analyses are provided to indicate the effect of the number of images and the size of the time-step used to evaluate the Duhamel integral for the finite-time release case on the accuracy of the results. The applicability of the proposed methodology to certain types of field situations is demonstrated by an example. The analytical model is simple and is expected to provide reasonably accurate results for many situations and for preliminary evaluations of a number of complex field problems. (Baker-IVI)
W85-03781

INSTANTANEOUS EQUILIBRIUM APPROXIMATION ANALYSIS,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W85-03784

WATER QUALITY ANALYSIS OF NEW YORK HARBOR COMPLEX,
Manhattan Coll., Bronx, NY. Dept. of Civil Engineering.
D. J. O'Connor, and J. A. Mueller.
Journal of Environmental Engineering, Vol. 110, No. 6, p 1027-1047, December, 1984. 11 Fig, 5 Tab, 21 Ref.

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Descriptors: *Harbors, *Water quality, *Water analysis, *New York Harbor, *Model studies, Dissolved oxygen, Salinity, Nitrogen compounds.

The impact of continuous and intermittent wastewater sources on water quality in the New York Harbor complex was quantified and provided a basis for plans to improve the water quality, particularly with respect to dissolved oxygen and coliform bacteria. A mathematical model of water quality, coupled with a simplified rainfall-runoff model, was used to define the relative impacts of the continuous and intermittent discharges. A unique feature of the analysis, which was incorporated in the model, related to the density-driven circulation and salinity stratification. This phenomenon produced a difference of dissolved oxygen between the surface and bottom layers. The lower concentration in the bottom layer was used as a basis for comparison with water quality standards. During the low flow conditions, a depletion of up to 5 mg/L at the Battery occurs. About 55% of this deficit is due to the 24 major municipal effluents and untreated sources, and almost 15% is due to benthal demands. The residual is about equally distributed among the other sources, combined sewer overflows and urban runoff and the combined effect of a large number of the smaller municipal and industrial discharges. The effect of nitrification, although potentially significant, has not been a major factor in oxygen depletion over the past two decades. The general elements of the wastewater control plan involve the treatment of the carbonaceous component of raw inputs and upgrading of the existing major municipal plants. If 85% removal is effected from all sources, the resulting minimum dissolved oxygen is in the order of 5 mg/L at the Battery, about 1 mg/L above the standard. It is recommended that serious consideration be given to selective levels of treatment, particularly for the proposed plants, in view of the present economic conditions. (Baker-IVI)
W85-03801

TEMPERATURE DISTRIBUTIONS IN TIDAL FLOW FIELD,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W85-03804

ENVIRONMENTAL IMPACT OF AN OPENCAST OPERATION IN THE FOREST OF DEAN, ENGLAND,
College of St. Paul and St. Mary, Cheltenham (England).
For primary bibliographic entry see Field 4C.
W85-03824

SIMPLE MASS TRANSPORT MODEL FOR METAL UPTAKE BY MARINE MACROALGAE GROWING AT DIFFERENT RATES,
State Univ. of New York at Binghamton. Dept. of Geological Sciences.
D. L. Rice.
Journal of Experimental Marine Biology and Ecology, Vol. 82, No. 2/3, p 175-182, 1984. 1 Fig, 13 Ref.

Descriptors: *Mass transport model, *Algal growth, *Metals, *Bioaccumulation, Cadmium, Rubidium, Manganese, Microalgae, Trace metals, Model studies.

A simple mass transport model was developed to describe metal uptake from sea water by marine macroalgae growing at different rates. Although algae growing at different rates may exhibit different concentrations of a given metal, such differences in algal chemistry may or may not reflect actual effects of environmental growth factors on the kinetics of metal uptake. Published data on uptake of rubidium, cadmium, and manganese by the green seaweed Ulva fasciata Delile grown at different rates in open system sea water was interpreted using the model. Differences in exposure time to sea water of relatively old and relatively young thalli were responsible for significant decreases in algal rubidium and cadmium concentrations with increases in specific growth rate. The biomass-specific rates of uptake of these two metals did not vary with growth rate. Both algal concentrations and specific rates of uptake of manganese increase significantly with increasing growth rate, thus indicating a distinct link between the kinetics of manganese uptake and metabolic rate. Under some circumstances, seaweed bioassay coupled with an interpretive model may provide the only reasonable approach to the study of chemical uptake-growth phenomena. In practice, if the residence time of sea water in culture chambers is sufficiently low to preclude pseudo-closed system artifacts, differences in trace metal concentrations between input and output sea water may be difficult to detect. In the field an in situ experiment based on time-series monitoring of changes in the water chemistry would be technically difficult or perhaps impossible to perform. (Baker-IV)
W85-03831

LEACHING OF ATRAZINE IN THE ROOT ZONE OF AN ALLUVIAL SOIL IN NEBRASKA,
Auburn Univ., AL. Dept. of Agonomy and Soils.
G. Wehtje, L. N. Mielke, J. R. C. Leavitt, and J. S. Schepers.
Journal of Environmental Quality, Vol. 13, No. 4, p 507-513, October-December, 1984. 3 Fig, 2 Tab, 39 Ref.

Descriptors: *Leaching, *Groundwater pollution, *Atrazine, *Platte River Valley, Illinois, Herbicides, Nonpoint pollution sources.

To investigate the leaching of atrazine, a field site was selected that had been continuously cropped to corn and irrigated by either furrow or center-pivot systems. The history of atrazine use on this field was unknown previous to this study. However, irrigated corn had been produced at this site for more than 25 yr with herbicides used for at least 10 yr. In 1979, the basic fertilizer application program was as follows: 9 kg N/ha as urea ammonium nitrate (UAN) on 10 May, 168 kg N/ha as anhydrous NH3 knifed in on 13 June, and 64 kg N/ha as UAN applied with irrigation water through the center pivot on 10 July. Fertilizer applications in 1980 were: 31 kg /ha as UAN on 18 May, and 179 kg N/ha as UAN applied with the irrigation water through the center pivot on 10 June. Each year an additional 112 kg N/ha as ammonium nitrate was broadcasted over four extractors within 2 weeks of planting. Water samples were collected from preplanting until past harvest in 1979 and 1980. Vacuum soil water extractors located 1.5 m below the soil surface recovered an average of 0.072% of the atrazine applied to the surface during 1979 and 1980. Analysis of groundwater recovered from wells on opposite ends of the experimental field indicated enrichment with atrazine in the direction of the hydraulic gradient. Results support direct downward leaching as largely responsible for the low-level atrazine contamination detected in groundwater throughout the irrigated corn production areas of the Platte River Valley. (Baker-IVI)
W85-03851

DENITRIFICATION ASSOCIATED WITH STREAM PERIPHYTON: CHAMBER ESTIMATES FROM UNDISRUPTED COMMUNITIES,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2H.
W85-03852

WATER QUALITY OF IRRIGATION AND SURFACE RETURN FLOWS FROM FLOOD-IRRIGATED PASTURE AND ALFALFA HAY,
Nevada Univ., Reno. Dept. of Plant, Soil and Water Science.
W. W. Miller, J. C. Guitjens, and C. N. Mahannah.
Journal of Environmental Quality, Vol. 13, No. 4, p 543-548, 1984. 2 Fig, 6 Tab, 32 Ref.

Descriptors: *Irrigation, *Water pollution sources, *Water quality, *Flood irrigation, Alfalfa, Hay, Agricultural chemicals, Irrigation practices.

A three year study was made of pollutant contributions from flood-irrigated grass and alfalfa hay, both pastured and nonpastured. Irrigation and surface return flows were metered and the volume of infiltrated water determined at four sites during three irrigation seasons. BOD 5 and P had a net loss from the fields via surface return flow. Statistical relationships among the water quality parameters varied seasonally. Differences were attributed to seasonal changes in irrigation water supply and availability. Even with these differences, similar sites continued to produce similar tendencies over the three year period of study. Levels of constituent contributions to surface runoff appeared to be more related to site characteristics, water management practice, and hydrologic variation than to the presence or absence of grazing animals. Future efforts in water quality management and control should be directed towards quantifying the relationship between water quality as affected by specific management activities, followed by appropriate economic impact assessment of the control measure effects on agricultural productivity. (Baker-IVI)
W85-03856

ADSORPTION OF CURIUM-244: EFFECTS OF DISSOLVED ORGANICS AND SEDIMENT EXTRACTION,
Savannah River Ecology Lab., Aiken, SC.
T. H. Sibley, and J. J. Alberts.
Journal of Environmental Quality, Vol. 13, No. 4, p 553-556, 1984. 1 Fig, 2 Tab, 22 Ref.

Descriptors: *Curium, *Adsorption, *Organic compounds, *Radioactive wastes, Suspended sediments, Partition coefficients.

Curium, like Pu and Am, adsorbs strongly to suspended sediments with resultant Kd values in the range of 10000 to 100000 L/kg. It appears that at low Cm concentrations, adsorption is not directly related to cation exchange capacity (CEC), sediment surface area, or the presence of hydrous oxide coatings. However, organic compounds in sediments and in solution do alter the sediment/water partitioning of Cm. Removal of dissolved organic compounds from solution by ultrafiltration significantly increases adsorption of all sediment types. Similarly, removal of organics from the sediments by NaOH extraction increases Kd values, perhaps by exposing previously blocked adsorption sites. Finally, the slow adsorption kinetics observed for untreated sediments are thought to result from interactions with organics in the sediments. Thus, dissolved and particulate organic matter affects both the distribution coefficients and the adsorption kinetics. (Baker-IVI)
W85-03857

PREDICTED EROSION AND SEDIMENT DELIVERY OF FALLOUT PLUTONIUM,
Los Alamos National Lab., NM.
G. R. Foster, and T. E. Hakonson.
Journal of Environmental Quality, Vol. 13, No. 4, p 595-602, 1984. 1 Fig, 6 Tab, 31 Ref.

Descriptors: *Plutonium, *Fallout, *Water pollution sources, *Erosion, Sediment transport, *Radioactive wastes, Soil erosion.

Plutonium fallout after atmospheric explosion of nuclear weapons in the 1950s and 1960s exists in soils and is strongly associated with clay and silt sized soil particles. Plutonium is being redistributed over the landscape by soil erosion and carried by streams to oceans by sediment transportation. Erosion rates were used to estimate the removal rate of Pu by soil erosion by water. About 96% of the eroded sediment is deposited somewhere between the point where erosion produced the sediment and a river outlet. Since Pu is principally associated with clay, deposition enriches the concentration of Pu in the sediment load. A typical enrichment ratio is 2.7. Based on estimated enrichment ratios, sediment delivery ratios, and erosion rates for major river basins, estimates of annual delivery of fallout Pu included 0.002% of the initial fallout Pu inventory for the Savannah River basin, 0.01% for the Columbia River basin, 0.02% for the Hudson and Rio Grande river basins, and 0.08% for the

lississippi River basin. The deposited sediment is ermanently located at least within the time frame f a few hundred years. As much as 90% of the itially deposited Pu will remain on the landscape ut redistributed by erosion and deposition. Al-ough the delivery rate of Pu by most major vers will not decrease greatly in the next 10 ears, a singificant decrease will likely occur by 00 years when estimated erosional losses of fall-ut Pu will be about 5% of current rates. (Baker-VI)
/85-03858

FFECTS OF WASTEWATER DISPOSAL ON ROWTH RATES OF CYPRESS TREES,
lorida Univ., Gainesville. School of Forest Re-ources and Conservation.
. K. Lemlich, and K. C. Ewel.
ournal of Environmental Quality, Vol. 13, No. 4, 602-604, 1984. 2 Fig, 1 Tab, 5 Ref.

escriptors: *Wastewater disposal, *Swamps, Florida, *Wetlands, *Cypress, *Trees, Nitrogen, hosphorus, Heavy metals.

ong-term impacts of wastewater discharge were udied in a swamp in north Florida which had eceived raw sewage from 1914 to 1951, primary astewater from 1952 to 1972, and secondary astewater from 1973 through the present. Incre-ent cores were taken from cypress trees in this vamp and from a nearby undisturbed cypress vamp. Annual basal area increments were calcu-ted for 75 yr to determine whether the growth tes differed during the various discharge periods elative to growth rates at the control swamp. isposal of untreated or primary wastewater was etrimental to tree growth. Secondarily treated astewater enhanced tree productivity, and rowth rates during this period returned to levels at were similar to control growth rates. Cypress vamps should not be used for disposal of raw ewage or primary wastewater because of the neg-tive impact on the trees, but trees that survive ch conditions are apparently able to recover ormal growth rates when the wastewater is up-raded. (Baker-IVI)
/85-03859

STIMATING LABILE AND DISSOLVED IN-RGANIC PHOSPHATE CONCENTRATIONS N SURFACE RUNOFF,
gricultural Research Service, Columbia, MO. lorth Central Watershed Research Center.
. C. Wendt, and E. E. Alberts.
ournal of Environmental Quality, Vol. 13, No. 4, 613-618, 1984. 3 Fig, 3 Tab, 26 Ref.

escriptors: *Phosphates, *Surface runoff, *Path f pollutants, Eutrophication, Lakes, Nonpoint ource pollution, Aggregates, Adsorption isoth-rms.

lathematical models are suggested to better esti-ate effects of alternative management methods on e amounts of bioavailable P lost in surface runoff ver a variety of soil, topographic, and climatic onditions. Methods for estimating concentrations f soil-derived labile and dissolved P in runoff are roposed and tested. Soil derived labile P concen-rations in runoff may be estimated from results of oil analyses and knowledge of the amount and size istribution of eroded soil particles. Models for redicting the latter in combination with soil anal-ses should provide a basis for predicting labile P ovement in runoff. Accuracy of predictions with ch an approach would also be dependent on rrors associated with predicting size distributions. esults also show that the distribution of labile P etween dissolved and adsorbed forms may be stimated. However, additional factors affecting is distribution, such as electrolyte concentration nd temperature, may need to be considered in rder to provide consistently accurate predictions. he approach used in this study may also be useful or predicting movement in runoff of other strong-y adsorbed chemicals such as some pesticides. owever, additional information is needed in rder to determine the range of adsorption ener-ies and soil types over which the assumptions inherent in the development of this approach apply. (Baker-IVI)
W85-03860

CAUSES OF ACIDIFICATION OF FOUR STREAMS ON LAUREL HILL IN SOUTH-WESTERN PENNSYLVANIA,
Pennsylvania State Univ., University Park. School of Forest Resources.
W. E. Sharpe, D. R. de Walle, R. T. Leibfried, R. S. Dinicola, and W. G. Kimmel.
Journal of Environmental Quality, Vol. 13, No. 4, p 619-631, 1984. 10 Fig, 13 Tab, 22 Ref. OWRT grant B-117-PA.

Descriptors: *Laurel Hill, *Pennsylvania, *Forest watersheds, *Acidification, *Acid rain, Leachate, Fish populations, Streams, Water pollution sources, Storm runoff.

Atmospheric deposition is causing acidification of poorly buffered mountain streams on Laurel Hill during storm runoff periods. Spruce Bog, the two inactive gas wells, and the ski area development do not have a significant effect on the chemistry of the main streams on the four study basins. Hydrogeology of the basins, especially the burial depth, dip, and strike of the Loyalhanna Limestone formation exerts a major control on the natural base-flow chemistry and the buffering capacity of the streams. Acidic atmospheric deposit reaches the soil surface during the dormant season in a somewhat enriched state as throughfall and/or meltwater. Interaction with the leafless deciduous forest canopy, debris in the snowpack, and dry deposition probably cause chemical changes. Due to intermittent snowpack melting and rain-on-snow events, snowpack pollutants were released gradually during the dormant season rather than in a flux of highly concentrated meltwater at the onset of the spring melt. Although forest soils found on these basins did decrease H(+) concentration in percolating water during major runoff events by 72%, soil leachate reaching streams was still at pH 4.3 and exhibited high total Al concentrations. Streams without buffering capacity from Loyalhanna Limestone dropped to pH 4.4 or 4.5 at peak flow during these events and exhibited dramatic increases in total and dissolved Al concentrations. The extent of the problem with acidified soils and streams observed on Laurel Hill is unknown. (Baker-IVI)
W85-03861

ACIDIFICATION OF HEADWATER STREAMS IN THE NEW JERSEY PINELANDS: A RE-EVALUATION,
Rutgers - The State Univ., Camden, NJ. Dept. of Biology.
M. D. Morgan.
Limnology and Oceanography, Vol. 29, No. 6, p 1259-1266, 1984. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Acidity, *Pinelands, *New Jersey, *Acid rain, *Streams, Acid deposition, Hydrogen ion concentration, Oyster Creek, McDonalds Branch.

In an earlier study, Johnson (Johnson, A. H., 1981. Science 206:834-836) indicated that the decline in the pH of the two headwater Pinelands steams could be explained by no factor other than acid deposition. However, a quantitative understanding of hydrogen ion flux through the watershed and corresponding precipitation pH records was lacking. The current analysis shows that the long term trends, if they really exist at all, can be subdivided into several short term trends, none of which is entirely consistent with acid deposition hypothesis. The McDonalds Branch has shown no significant decline in pH from 1958 to 1982. The other, Oyster Creek, showed a significant decline in pH from 1965 to 1982, but the data indicate that a return to normally low pH levels following a short term watershed disturbance in the mid-1960s is more likely to have been responsible than acid deposition. (Baker-IVI)
W85-03877

INWASH OF CATCHMENT DIATOMS AS A SOURCE OF ERROR IN THE SEDIMENT-BASED RECONSTRUCTION OF PH IN AN ACID LAKE,
University Coll., London (England). Dept. of Geography.
For primary bibliographic entry see Field 5A.
W85-03880

RECONNAISSANCE OF THE SHALLOW-UNCONFINED AQUIFER IN SALT LAKE VALLEY, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03892

IMPACT OF DISCHARGES FROM POINT AND NONPOINT SOURCES ON WATER QUALITY OF THE UPPER REEDY RIVER NEAR GREENVILLE, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
D. I. Cahal, and G. K. Speiran.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225, USGS Water-Resources Investigations Report 83-4054, 1983. 35 p, 19 Fig, 3 Tab, 11 Ref.

Descriptors: *Water quality, *South Carolina, *Nonpoint pollution sources, *Wastewater disposal, *Biochemical oxygen demand, *Nitrification, *Dissolved oxygen, Nitrogen compounds, Ammonium, Nitrates, Orthophosphates, Storm runoff, Urban areas.

Impacts of discharge from nonpoint sources in the urban area of Greenville, South Carolina and from the point source, the Mauldin Road Wastewater Treatment Plant, on water quality of the Reedy River were studied from October 1979 through September 1980. Streamflow and water-quality data were collected before and during two storms. The pH and concentrations of organic nitrogen, ammonium, nitrate plus nitrate, ultimate carbonaceous biochemical oxygen demand, dissolved oxygen, and orthophosphate were determined. Streamflow and concentrations of dissolved oxygen were measured continuously at three stations from May through September 1980. Discharge from the point source resulted in average daily concentrations of dissolved oxygen less than 5 milligrams per liter in the Reedy River on 34 days during low streamflow in the summer of 1980. During periods of high streamflow that resulted from the two storms. Dissolved oxygen remained at about 5 milligrams per liter in the Reedy River because increased dilution of loads of oxygen-demanding materials reduced the impacts of these loads on the quality of the Reedy River. (USGS)
W85-03895

SANITARY QUALITY OF THE JORDAN RIVER IN SALT LAKE COUNTY, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. R. Thompson.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 83-4252, 1984. 36 p, 13 Fig, 6 Tab, 14 Ref.

Descriptors: *Water quality, *Public health, Pathogenic bacteria, *Sewage, *Sewage effluents, *Organic wastes, *Bacteria, *Sanitary quality, Indicator bacteria, *Utah, Jordan River, Salt Lake County, Water pollution sources.

This investigation of the sanitary quality of the Jordan River was conducted from July 1980 to October 1982 using indicator bacteria rather than specific pathogens. A serious sanitary problem was identified. Concentrations of total coliform bacteria often exceeded 5,000 colonies per 100 milliliters and concentrations of fecal coliform bacteria often exceeded 2,000 colonies per 100 milliliters in the lower reaches of the river. At times these levels were greatly exceeded. The most conspicuous aspect of the bacteriological data is its extreme variability. Seven waste-water treatment plants, seven major tributaries, numerous storm conduits, irrigation-return flow, and other sources all con-

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tribute to the dynamic system that determines the sanitary quality of the river. Because of this variability the sanitary quality of the river cannot be predicted at any one time. In general, concentrations of all three indicator bacteria increased in a downstream direction. Storm runoff from urban areas contributed large concentrations of indicator bacteria to the river. Regression analysis of 9 years of data collected at 1700 South Street showed a significant positive correlation between both fecal coliform and fecal streptococcal concentrations versus time. Concentrations of fecal coliform and fecal streptococci have both been increasing since 1974 at 1700 South Street. (USGS)
W85-03908

ATTENUATION OF STORMWATER CONTAMINANTS FROM HIGHWAY RUNOFF WITHIN UNSATURATED LIMESTONE, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller, H. Klein, and L. K. Lefkoff.
Available from the OFSS, USGS, Box, 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4083, 1984. 12 p, 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Unsaturated zone, *Stormwater, Runoff, *Percolation, *Infiltration, Attenuation, Soil, Lead, Zinc, *Highway runoff, Dade County, Miami Oolite, *Florida.

Infiltration of stormwater in heavily urbanized parts of Dade County, Florida, is a prime source of recharge to the unconfined Biscayne aquifer, the sole source of drinking water for southeast Florida. Ponded stormwater at the test site contained greater concentrations of lead, zinc, manganese, nitrogen (except nitrate), and phosphorus than the water which percolated through the unsaturated limestone. Attenuation of some stormwater contaminants in the surface soils and limestone is indicated at the test site adjacent to a busy throughfare. Lead concentrations of 610 micrograms per kilogram and zinc concentrations of 91 micrograms per kilogram were found in the thin surface soils, nearly 20 times more than the concentrations of these metals at greater depth. In contrast, soil and rock sample at a control site remote from heavy traffic contained low concentrations of metals and showed little variation in concentration with depth. (USGS)
W85-03912

EFFECTS OF STORM-WATER RUNOFF ON WATER QUALITY OF THE EDWARDS AQUIFER NEAR AUSTIN, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
F. L. Andrews, T. L. Schertz, R. M. Slade, Jr., and J. Rawson.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4124, 1984. 50 p, 9 Fig, 7 Tab, 21 Ref.

Descriptors: *Water quality, *Storm runoff, Recharge, Discharge, Data collection, Nitrogen, Phosphorus, Total organic carbon, Groundwater, Fecal coliform, Bacteria, Fecal streptococcal bacteria, Edwards aquifer, *Texas, Barton springs, Barton Creek.

Analyses of samples collected from Barton Springs at approximately weekly intervals and from Barton Creek and five wells in the Austin area during selected storm runoff periods generally show that recharge during storm runoff resulted in significant temporal and areal variations in the quality of ground water in the recharge zone of the Edwards aquifer. Recharge during storm runoff resulted in significant increases of bacterial densities in the ground water. Bacteriological data for Barton Springs and selected wells indicate that the ground water in the aquifer is susceptible to bacterial pollution, especially during storm runoff. Recharge during storm runoff resulted in significant decreases in the specific conductance and the concentration of total nitrate nitrogen in the ground water. Nitrate nitrogen was the most prevalent form of nitrogen in the ground water. Although the values of these and other properties or constituents in ground water varied temporally and areally, available data indicate that the values of most of the major and minor elements in ground water in the recharge zone of the Edwards aquifer were significantly less than the primary or secondary contaminant levels set by the U.S. Environmental Protection Agency for public water systems. (USGS)
W85-03914

WATER-QUALITY STUDY OF THE RUSSIAN RIVER BASIN DURING THE LOW-FLOW SEASON 1973-78, SONOMA AND MENDOCINO COUNTIES, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
M. A. Sylvester, and R. L. Church.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Water-Resources Investigations Report 83-4173, 1984. 106 p, 32 Fig, 8 Tab, 28 Ref.

Descriptors: *Streams, Water quality, *Nutrients, Aquatic bacteria, Bioindicators, Aquatic algae, Primary productivity, Water temperature, Turbidity, Dissolved oxygen, Droughts, Water pollution control, Land use, Water-quality standards, *California, Russian River, Lake Mendocino, Big Sulphur Creek, Mark West Creek, Sonoma County, Mendocino County.

Water quality and streamflow in the Russian River basin during low-flow seasons (May to October), were studied for water years 1973-78 to document water-quality and streamflow conditions in the basin, and to determine the extent and cause of any water-quality impairment. The most important factors affecting surface-water quality and streamflow during the period of the study were wastewater discharges, their abatement beginning in 1975, and the drought during 1976 and 1977. Substantial decreases in fecal-coliform bacteria and nutrients occurred from 1975 through 1978, corresponding to regulations specifying no discharge of wastewater during the lowflow season. Generally, turbidity and nutrients were least during the 1977 lowflow season. However, specific conductance increased markedly during 1976 and 1977 in response to substantially decreased streamflow during the drought. Algal growth in the Russian River depends on the amount of nitrogen in the water and is not limited by the amount of phosphorus in the water. Cold water releases from Lake Mendocino seem to be important for maintaining downstream water temperatures at acceptable levels for survival of certain aquatic organisms, retarding aquatic community respiration, and preventing nuisance growths of photoplankton and periphyton. During August 1977, a diel study showed the Russian River was a heterotrophic system where photosynthetic production of oxygen was not sufficient to offset respiration. (USGS)
W85-03919

WATER-QUALITY ASSESSMENT OF THE ILLINOIS RIVER BASIN, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
J. E. Terry, E. E. Morris, J. C. Petersen, and M. E. Darling.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. U.S. Geological Survey Water Resources Investigations Report 83-4092, 1984. 435 p, 76 Fig, 54 Tab, 83 Ref.

Descriptors: *Dissolved oxygen, *Biological oxygen demand, *Oxygen sag, *Nitrification, Simulation, Water pollution, Biological communities, Sources, Sinks, Reaeration, Wastewater treatment plants, *Arkansas, Model studies, Illinois River Basin.

A water-quality assessment was made of Illinois River, Muddy Fork, Spring Creek, and Osage Creek in northwest Arkansas. Data were collected to calibrate and verify steady-state digital, stream, water-quality models. The models were then used to simulate changes in instream diel-minimum dissolved-oxygen resulting from changes in nutrien loading. The city of Fayetteville proposes to diver part of its projected wastewater-treatment plan discharge to Illinois River. Muddy Fork, Sprin Creek, and Osage Creek currently received efflu ent from the cities of Prairie Grove, Springdale and Rogers, respectively. The diel-minimum dis solved-oxygen standard for each of these streams i 4.0 mg/L under projected loadings. Data collecte indicate that none of the four streams meet Arkan sas state standards for diel-minimum dissolve oxygen, total phosphorus, and fecal coliform bacte ria. Computed dissolved-oxygen deficits indicat that benthal demand is the principal reason fo dissolved-oxygen not meeting standards. Mode simulations indicate that Spring Creek and Osag Creek can meet dissolved oxygen standards wit stringent effluent limits imposed at the inspectin waste water-treatment plants; Muddy Fork an Illinois River can not. (USGS)
W85-03925

ATTENUATION OF STORMWATER CON TAMINANTS FROM HIGHWAY RUNOFI WITHIN UNSATURATED LIMESTONE, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Re sources Div.
B. G. Waller, H. Klein, and L. J. Lefkoff.
Available from OFSS, USGS, Box 25425, Fed Ctr., Denver, CO 80225. USGS Water-Resource Investigations Report 84-4083, 1984. 12 p, 2 Fig, Tab, 8 Ref.

Descriptors: *Unsaturated zone, *Stormwater Runoff, *Percolation, *Infiltration, *Attenuation Soil, Lead, Zinc, *Florida, Dade County, Miam Oolite, Biscayne aquifer.

Infiltration of stormwater in heavily urbanized parts of Dade County, Florida, constitutes a prim source of recharge to the unconfined Biscayn aquifer-the sole source of drinking water for south east Florida. Ponded stormwater at the test sit contained greater concentrations of lead, zinc manganese, nitrogen (except nitrate), and phospho rus than that water which percolated through th unsaturated zone. Attenuation of some stormwate contaminants in the surface soils and limestone i indicated at the test site adjacent to a busy thor oughfare. Lead concentrations of 610 microgram per gram and zinc concentrations of 91 micro grams per gram were found in the thin surfac soils, nearly 20 times more than the concentration of these metals at greater depth. In contrast, soi and rock samples at a control site remote from heavy traffic contained low concentrations o metals and showed little variation in concentratio with depth. (USGS)
W85-03944

HYDROLOGY OF THE WIBAUX-BEACH LIGNITE DEPOSIT AREA, EASTERN MONTANA AND WESTERN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2K.
W85-03945

DRIFT MINE RECLAMATION IN BIG FOUR HOLLOW NEAR LAKE HOPE, OHIO--A PRELIMINARY DATA REPORT,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5G
W85-03950

HEAVY METALS IN SEDIMENTS FROM DIFFERENT ENVIRONMENTS OF A NORTHERN ADRIATIC SEA AREA, ITALY,
Consiglio Nazionale delle Ricerche, Bologna (Italy). Ist. per la Geologia Marina.
S. Guerzoni, M. Frignani, P. Giordani, and F. Frascari.
Environmental Geology and Water Science, Vol 6, No. 2, p 111-119, 1984. 10 Fig, 5 Tab, 30 Ref

Descriptors: *Heavy metals, *Sediment contamination, *Po River, *Italy, *Adriatic Sea, Water pollu

n sources, Fate of pollutants, Path of pollutants, rganic carbon, Coastal waters, Lagoons, Marine vironment, Adsorption, Water circulation.

ie distribution, enrichment, and transport patrns of 11 trace metals were studied in the surface d core sediments of the area of the Adriatic sea rectly affected by the Po River (Italy). The study ea is the part of the northern Adriatic Sea beeen Ancona and Chioggia, not extending further at 20 km from the coast. The source of pollutants the Po River, the other rivers having a minor fluence. The Po River samples are characterized the highest contents of Cd, Co, Cr, Cu, Ni, Mn, n, and total organic carbon (TOC). Trace eleents coming from the Po River and adsorbed on ie particles concentrate in lagoons. Lagoons do ot show maximum concentrations (except for Pb), robably because of desorption phenomena due to e salt wedge. Coarse coastal sediments along the elta are not polluted and only show an enrichent in Ni content due to spinel and magnetite inerals. Offshore muds, settled from the Po River ad, are characterized mainly by Zn, Cr, Pb, Cu, d Hg and secondarily by Co, Ni, Cd, V, and OC. Mn is fairly concentrated in the Po River fluents and less so in marine sediments off the elta. Hg and V are more concentrated in marine an in riverine or lagoon sediments. Ti and, to me extent, Pb originate from sources to the north the study area. TOC plays an important role in ansport and distribution mechanisms of the etals. On the basis of the maximum background vels determined for Cd, Hg, Pb, and Zn, most of ie samples show concentrations very close to, or wer than the natural ones. Surface and bottom rrents, together with different sources, physical id chemical phenomena are responsible for the bserved distribution of elements in the study area. Moore-IVI)
785-03981

PPROACH TO MODELLING RADIONUCLIDE MIGRATION IN A MEDIUM WITH TRONGLY VARYING VELOCITY AND LOCK SIZES ALONG THE FLOW PATH,
oyal Inst. of Tech., Stockholm (Sweden). Dept. f Chemical Engineering.
Neretnieks, and A. Rasmuson.
Vater Resources Research, Vol. 20, No. 12, p 823-1836, December, 1984. 20 Fig, 5 Tab, 22 Ref.

Descriptors: *Radionuclides, *Solute transport, Velocity, *Groundwater movement, *Block size, orption, Diffusion, Radioactive wastes, Mathenatical models, Advection, Waste disposal.

Radionuclides escaping from a repository in crysalline rock for spent nuclear fuel will migrate with he seeping water in the fissures. Most radionulides will be retarded by sorption on the rock urfaces and by diffusion into the rock matrix. Available surface for sorption and residence time re two prime variables which influence the radioiuclide movement. The water velocity may vary ery much along a flow path, especially if the flow ath enters a strongly fissured zone (lineament). In his paper the radionuclides in a stream tube with n arbitrary velocity along the flow path have een investigated, and a numerical scheme based n the integrated finite difference method (IFDM) s proposed for practical calculations. The transort mechanisms considered are advection and longitudinal dispersion and the retardation mechaisms used are instantaneous sorption in a portion f the rock (surface sorption) and diffusion into the ock matrix and sorption on the micropore surfaces. An attempt is also made to account for locks of various sizes and shapes in introduction f a 'pseudobody.' This method accounts for the arge sorption surface but small volume of small locks and small surface area but large volume of arge blocks. Any block size distribution can be handled. (Author's abstract)
W85-03988

NONSTEADY THREE-PHASE IMMISCIBLE FLUID DISTRIBUTION IN POROUS MEDIA,
Waste Water and Land, Inc., Fort Collins, CO.
D. K. Eckberg, and D. K. Sunada.
Water Resources Research, Vol. 20, No. 12, p 1891-1897, December, 1984. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Groundwater pollution, *Aquifers, *Oil spills, Porosity, Porous media, Soil porosity, Oil, Path of pollutants, Capillarity, Soil water.

The three-phase fluid distribution caused by a petroleum spill in an unconfined aquifer was investigated experimentally. The experiment consisted of introducing oil at the top of a vertical column of soil containing water and measuring the soil and water contents at various elevations and times. The static fluid distribution was then compared to the calculated distribution based on two-phase capillary pressure versus saturation data obtained by a separate lab experiment. The water saturation changed as oil was introduced into the soil, but the water pressure stayed relatively constant and, at equilibrium, the water pressure distribution was identical to the initial water pressure distribution. The assumption that the total liquid content in a static oil, water, and air system is a function of the capillary pressure between oil and air only is not acceptable. The major difficulty encountered with this approximation is that the capillary pressure between oil and air increases much quicker than the capillary pressure between oil and water with increases in elevation. Therefore the calculated total liquid content curve approaches residual much faster than the calculated water content curve. (Baker-IVI)
W85-03995

INFLUENCE OF WETLANDS AND COAL MINING ON STREAM WATER CHEMISTRY,
West Virginia Univ., Morgantown. Dept. of Biology.
R. K. Wieder, and G. E. Lang.
Water, Air, and Soil Pollution, Vol. 23, No. 4, p 381-396, November, 1984. 3 Fig, 4 Tab, 53 Ref.

Descriptors: *Wetlands, *Mining, *Water pollution sources, *East Fork, *Big Run, *West Virginia, Stream pollution, Water chemistry, Sulfates, Iron, Bogs.

Despite generally similar mean ionic concentrations in East Fork and Big Run (West Virginia), statistical analyses revealed that Big Run Bog does influence the chemistry of Big Run. Tub Run Bog also influences stream water chemistry, apparently accomplishing a chemical modification of inputs of acid mine drainage, thus minimizing the impact of the mine drainage on stream water quality. The concept that wetland areas contribute to the regulation of stream water chemistry in ways that are different from upland areas has been documented in other relatively undisturbed systems as well. The present study suggests two areas for further study. First, the concentrations of individual ions, particularly hydrogen, sulfate and ferrous ions, are clearly influenced by physico-chemical and microbially-mediated transformations, yet our knowledge of the factors controlling these processes in wetland peat is in complete. Secondly, a characterization of regional hydrology, including short-term hydrologic and biogeochemical responses to individual storm events within these three watersheds would both complement and expand upon the present study. (Baker-IVI)
W85-04011

SPECIATION OF ANTIFOULANT ORGANOTIN COMPOUNDS IN WATER,
District of Columbia Univ., Washington. Dept. of Chemistry.
V. V. Nguyen, I. J. Posey, and G. Eng.
Water, Air, and Soil Pollution, Vol. 23, No. 4, p 417-422, November, 1984. 1 Fig, 2 Tab, 6 Ref. Dept. of the Interior Grant A-020-DC.

Descriptors: *Organotin compounds, *Antifoulants, *Chemical speciation, Chemical reactions, Spectroscopy, Chromatography, Pollutant identification, Fate of pollutants.

The fate of three antifoulant organotin compounds in water has been investigated using IR spectroscopy and thin-layer chromatography. The compounds are triphenyltin hydroxide (Ph3SnOH), triphenyltin chloride (Ph3SnCl), and triphenyltin acetate (Ph3SnOCOCH3). On the thin-layer chromatography studies the Rf value increased with increasing concentrations of methanol. Species that would predominate on developing the chromatogram with low concentrations of methanol would be the Ph3SnX and Ph3SnX.Solv. These species would migrate faster and exhibit higher Rf values as the solvent polarity is increased. At sufficiently high solvent polarity, ionization of Ph3SnX occurs and the Ph3Sn(+).Solv species is formed. The ratio of Ph3Sn(+).Solv/Ph3SnX.Solv would increase with increasing polarity of the solvent reaching a maximum in pure methanol. As the ratio of Ph3Sn+.Solv/Ph3SnX.Solv increases, the rate of migration of the spot and the value of Rf decreases due to the increasing polarity of the species. The ratio of Ph3Sn+.Solv/Ph3SnX.Solv reaches a maximum and the Rf value a minimum when the developing solvent is pure methanol. This reasoning accounts for the fact that attempts to resolve mixtures of the three organotin compounds did not prove fruitful with the solvents studied. In the IR studies, the IR spectrum of the residue from shaking Ph3SnOCOCH3 with water for 7 days showed evidence for the formation of Ph3SnOH. Thus it would appear that mixing Ph3SnX with water forms the Ph3Sn+ ion which can then react with water to form the hydroxide compound or with the anion to reform the original compound, Ph3SnX. While antifoulant coatings are complex systems, the findings of this study suggest that the X group in the compounds of the type Ph3SnX is labile in polar solvents and that Ph3SnOH and/or PH3SnX are the species that are formed in aqueous solution. (Baker-IVI)
W85-04013

RESIDUES RELATED TO AGRICULTURAL CHEMICALS IN THE GROUNDWATERS OF THE BURDEKIN RIVER DELTA, NORTH QUEENSLAND,
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Chemistry.
J. E. Brodie, W. S. Hicks, G. N. Richards, and F. G. Thomas.
Environmental Pollution, Series B, Vol. 8, No. 3, p 187-215, 1984. 6 Fig, 9 Tab, 31 Ref.

Descriptors: *Groundwater pollution, *Burdekin River Delta, *Queensland, *Australia, *Agricultural chemicals, Mercury, Chlorides, Sodium, Potassium, Ammonia, Nitrates, Phosphates, Heptachor, Fertilizers, Mercury, Sugar cane.

The concentrations of a range of species, related to agricultural chemicals applied to the sugar cane crops, have been determined in the groundwaters of the Burdekin River Delta, Australia. In the majority of samples the organic mercury fraction was greater than the inorganic fraction. A strong adsorption of mercury onto particulate matter was noted. No correlation between mercury concentrations and environmental factors such as water table levels, borehole depths or the concentrations of other species in the water, were found. Three nitrogen species, nitrite, nitrate, and ammonia, were determined. In samples where high nitrate concentrations were found, ammonia was considerably lower than nitrate. The nitrate results divide the boreholes into two groups, one having an average nitrate concentration approximately one hundred times the other. The high amount of nitrate in many of the boreholes is almost certainly derived from nitrogenous fertilizers. Heptachlor and gamma-HCH concentrations were in the 0-3 ng/cu dm range in the vast majority of cases. (Baker-IVI)
W85-04039

MASS TRANSFER OF NH3 INTO WATER AT ENVIRONMENTAL CONCENTRATIONS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 2K.
W85-04040

IMPACT OF PROPOSED GLENGOWAN DAM FLOW AUGMENTATION ON THAMES RIVER WATER QUALITY,
Gore and Storrie Ltd., Toronto (Ontario). Water Resources Div.
For primary bibliographic entry see Field 6G.
W85-04044

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RIVER MIXING - A STATE-OF-THE-ART REPORT,
Minnesota Legislature Science and Technology Research Office, St. Paul.
N. Elhadi, A. Harrington, I. Hill, Y. L. Lau, and B. G. Krishnappan.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 585-609, September, 1984, 9 Fig, 2 Tab, 70 Ref, 5 Append.

Descriptors: *River mixing, *Mixing zones, *Diffusion, *Transport, Mathematical studies, Model studies, Numerical analysis, Ice, Turbulence, River mechanics, Fate of pollutants.

Many engineering problems, such as the calculation of mixing zones, and the estimation of pollutant spreading from accidental spills, are related to some aspect of river mixing. This task-group report is primarily a reference document from which the practicing engineer can obtain a basic understanding of the mechanisms of transport and mixing as well as recommendations on how various mixing problems can be approached. A description of the various physical processes involved in the spreading of a substance in river flows as well as the mathematical formulation of these processses is given. These processes are combined in the mass balance equation to describe the mixing of substances released into rivers. For three-dimensional mixing problems, analytical solutions that are available are not very applicable to practical problems. Numerical modelling, including modelling of the flow field, will be necessary and this may lead to prohibitive computational requirements for real river situations. For steady state problems involving the continuous release of a tracer, the two-dimensional equation is applicable at some distance downstream from the source. The equation may be simplified into two dimensions using depth averaging and the stream-tube approach which takes into account variations in river curvature, depth, and velocity. Analytical solutions can be used to obtain rough estimates and numerical solutions are available for more accurate predictions. The conventional Fickian solution of one-dimensional mixing is often not applicable for the concentrations resulting from the release of a slug of material. A model is recommended that predicts different mixing behavior at different distances from the source; the model becomes Fickian only in the final stage. The presence of an ice cover reduces the turbulent diffusive transport; this may be due to a reduction in the intensity of the turbulence because turbulence intensity can be expected to scale to the boundary shear stress, which, for the ice-covered flow, is smaller than that of the corresponding free surface flow. (Collier-IVI)
W85-04050

VARIATION IN POLYCHLORINATED BIPHENYL LEVELS IN COMMON CARP FROM A PRIMARILY AGRICULTURAL DRAINAGE,
Iowa Cooperative Fishery Research Unit, Ames.
W. A. Hubert, E. D. Ricci, and J. J. Richard.
Hydrobiologia, Vol. 118, No. 3, p 293-297, 1984. 2 Tab, 19 Ref.

Descriptors: *Carp, *Polychlorinated biphenyls, *Des Moines River, *Iowa, Organic compounds, Industrial wastes, Fish, Agricultural runoff, Seasonal variation, Water pollution sources.

Concentrations of polychlorinated biphenyls (PCBs) in common carp from the Des Moines River, Iowa, were assessed for variability related to sampling location, sampling period, fish age, and fat content. Concentrations were highest at a location near the City of Des Moines. They were substantially lower in 1981 than in 1980. Variation in PCB levels in fish from the four sampling locations was probably due to point sources of PCBs. The two upstream sampling locations drain primarily agricultural lands with small municipalities and little industrial development. PCB residues were low from these two locations. Concentrations of PCBs were four to five times higher in fish from the City of Des Moines sampling location. Seasonal variations were also noted, and may be related to overall stream discharge for a period preceeding sampling. (Baker-IVI)
W85-04065

EDTA CHELATION AND ZINC ANTAGONISM WITH CADMIUM IN SEDIMENT: EFFECTS ON THE BEHAVIOR AND MORTALITY OF TWO INFAUNAL AMPHIPODS,
Moss Landing Marine Labs., CA.
J. M. Oakden, J. S. Oliver, and A. R. Flegal.
Marine Biology, Vol. 84, No. 2, p 125-130, December, 1984. 2 Fig, 3 Tab, 36 Ref. EPA grant 808772-01.

Descriptors: *Cadmium, *Zinc, *Water pollution effects, *Chelating agents, *Amphipods, *Benthos, Crustaceans, EDTA, Metals, Heavy metals, Sediments, Fate of pollutants, Water pollution effects.

The two species of infaunal amphipod crustaceans Rhepoxynius abronius (Phoxocephalidae) and Eohaustorius sencillus (Haustoriidae) are characteristic of nearshore sandy bottoms along the California (USA) coast, and are highly sensitive to moderate levels of heavy metals. In laboratory experiments, both zinc and the chelator ethylene diamine tetraacetic acid (EDTA) increased the survival of amphipods in sediment containing otherwise lethal levels of cadmium (8.5 micro g/g), which are representative of moderately polluted environments. In simple choice experiments, amphipods prefer sediment with complexed cadmium. The behavioral and survival patterns of both species were similar in the experiments. EDTA prevented about 50% of the added cadmium from initially being incorporated into the sediment, and increased the rate of cadmium released from the sediment. These data illustrate the limitations of operational definitions of chemical analyses, since weak-acid (0.5 N HC1) leaches that were intended to provide an estimate of the 'biologically available' metal concentrations extracted both toxic and EDTA-complexed cadmium species and did not account for their antagonistic interactions with zinc. (Author's abstract)
W85-04084

INVESTIGATION OF THE POSSIBILITY OF USING THE COMPOSITION METHOD FOR DETERMINING MINERALIZATION OF WATER IN A RIVER SYSTEM,
For primary bibliographic entry see Field 2K.
W85-04120

STUDY OF HEAVY-METAL CONCENTRATION IN RIVER RUNOFF FROM URBANIZED TERRITORIES,
Yu. V. Gontar, K. N. Krupskii, V. A. Bocharov, and V. V. Kisilevskii.
Water Resources, Vol. 10, No. 4, p 369-375, July-August, 1983. 2 Fig, 8 Tab, 10 Ref. Translated from Vodnye Resursy, No. 4, p 89-95, July-August, 1983.

Descriptors: *Water pollution sources, *Rivers, *Runoff, *Heavy metals, *Urban areas, Industrial wastewaters, Municipal wastewaters, Wastewater treatment, Water quality, Effluents.

Trace amounts of a number of heavy metals in river water and municipal wastewaters being discharged into it represent a mixture of domestic and industrial wastewaters that underwent complete biological treatment. The river in question has a length of about 10 km and drainage area of 2300 sq km. The level of pollution of the river is governed by the surface runoff from the city and especially by the discharge of biologically treated municipal wastewaters (BTMWW). The surface runoff and its sediments have a decisive effect on the degree of pollution of the water and bottom sediments by heavy metals before the discharge of the BTMWW, especially in the case of river regulation. On the stretch after the discharge of wastewaters, the concentrations of metals in the wastewater have a decisive effect on the quality of the river water. After the discharge of BTMWW, the concentration of heavy metals in the river water increases by about one order or magnitude. The concentration of heavy metals in the river water on the whole does not exceed the corresponding maximum allowable concentration. Secondary pollution of the river water by such metals as Pb, C, Ni, Fe, Zn, and Hg is possible, and therefore it is desirable to periodically remove the bottom sediments from the river. To prevent wate pollution by heavy metals within urbanized territo ries it is necessary to treat the surface runoff of th city and polish the wastewaters. A better way t solve the problem is to construct local treatmer plants at industrial enterprises which shoul remove heavy metals from wastewaters before d livering them to municipal treatment plant (Baker-IVI)
W85-04121

MULTICOMPONENT SOLUTE TRANSPOR WITH SORPTION AND SOLUBLE COMPLEX ATION,
Notre Dame Univ., IN. Dept. of Civil Enginee ing.
D. J. Kirkner, T. L. Theis, and A. A. Jennings.
Advances in Water Resources, Vol. 7, No. 3, 120-125, September, 1984. 5 Fig, 1 Tab, 14 Re DOE grant DE-AC02-79EV 10253.

Descriptors: *Solute transport, *Sorption, *Con plexation, Path of pollutants, Groundwater poll tion, Dispersion, Convection, Algorithms, Fate pollutants, Mass transport.

Physical, chemical and biological interactio which are frequently complex are involved in th movement of groundwater contaminants. Organ and inorganic pollutants from such sources as sol wastes and sludges disposed of on lan wastewaters renovated through groundwater r charge, and polluted surface waters which r charge groundwater aquifers are examples whe the need for an understanding of the principl governing mass transport exist. A numerical alg rithm for predicting the migration of multiple su surface pollutants has been developed accountir for dispersion, convection, soluble complexatio and solid phase accumulations (sorption). The pr cedure employs a Galerkin finite element spati discretization and a finite difference time marchir scheme. Sorption terms are treated as implic function of the total soluble concentration var bles. The principle advantage of this approach the modularization of the chemical calculation Solution phase calculations are performed sep rately from solid phase calculations. (Moore-IV
W85-04171

GUIDELINES ON THE USE AND ACCEP ABILITY OF OIL SPILL DISPERSANTS, 2N EDITION.
Environmental Protection Service, Ottawa (Onta io).
Available from Environment Canada, Ottawa K1 1C8, March, 1984. Report EPS 1-EP-84-1. 31 p, Fig, 1 Tab, 12 Ref, 2 Append.

Descriptors: *Standards, *Dispersants, *Oil spill *Water pollution treatment, *Water pollution co trol, Surface water, Clean-up operation, Water po lution, Environmental protection, Guidelin *Canada.

Oil spills on water can have adverse effects aquatic life, coastal resources, and human being When selecting countermeasures to deal wi spilled oil, the first consideration should be phy cal containment and removal of the oil from t water. In some situations, chemical dispersion the oil into the water can also be an effecti countermeasure. In most situations it is essenti that the enviromental advantages and disadva tages that may result from the use of dispersants carefully scrutinized to ensure that a net enviro mental benefit will be achieved. This can be a complished through the use of toxicity testing pr tocols as described in these guidelines. Dispersan are chemical formulations that promote the disp sion of oil into water. They are distinct from washes, bilge cleaners, etc., and they are intend for use in larger quantities. The active ingredien are surfactants that lower the interfacial tensi between oil and water. With the application mixing energy the oil breaks up into small drop and becomes distributed into the water column an oil-in-water dispersion. Ultimately the disper oil droplets are transported from the spill site a degraded by natural processes in the sea. Th report sites a series of guidelines provided for t

nformation of On-Scene-Commanders, contingen-y planners, operators involved in oil spill counter-neasures and manufactures of oil spill dispersants. They are intended to advise when and where lispersants should be considered for use, and the ninimum requirements for acceptance of a dispers-nt. General criteria for making dispersant use lecisions are included.
W85-04194

EARLY BIOTIC RESPONSES TO ADVANCING LAKE ACIDIFICATION,
For primary bibliographic entry see Field 5C.
W85-04198

CHANGES IN THE TEMPORAL BEHAVIOR AND SIZE STRUCTURE OF PLANKTON SYSTEMS IN ACID LAKES,
Environmental and Social Systems Analysts Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 5C.
W85-04199

EFFECT OF LAKE PH ON MICROBIAL DECOMPOSITION OF ALLOCHTHONOUS LITTER,
Brookhaven National Lab., Upton, NY. Terrestrial and Aquatic Ecology Div.
For primary bibliographic entry see Field 5C.
W85-04200

SUBSURFACE TRANSPORT WITH EMPHASIS ON HYDROLOGY: RESEARCH NEEDS,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Chemistry Section.
J. M. Zachara, and R. E. Wildung.
Subsurface Transport Program Working Paper DOE/EP-0177, March, 1982. 28 p, 1 Fig, 4 Tab, 38 Ref. Contract/Grant No. DE-AC06-76RLO 1830.

Descriptors: *Waste disposal, *Solid wastes, *Leachates, *Leaching, *Waste management, *Solid waste disposal, Research priorities, Underground waste disposal, Hydrology, Subsurface drainage, Project planning, Environmental effects, Waste characteristics, Waste identification, Wastes, Industrial wastes, Fate of pollutants, Path of pollutants, Groundwater movement.

This report develops the concept of multitechnology or generic research in subsurface transport of solid waste leachate in order to identify priority research needs and projects. Proposed areas of research cover a variety of processes internal to a disposal site including such important features as contaminant identification, solubilization, transformation and transport, as well as mitigating procedures and environmental control. In addition, proposed studies addressing processes external to the site such as contaminant/leachate transport through soil/substrata are necessary in refining the regulatory process and in evaluating the hazards to the environment and human health in the event of a leachate release. The generic research approach when supplemented with waste-specific studies, and judicious selection of experimental parameters to represent a wide range of conditions, has considerable potential for application to site-specific problems.
W85-04217

AQUATIC PATHWAYS MODEL TO PREDICT THE FATE OF PHENOLIC COMPOUNDS,
Battelle Pacific Northwest Labs., Richland, WA.
R. L. Aaberg, R. A. Peloquin, D. L. Strenge, and P. L. Mellinger.
Available from the National Technical Information Service, Springfield, VA 22161. Report PNL-4202, April, 1983. 50 p, 8 Fig, 8 Tab, 56 Ref. Contract/Grant No. DE-AC06-76RLO 1830.

Descriptors: *Model studies, *Fate of pollutants, *Biodegradation, *Phenols, *Computer models, *Fuel spills, Ecosystems, Industrial wastes, Organic compounds, Aquatic environment, Bioaccumulation, Biotransformation, Ponds, Adsorption, Hydrolysis, Oxidation, Simulation analysis, *Path of pollutants.

A computer code, Aquatic Pathways Model (APM), was written to implement a model developed to predict the fate of spills or pollutant discharges into flowing or static bodies of fresh water. The APM estimates concentrations of chemicals in fish tissue, water and sediment and has been implemented with parameters for distribution of phenols found in the water-soluble fraction of coal liquids. Current modeling efforts show that the lighter phenolics are not as persistant in the environment as are many of the pesticides and polyaromatic hydrocarbons. For the twelve phenolics studied, biodegradation appeared to be the major pathway for elimination from aquatic environments. A pond system simulation (using APM) of a spill of solvent refines coal materials showed that phenol, cresols, and other single cyclic phenolics are degraded to 16 to 25% of their original concentration within 30 hr. Results of a simulated spill of a coal liquid into a pond showed that APM predicted the allocation of 12 phenolic components among six compartments at 30 hr after a small spill.
W85-04222

ACID RAIN AND ATMOSPHERIC DEPOSITION: CAUSES, CONSEQUENCES, AND RESEARCH NEEDS,
North Carolina Agricultural Research Service, Raleigh.
E. B. Cowling.
In: Proceedings of the 1983 Annual Meeting of the Technical Association of the Pulp and Paper Industry, Atlanta, GA, March 2-4. p 293-299, 2 Fig, 37 Ref.

Descriptors: *Acid rain, *Lumber industry, Surface water, Forests, Deposition, Nutrients.

The forest products industries of the United States and Canada have 3 major reasons for interest in air pollution, acid rain, and atmospheric deposition and their influences on surface waters and forest productivity: the industry owns a significant part of the forest lands and surface waters into which man made and natural air emissions of nutrients and toxic substances are deposited on this continent; the productivity of these lands and surface waters (as well as all private nonindustrial and publicly owned forest lands) is determined in part by the balance between beneficial nutrient elements and potentially injurious substances transferred from the atmosphere into forests by wet and dry deposition processes; and the industry produces a continentally small but locally important share of the beneficial and injurious gases, aerosols, and particulate matter that are dispersed through the air and deposited on vegetation, soils, surface waters, and man made structures. For all three reasons, the forest products industries will benefit from cooperative research efforts with other industries and with government agencies to better understand the sources of emissions; the transport, transformation, and deposition processes; and the effects of the deposited matter on the land and water resources in various regions of this continent.
W85-04235

INCORPORATION OF PHENOL CARBON AT TRACE CONCENTRATIONS BY PHENOL-MINERALIZING MICROORGANISMS IN FRESH WATER,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Zoology.
R. H. Chesney, P. Sollitti, and H. E. Rubin.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 15-18, January, 1985. 5 Fig, 13 Ref. PHS grant RR-7059.

Descriptors: *Phenols, *Microorganisms, *Fate of pollutants, Mineralization, Bioaccumulation, Thymidine, Metabolism.

The fate of phenol carbon at phenol concentrations ranging from 1 ng/ml to 1 micro-g/ml was determined in freshwater samples. Approximately 20% of the parent phenol was incorporated into trichloroacetic acid-precipitable material by the microorganisms capable of mineralizing phenol. There was no apparent lag period before phenol incorporation commenced, and incorporation was complete within 2 h at all concentrations tested. A direct relationship was found between the initial phenol concentrations and both phenol mineralization and incorporation rates, indicating that cometabolism of phenol does not occur at concentrations that are environmentally significant. At all concentrations, approximately 80% of the initial phenol concentration was mineralized. This percentage plus the percentage of phenol incorporated at the various concentrations equaled approximately 100%. Therefore, the parent phenol does not remain in fresh water; it is either incorporated into cellular biomass or mineralized. However, the incorporated phenol carbon is subject to bioaccumulation in nature. There was no apparent lag period before thymidine was incorporated into biomass, and incorporation was complete within 4 to 8 h at all of the phenol concentrations tested. Thymidine incorporation was independent of phenol concentration at all levels tested. This is probably due to the small amount of thymidine incorporated by the phenol-mineralizing microorganisms in comparison with the amount of thymidine incorporated by the total microbial population. (Author's abstract)
W85-04257

SEASONAL DISTRIBUTION OF VIBRIO PARAHAEMOLYTICUS IN FRESHWATER ENVIRONS AND IN ASSOCIATION WITH FRESHWATER FISHES IN CALCUTTA,
National Inst. of Cholera and Enteric Diseases, Calcutta (India).
B. L. Sarkar, G. B. Nair, A. K. Banerjee, and S. C. Pal.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 132-136, January, 1985. 1 Fig, 5 Tab, 16 Ref.

Descriptors: *Vibrio, *Fish, *Plankton, *Calcutta, *India, Pathogenic bacteria, Seasonal variation, Ecological distribution, Sediments, Monsoons, Feces.

The seasonal distribution of Vibrio parahaemolyticus in freshwater environs and in association with freshwater fishes was studied in 1982 and 1983. The occurrence of this organism in water and sediments at the three sites studied was very infrequent and was restricted to the summer months, although it was not always isolated during these months. The association of V. parahaemolyticus with plankton was chiefly confined to the summer months and progressively declined with the onset of monsoons, remaining below detectable levels during the postmonsoon and winter months. The incidence and counts of V. parahaemolyticus were consistently higher in association with plankton than with water and sediment samples. V. parahaemolyticus could be recovered throughout the period of investigation from freshly caught and market samples of freshwater fishes. The highest recovery rate of this halophile from fishes was invariably from fecal samples. Most of the strains isolated in this study were untypable, and those which could be typed were predominantly serotypes encountered in the environment. All the isolates were Kanagawa negative. From this study, it could be concluded that the survival of V. parahaemolyticus in freshwater ecosystems is transient and dependent on a biological host. (Author's abstract)
W85-04261

SULFATE REDUCTION IN FRESHWATER SEDIMENTS RECEIVING ACID MINE DRAINAGE,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
A. T. Herlihy, and A. L. Mills.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 179-186, January, 1985. 5 Fig, 3 Tab, 38 Ref. NSF grant DEB-82-06827.

Descriptors: *Acid mine drainage, *Sulfates, *Reduction rate, *Lake Anna, *Virginia, Fate of pollutants, Seasonal variation, Sediments, Bacteria.

One arm of Lake Anna, Va., receives acid mine drainage (AMD) from Contrary Creek (SO4(2-) concentration = 2 to 20 mM, pH = 2.5 to 3.5). Acid-volatile sulfide concentrations, SO4(2-) re-

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duction rates, and interstitial SO4(2-) concentrations were measured at various depths in the sediment at four stations in four seasons to assess the effects of the AMD-added SO4(2-) on bacterial SO4(2-) reduction. Acid-volatile sulfide concentrations were always an order of magnitude higher at the stations receiving AMD than at a control station in another arm of the lake that received no AMD. Summer SO4(2-) reduction rates were also an order of magnitude higher at stations that received AMD than at the control station (226 versus 13.5 mmol/sq m/day), but winter values were inconclusive, probably due to low sediment temperature (6 C). Profiles of interstitial SO4(2-) concentrations at the AMD stations showed a rapid decrease with depth (from 1,270 to 6 micro-M in the top 6 cm) due to rapid SO4(2-) reduction. Bottom-water SO4(2-) concentrations in the AMD-receiving arm were highest in winter and lowest in summer. These data support the conclusion that there is a significant enhancement of SO4(2-) reduction in sediments receiving high SO4(2-) inputs from AMD. (Author's abstract)
W85-04263

BIOTRANSFORMATION OF TRICHLOROETHYLENE IN SOIL,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. T. Wilson, and B. H. Wilson.
Applied and Enviromental Microbiology, Vol. 49, No. 1, p 242-243, January, 1985. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Biotransformation, *Trichloroethylene, *Soil, Fate of pollutants, Organic compounds, Groundwater pollution.

The organic contaminants that are most commonly detected in groundwater are low-moleculate-weight, chlorinated aliphatic hydrocarbons such as trichloroethylene. Unsaturated soil was exposed to natural gas to enrich for methanotrophs and for organisms that oxidized the other small alkanes present in natural gas. Then the soil was examined for the capacity to remove trichloroethylene (TCE) from infiltrating water. The TCE was degraded aerobically to carbon dioxide in the unsaturated soil column. TCE was applied at 900 and 180 micro-g/liter. (Baker-IVI)
W85-04267

NEUTRALIZATION OF ACID RUNOFF BY GROUNDWATER DISCHARGE TO STREAMS IN CANADIAN PRECAMBRIAN SHIELD WATERSHEDS,
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2K.
W85-04268

USE OF A DIGITAL MODEL TO EVALUATE HYDROGEOLOGIC CONTROLS ON GROUNDWATER FLOW IN A FRACTURED ROCK AQUIFER AT NIAGARA FALLS, NEW YORK, U.S.A.,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-04273

ACID MINE-WATER AND AGRICULTURAL POLLUTION IN A RIVER SKIRTING THE DONANA NATIONAL PARK, (GUADIAMAR RIVER, SOUTH WEST SPAIN),
Centro de Edafologia y Biologia Aplicada del Cuarto, Seville (Spain).
F. Cabrera, C. G. Toca, E. Diaz, and P. De Arambarri.
Water Research, Vol. 18, No. 12, p 1469-1482, 1984. 8 Fig, 7 Tab, 37 Ref.

Descriptors: *Acid mine drainage, *Farm wastes, *Guadiamar river, *Spain, Donana National Park, Mine wastes, Rice fields, Food-processing wastes, Olive mills, Heavy metals, Fertilizers, Herbicides, Organic matter, Water pollution sources.

The Agrio river receives the drainage waters from Aznalcollar opencast-worked polymetallic sulfide deposits and the old mine spoil heaps. Some 7 km downstream, the Agrio river joins the Guadiamar river, which is the last tributary on the right of the Guadalquivir river. The southern right bank of the Guadiamar river includes the marshy part of Donana National Park. Drainage waters from the mine and old spoil heaps are the source of high concentrations of heavy metals in the water and sediments of the Agrio and Guadiamar rivers. When river flows increase because of heavy rains or reservoir discharges, sediments are resuspended and transported downstream. The presence of other effluents rich in organic matter with active chelating agents facilitates the dissolution and transport of the metals. Consequently, 30 km downstream from the mine heavy metal concentrations in Guadiamar river are still higher than those in other unpolluted rivers of this zone. Pollution by olive mill effluents (alpechines) is important during the grinding season, causing increases in the K, P and organic matter, and decreases in dissolved oxygen. Nitrogen and P fertilization of rice fields at present does not produce abnormal increases in the concentration of these elements in the water. Concentrations of herbicides in rice field canals and Donana National Park waters reach values considered as the limit of safety for aquatic life. (Moore-IVI)
W85-04293

OCCURRENCE OF POLYCHLORINATED BIPHENYLS (PCB'S) IN ADULT MAYFLIES (HEXAGENIA BILINEATA) OF THE UPPER MISSISSIPPI RIVER,
Viterbo Coll., La Crosse, WI. Dept. of Biology.
J. R. Clements, and J. A. Kawatski.
Journal of Freshwater Ecology, Vol. 2, No. 6, p 611-613, December, 1984. 1 Fig, 10 Ref.

Descriptors: *Polychlorinated biphenyls, *Mayflies, *Mississippi River, Spatial distribution, Chlorinated hydrocarbons, Aquatic insects.

Gas chromatographic analysis of extracts prepared from adult mayflies (Hexagenia bilineata) collected from the Mississippi River between Prescott, WI and McGregor, IA indicated that polychlorinated biphenyls (PCB's) were as widely distributed and as abundant in 1983 as they were in 1980. The ranges of total body burden of PCB (micro-g/g wet weight) within this 300-kilometer section of the river were 0.17 - 2.10 in 1980 and 0.21 - 3.10 in 1983. The 1980 geographic distribution pattern of PCB concentrations was similar to that which others found in 1976 for H. bilineata, but the mayfly body burden was less at nearly all sites similarly sampled in 1980. This trend did not persist in 1983; PCB's were as abundant and as widely dispersed in H. bilineata in 1983 as they were in 1976. (Author's abstract)
W85-04316

NOMOGRAM FOR CALCULATING WATER TEMPERATURE AND ADDITIONAL EVAPORATION LOSSES IN THERMALLY POLLUTED SURFACE WATER (EIN NOMOGRAMM ZUR BERECHNUNG DER WASSERTEMPERATUR UND DER ZUSATZLICHEN VERDUNSTUNGSVERLUSTE THERMISCH BELASTETER GEWASSER),
Meteorologischer Dienst der DDR, Berlin. Forschungsinstitut fuer Hydrometeorologie.
A. Klamt.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 11, p 392-393, November, 1983. 2 Fig, 2 Tab.

Descriptors: *Nomograms, *Water temperature, *Evaporation losses, *Thermal pollution, Graphical methods, Cooling zones, Wind speed.

An easy-to-use nomogram was developed to calculate water temperature and additional evaporation losses for thermally polluted waters in the German Democratic Republic based on the exponential method of determining water temperature and two previously published formulas for evaporation. The nomogram takes the form of four quadrants separated by a horizontal and a vertical axis: the lower left quadrant contains a diagram for the change in the evaporation function dV/dT sub w (where V = evaporation and T sub w = water temperature of the cooling surface in degress C); the upper right quadrant contains a diagram of a function to calculate mean excess temperature; in the upper left, the evaporation level Delta V in mm/day can be read off; and at lower right is a double abscissa showing the proportional relationship between the dimensionless cooling surface F* (from which the concrete surface F can be determined in sq m) and the cooling effect in %. In the lower left quadrant, both formulas for evaporation are plotted (a includes wind speed, while b takes into account global radiation). Mean excess temperature is shown in its dependence on the extent of the cooling zone (T sub A-T sub n, i.e., cooling-water discharge temperature-natural water temperature). An example of the use of the nomogram is given: if, for a cooling zone of 10 K, a cooling effect of 1 K or 10% is required, the nomogram shows that a cooling surface of F* = 2.3 is necessary and also, by reading off the ordinate, that the mean excess temperature (mean T sub w - T sub n) is 4 K for the total cooling surface, the value in the lower left quadrant is therefore 22 C, and the intersection of this line and the 4-K line from the upper right gives, in the upper left quadrant, the additional evaporation loss of 2.9 mm/day for formula a at a wind speed of 2 m/sec and of 2.2 mm/day for formula b. (Gish-IVI)
W85-04325

PHOTOLYSIS OF AROMATIC COMPOUNDS IN WATER IN THE PRESENCE OF HYDROGEN PEROXIDE,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
M. Mansour.
Bulletin of Environmental Contamination and Toxicology, Vol. 14, No. 1, p 89-95, January, 1985. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Hydrogen peroxide, *Photolysis, *Fate of pollutants, *Aromatic compounds, Chemical reactions, Solar radiation, Acidity, Organic compounds, Benzene, Hydrogen ion concentration, Decomposition.

The reactivity of certain aromatic compounds with OH-radicals generated in aqueous solution by photolysis of hydrogen peroxide was investigated. By extrapolation, the decrease in concentration on irradiation with sunlight can serve as a simple measure of the degradability of a compound. Decomposition of hydrogen peroxide into radicals is effected by light and is faster at higher pH values. The rate of decomposition of H2O2 into OH radicals thus depends on pH and on the nature and concentration of impurities in the water. The effect of H2O2 on the oxidation of benzene was examined and the rate and product distribution were determined accurately. Decomposition rates of H2O2 were greater than those of benzene. The concentration of H2O2 altered only little during the early stage of the reaction, so it may be considered to be constant in this first phase, while the second reaction phase proceeds faster as the initial ratio of substrate to hydrogen peroxide increased. At about equal initial substrate and H2O2 concentrations the reaction slows progressively with time. At pH 3, the H2O2 decomposition and the oxidation of organic compounds take place quickly. At pH 2.5 the H2O2 reaction rate depends on the organic substrate and its behavior in aqueous solution. Increasing concentrations of oxygen accelerate the H2O2 breakdown in comparison with rates after flushing with nitrogen. Ultraviolet light causes changes in the chemical compounds in the presence of OH radicals and may play an important role in the disappearance of the substances in aquatic environment. Apparently, some compounds can be detoxified by hydroxylation. (Baker-IVI)
W85-04349

EFFECT OF AROCLOR 1254 ON THE BIOLOGICAL FATE OF 2,6-DIMETHYNAPHTHALENE IN COHO SALMON (ONCORHYNCHUS KISUTCH),
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center
T. K. Collier, E. H. Gruger, Jr., and U. Varanasi.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 1, p 114-120, March 1985. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Salmon, *Polychlorinated biphenyls, *Fate of pollutants, *Dimethylnaphthalene, Aroclor 1254, Organic compounds, Oil spills, Fish, Water pollution effects.

The effect that exposure of coho salmon to PCBs (polychlorinated biphenyls) can have on the subsequent biological fate of 2,6-dimethylnaphthalene (DMN) was investigated. The results show that the biological fate of DMN in salmon can be substantially altered by prior exposure of the fish to PCBs. For example biliary levels of DMN metabolites were increased in fish injected with 100 mg PCBs/kg body weight as compared to controls. No increase was seen in either the amount or the proportion of DMN metabolites in the liver of PCB-exposed fish. PCBs did induce hepatic metabolism of xenobiotics in the liver, but the DMN metabolites were readily excreted from this organ into the bile, where increased levels of DMN-derived C-14 were found after PCB exposure. Analyses of the extrahepatic tissues provided further evidence for enhanced excretion of DMN or its metabolites from PCB-exposed coho salmon. Muscle, brain, and blood all showed decreases in DMN-derived radioactivity as a result of PCB exposure at the high dose. In the blood the biological half-life of DMN-derived C-14 was reduced by about 40% after PCB exposure at both doses. The overall effect of PCBs appears to be increased levels of DMN metabolites in the bile, resulting in generally lower levels of DMN or its derivatives in extrahepatic tissues. (Baker-IVI)
W85-04351

ORGANO-CHLORINE INSECTICIDES AND PCBS IN RIVER NILE WATER, EGYPT,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
M. A. El-Dib, and M. I. Badawy.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 1, p 126-133, January, 1984. 1 Fig, 4 Tab, 17 Ref.

Descriptors: *Nile River, *Egypt, *Organochlorines, *Insecticides, *Path of pollutants, *Polychlorinated biphenyls, Agricultural chemicals, Industrial wastes, DDE, DDT, DDD, Lindane, Endrin, Pesticide residues.

Attempts were made to identify and measure the concentration of organochlorine insecticides and PCBs (polychlorinated biphenyls) liable to reach the River Nile in the Delta region where intensive agricultural and industrial activities are carried on. Residues of BHC, lindane, endrin, p,p'-DDT, p,p'-DDE and p,p'-DDD were identified in all river water samples studied. The highest concentrations of these chemicals were found in the river water at Kafr Al-Ziat. At that location, refinery and pesticide-packing firms discharge their wastewaters into the river. Further downstream the concentrations were smaller as evaporation, adsorption on suspended clays and uptake by aquatic organisms contributed to the decline in residue levels. Residue levels of the studied organochlorines and PCBs may affect aquatic life and lead to their accumulation in the food chain. (Baker-IVI)
W85-04352

INCORPORATION OF PLUTONIUM, AMERICIUM AND CURIUM INTO THE IRISH SEA SEABED BY BIOLOGICAL ACTIVITY,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab.
P. J. Kershaw, D. J. Swift, R. J. Pentreath, and M. B. Lovett.
Science of the Total Environmental, Vol. 40, p 61-81, December, 1984. 18 Fig, 15 Ref.

Descriptors: *Fate of pollutants, *Plutonium, *Americium, *Curium, *Irish Sea, *England, *Bioturbation, Radionuclides, Echiurans, Animal behavior, Seabed.

Bioturbation was considered as a potentially significant mechanism for the incorporation of long-lived radionuclides into the seabed and in particular the activities of a large echiuran Maximulleria lankesteri. Radionuclides of the transuranium elements plutonium, americium and cirium are discharged into the Irish Sea under authorization as part of the low-level liquid effluent from the British Nuclear Fuels plc reprocessing plant at Sellafield, Cumbria, England. The distribution of Pu-239, 240, Pu-238, Am-241 , Cm-244 and Cm-242 concentrations and the Pu-239, 240/Pu-238 quotient in samples taken in April and May 1983 from the sediment surface, burrow linings, sediment adjacent to burrows, and the gut contents and body of a large M. lankesteri clearly indicate that bioturbation is responsible, at least in part, for the incorporation of these radionuclides to depths of up to 140 cm. This area of sediment represents a significant present-day sink, but the permanence of this sink and the likelihood that radioactivity will be remobilized and be returned to man, depends on a large number of factors. (Collier-IVI)
W85-04357

EFFECT OF DOMESTIC EFLUENTS ON GROUNDWATER QUALITY: A CASE STUDY,
North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Plant Science and Technology.
M. R. Reddy, and S. J. Dunn.
Science of the Total Environment, Vol. 40, p 115-124, December, 1984. 3 Fig, 3 Tab, 26 Ref.

Descriptors: *Groundwater pollution, *Greensboro, *North Carolina, *Wastewater disposal, *Septic wastewater, Path of pollutants, Nitrate, Phosphorus, Chlorides, Lead, Copper, Iron, Manganese.

A community to the east of Greensboro, North Carolina, disposes of domestic waste into septic systems and the effluent has been seeping into an adjacent watershed over a long period of time. To determine the extent of contamination, a network of observation wells was established in the drainage area of the septic systems; groundwater samples from the observation wells were collected in the spring, summer and fall of 1981, 1982 and 1983 and analyzed for nitrate, phosphorus, chloride, lead, copper, iron, and manganese using standard methods. Nitrate, phosphorus, and chloride were shown to be coming from septic systems and moving into groundwater. Nitrate and chloride levels were less than the maximum allowable limits in drinking water, whereas phosphorus was above the limits in 41% of the wells. Concentrations of iron and manganese were above the recommended levels in 27 and 50% of the wells, respectively. The concentrations of lead and copper were below the allowable maximum levels in drinking water. Contamination of groundwater in the study area with phosphorus could be attributed to domestic use of detergents, and contamination with iron and manganese could be attributed to corrosion of household pipes. (Collier-IVI)
W85-04361

PH OF THE ATMOSPHERIC PRECIPITATION IN VENICE, RELATED TO BOTH THE DYNAMICS OF PRECIPITATION EVENTS AND THE WEATHERING OF MONUMENTS,
Consiglio Nazionale delle Ricerche, Padova (Italy). Ist. di Chimica e Tecnologia dei Radioelementi.
D. Camuffo, M. Del Monte, and A. Ongaro.
Science of the Total Environment, Vol. 40, p 125-139, 1984. 7 Fig, 1 Tab, 27 Ref. Commission of the European Communities, Directorate-General for Science, Research, and Development contract ENV-757-I/SB.

Descriptors: *Precipitation, *Hydrogen ion concentration, *Venice, *Italy, *Water pollution effects, *Weathering, Chemistry of precipitation, Wind direction, Acid deposition, Scirocco, Bora.

The pH of precipitation in Venice during the 1960s appears to have been slightly above the level of uncontaminated rainfall and very high compared with data generally found in the literature for the rest of Italy and Europe in general. On the contrary, from observations of the weathering of marble monuments in Venice, one would expect aggressive precipitation, i.e. that characterized by lower pH levels. However, the pH level is recognized as an inadequate index for the aggressivity of precipitation and the stone deterioration appears to be closely related to the way rainfall wets the surface of the monuments and activates the dry deposition occurring between two precipitation events. Only rarely does it seem to be due to acid rainfall. On the basis of local dynamic climatology, an analysis has been carried out of present and past data and of the possible hypotheses leading to these unusual values. Particularly interesting is the frontal situation originated aloft by a warm, moist wind (i.e. Scirocco) passing over the Alps and a cold wind below from Dalmatia (i.e. Bora). This situation favors heavy rainfall which is relatively uncontaminated by anthropogenic emissions, but is contaminated, on the other hand, by Saharian dust. From laboratory tests this dust was found to be capable of neutralizing the free acidity in rain. Precipitation events associated with NE wind are very frequent, as shown by the precipitation roses. Therefore, in Venice and its hinterland, precipitation dynamics is often associated with the meeting of air masses which are relatively uncontaminated by anthropogenic activity. The presence of buffering agents, both natural (i.e. Saharian dust, soil particles) and anthropogenic (i.e. agricultural fertilizers), are the main causes of precipitation, with high pH levels in the whole of the region subjected to Boro-type inflows, unlike the rest of the territory, as present measurements appear to confirm. (Author's abstract)
W85-04362

REDOX STATE AND SEASONAL TOXICITY OF NATURAL WATER,
Akademiya Nauk SSSR, Moscow. Inst. Khimicheskoi Fiziki.
Yu. I. Skurlatov, L. S. Ernestova, E. V. Shtamm, T. V. Shpotova, and V. B. Kalinin.
Doklady Biological Sciences, Vol. 276, No. 1-6, p 339-341, June, 1984. 1 Fig, 8 Ref. Translated from Doklady Akademii Nauk SSSR, Vol. 276, No. 4, p 1014-1016, June, 1984.

Descriptors: *Hydrogen peroxide, *Chemical kinetics, *Toxicity, *Natural waters, *Volga River, *USSR, Oxidation-reduction potential, Seasonal variation, Surface water, Photolysis, Decomposition, Fish.

The kinetics of decomposition of H2O2 added to natural water under various conditions is examined. The reaction is of zero order with respect to H2O2 concentration, its velocity is dependent on the source of the natural water and its content of hydrobionts, is virtually independent of illumination and the time of day, and is much greater than the velocity of H2O2 photolytic decomposition in sunlight in distilled water. Until recently the state of natural water in the Volga was characterized by an oxidative function - the analysis of water samples showed only H2O2. In 1982 when working on the Volga it was noted that a seasonal change in the redox state of the water from the normal oxidative in the spring to the toxic reductive in the summer was occurring. This transition did not involve pronounced changes in any standard hydrochemical or hydrobiological parameters. The transition of natural water from the oxidative to the reductive state is accompanied by the death of fish larvae at the earliest stages of their development. Thus, the parameters of the self-purification capacity and redox state of natural water can be considered as the most important parameters of the quality of natural water, characterizing not only the direction and intensity of self-purification chemical processes but also the toxic properties of water with respect to hydrobionts, in particular fish larvae at the early states of their development. (Baker-IVI)
W85-04363

TIME TRENDS OF ORGANOCHLORINE CHEMICAL RESIDUES IN SEVEN SEDENTARY MARINE FISH SPECIES FROM A NORWEGIAN FJORD DURING THE PERIOD 1972-1982,
Norges Veterinaerhoegskole, Oslo. Inst. for Farmakologi og Toksikologi.
J. U. Skare, J. Stenersen, N. Kveseth, and A. Polder.

Archives of Environmental Contamination and Toxicology, Vol. 14, No. 1, p 33-41, January, 1985. 6 Fig, 2 Tab, 28 Ref.

Descriptors: *Chlorinated hydrocarbons, *DDT, *Norway, *Fish, Fate of pollutants, Organic compounds, Insecticides, Water pollution effects, Fjords, Polychlorinated biphenyls, DDE, DDD.

Prior to the 1970 banning of the use of DDT in Norway, the insecticide had been used for about 25 yr in spraying commercial fruit orchards 1 to 3 times each year. The contamination levels of organochlorines were biologically monitored in seven sedentary fish species. All of the 225 specimens of fish liver analyzed during the 10 year study contained residues of the insecticide p,p'-DDT and/or its principal degradation product, p,p'-DDE. In addition 182 samples had detectable amounts of the metabolite p,p'-DDD. Residues of PCBs were found in 189 of the livers. The residue levels varied considerably, even within the same species from the same locality. As expected, a decrease was noted in the relative amount of untransformed DDT from 1972 to 1982. The flux of PCBs and DDT-related pollutants into and out of the fjord ecosystem and its biomass is dependent on the water currents, the temperature, and precipitation. The overall trends in the levels found during the study were assumed to reflect the change in biological availability of these contaminants in the local fjord over the time period studied. (Baker-IVI)
W85-04365

GROSS ALPHA AND BETA RADIOACTIVITIES ASSOCIATED WITH AQUATIC ENVIRONMENTS OF UPPER-EAST TENNESSEE IMPACTED BY INDUSTRIAL AND MINING ACTIVITIES,
East Tennessee State Univ., Johnson City. Dept. of Health Sciences.
R. D. Blevins, J. C. Schreiber, and O. C. Pancorbo.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 1, p 83-88, January, 1985. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Radioactivity, *Water pollution sources, *Fate of pollutants, *Tennessee, Mining, Industrial wastes, Vegetation, Sedimentation, Radioactive wastes, Bioaccumulation, Aquatic plants.

Gross alpha and beta radioactivities present in water, sediments, and macrophytes from several surface water systems in Upper-East Tennessee impacted by industrial and mining concerns were monitored during 1982. Values in both the Johnson City and Jonesboro municipal water supplies were significantly less than the EPA maximum radiological contaminant levels for drinking water. Gross alpha and beta radioactivity present in surface water samples from all 14 sampling stations were also lower than the drinking water EPA standards. Surface water samples were taken from stations immediately below the Nuclear Fuel Services (NFS) and TNS, Inc. facilities which are involved with the nuclear fuel cycle. Surface water samples taken from a station on Martin Creek below NFS had the highest mean gross alpha radioactivity (7.3 pCi/L) and the highest alpha radioactivity for an individual sample (10.1 pCi/L). Measurements of gross alpha radioactivity in several aquatic sediments indicated the presence of high natural levels of alpha-emitting radionuclides in geological formations within the confines of the watershed areas of the Nolichucky River, the Stoney Creek and the Watauga River above Stoney Creek. Measurements of gross alpha and gross beta radioactivity in aquatic vegetation indicated extremely high concentrations in samples of Ludwigia palustris and Potamogeton tenuifolius harvested from Martin Creek below NFS. Radionuclides are being extensively bioaccumulated by aquatic life present in Martin Creek immediately downstream from the NFS facility. (Baker-IVI)
W85-04367

CONTRIBUTION TO THE STUDY OF PHOSPHATE ION DESORPTION DURING THE DILUTION OF URBAN SEWAGE OUTFALLS IN THE MARINE ENVIRONMENT,
Centre Univ. de Luminy, Marseille (France). Lab. d'Oceanographie.
P. David, and F. Raffelini.
Marine Pollution Bulletin, Vol. 15, No. 12, p 444-447, 1984. 7 Fig, 2 Tab, 15 Ref.

Descriptors: *Phosphates, *Wastewater disposal, *Effluents, *Dilution, Mediterranean, Marine environment, Wastewater outfalls, Dispersion, Orthophosphates, Suspended solids, Colloids, Fate of pollutants.

The dilution and dispersion of the sewage load in the marine environment was studied, with particular attention to the orthophosphate ions. Samples were taken from the surface water, from the wastewater, from the polluted seawater and from offshore in the Mediterranean Sea. The study of unfiltered dilutions showed that the dissolved orthophosphates are not linearly diluted in the solutions. The dilution of sewage in seawater allows the particles and colloids to desorb phosphate ions, thus increasing the amount of already dissolved inorganic phosphate. The importance of particles and colloidal types of substances present in the continental output and particularly in a city outfall were demonstrated. The liberated ions fertilize the environment along the dilution and the dispersion gradient in seawater. (Baker-IVI)
W85-04380

APPEARANCE OF PCBS IN THE SURFICIAL SEDIMENTS OF CASCO BAY, MAINE,
Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME.
P. F. Larsen, D. F. Gadbois, A. C. Johnson, and R. F. Maney.
Marine Pollution Bulletin, Vol. 15, No. 12, p 452-453, 1984. 1 Fig, 1 Tab, 6 Ref. NOAA-NMFS contract NA-80-FA-C-0008.

Descriptors: *Casco Bay, *Polychlorinated biphenyls, *Portland Harbor, *Maine, Organic carbon, Organic compounds, Sediments.

The status of Casco Bay in regard to sediment polychlorinated biphenyl (PCB) levels is updated based on results of continuous monitoring of the benthic community and several chemical pollutants in this area. In the present study, PCBs were encountered at every station sampled. At station 29, PCB sediment levels ranged between 0.05 and 0.10 ppm with a mean of 0.06 ppm. In Portland Harbor, concentrations ranged from 0.08 to 0.34 ppm. The five stations spaced throughout Portland Harbor and sampled in August 1983 manifested sediment PCB concentrations between 0.1 and 0.32 ppm. Whereas this sampling density is not sufficient to draw definitive conclusions as to the absolute distribution of total PCBs in Portland Harbor sediments, the data are suggestive. The highest concentrations are at those stations closest to the Portland waterfront. Total organic carbon (TOC) was highly significantly correlated with the sediment fine fraction. The correlation between PCB concentration and both TOC and sediment fine fraction was not significantly different from zero. The lack of a relationship between TOC and PCB concentrations may suggest that PCBs are entering Portland Harbor directly, and not associated with sewage organic carbon. (Baker-IVI)
W85-04382

FIELD COMPARISON OF THREE MASS TRANSPORT MODELS,
Michigan Dept. of Natural Resources, Lansing. Bureau of Water Management.
D. A. Hamilton, D. C. Wiggert, and S. J. Wright.
Journal of Hydraulic Engineering, Vol. 111, No. 1, p 1-11, January, 1985. 8 Fig, 2 Tab, 9 Ref, 1 Append. EPA grant P00558801.

Descriptors: *Mass transport, *Model studies, *Fate of pollutants, *Groundwater pollution, Chromium, Analytical methods, Finite element method, Method of characteristics.

Three mass transport modeling methods were applied at a single site to predict the location of a chromium plume in an aquifer. The models are an analytical solution, a finite element formulation, and a method of characteristics formulation. A cost/benefit analysis of the three methods indicates that the analytical model is the most effective. The finite element and method of characteristics numerical formulations are capable of incorporating many aquifer complexities, but with much greater effort. The ease of use makes analytical models the obvious first step in any mass transport modeling. Only when the complexities of the situation, and the project goals require more refined analysis, and there is sufficient data should a numerical mass transport model be tried. The Peclet number criterion appears to be critical and must be carefully evaluated before using the finite element model. The method of characteristics methodology is numerically more accurate than finite elements in convection-dominated problems. It is also able to incorporate aquifer complexities, recharge, and withdrawals. (Moore-IVI)
W85-04393

MODEL OF DISPERSION IN COASTAL WATERS,
Miami Univ., Coral Gables, FL. Coll. of Engineering.
D. A. Chin, and P. J. W. Roberts.
Journal of Hydraulic Engineering, Vol. 111, No. 1, p 12-28, January, 1985. 15 Fig, 17 Ref, 1 Append.

Descriptors: *Coastal waters, *Dispersion, *Mathematical models, *Wastewater outfall, Simulation, Currents, Wastewater disposal, Marine environment.

A mathematical model that predicts the far field dispersion of wastewater discharged from ocean outfalls is presented. The model is a Lagrangian random walk-type simulation and directly uses the data obtained from spatially distributed, continuously recording, current meters. Such data are frequently obtained during the design of major ocean outfalls. The model is tested by using measured current meter data to predict the concentration distribution resulting from instantaneous and continuous point source releases during stratified and unstratified periods. Predictions of the temporal and spatial variations of maximum concentration, diffusing cloud size, and diffusion coefficient were found to be in excellent agreement with previous field studies. (Author's abstract)
W85-04394

5C. Effects Of Pollution

TOXICITY OF NITRITE TO CHANNEL CATFISH (ICTALURUS PUNCTATUS), TILAPIA (TILAPIA AUREA), AND LARGEMOUTH BASS (MICROPTERUS SALMOIDES): EVIDENCE FOR A NITRITE EXCLUSION MECHANISM,
Southwest Texas State Univ., San Marcos, Aquatic Station.
R. M. Palachek, and J. R. Tomasso.
Canadian Journal of Fish and Aquatic Sciences, Vol. 41, No. 12, p 1739-1744, December, 1984. 2 Fig, 1 Tab, 31 Ref.

Descriptors: *Water pollution effects, *Toxicity *Fish, *Nitrites, Chemical reactions, Catfish, Bass, Tilapia.

The 96 hr median lethal concentrations of nitrite to channel catfish, tilapia, and largemouth bass under similar water quality conditions were significantly different. Channel catfish were the least resistant with a value of 7.1 mg NO2-N/liter. Tilapia were intermediate in tolerance with 16.2 mg NO2-N/liter and largemouth bass had a value of 140.2 mg NO2-N/liter. Methemoglobin levels increased as environmental nitrite levels increased, with the exception of the largemouth bass whose methemoglobin levels did not increase until nitrite concentrations reached 48.7 mg/liter. These data indicate that there is a mechanism in largemouth bass that excludes nitrite from the plasma. This raises a question concerning the primary toxic mechanism of nitrite. The low plasma nitrite levels may be indicative of a more selective chloride uptake cell located in the gills, resulting in exclusion of nitrite. (Baker-IVI)
W85-03825

AMBIENT PH AND CALCIUM CONCENTRATION AS MODIFIERS OF GROWTH AND CALCIUM DYNAMICS OF BROOK TROUT, SALVELINUS FONTINALIS,
Ontario Hydro, Toronto. Research Div.
D. W. Rodgers.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 12, p 1774-1780, December, 1984. 2 Fig, 3 Tab, 45 Ref.

Descriptors: *Acidity, *Calcium, *Trout, *Fish growth, Trace metals, Water pollution effects, Hydrogen ion concentration, Fish tissues.

Juvenile brook trout were maintained in water of pH 5.3 or 6.5 and calcium concentrations of 5 or 40 mg/liter to determine the effects of these factors on fish growth and calcium dynamics. Growth rates varied more than two-fold and were significantly reduced by both low ambient calcium concentration and low pH. Calcium dynamics of the fish were significantly affected by calcium concentration but not pH. Brook trout in low calcium water retained less labeled dietary calcium and deposited less labeled calcium in axial skeleton and visceral tissues than fish in high-calcium water. Calcium concentrations of the skin and fins were slightly but significantly reduced among fish in low calcium water, but neither pH nor ambient calcium concentration significantly affected ash content or calcium concentration of axial skeleton and visceral tissues of experimental fish. The lack of effect of pH on calcium dynamics seems contrary to field reports of reduced calcium concentration in centra of vertebrae from white suckers caught in lakes of low pH and calcium concentration. However, in the present study, only pH and calcium concentrations were varied, while in the field, elevated concentrations of metals are frequently associated with low pH. (Baker-IVI)
W85-03828

PHOSPHORUS-BASED FISH KILL RESPONSE FUNCTION FOR USE WITH STOCHASTIC LAKE MODELS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
C. Mericas, and R. F. Malone.
North American Journal of Fisheries Management, Vol. 4, No. 4B, p 556-565, Fall, 1984. 7 Fig, 3 Tab, 12 Ref.

Descriptors: *Fish management, *Phosphorus, *Stochastic models, *Lakes, *Model studies, *Fish kills, Algal growth, Oxygen, Eutrophic lakes.

Twelve summer fish klls were noted over a 3 yr period in the hypereutrophic University Lakes System in Baton Rouge, La. Water quality data revealed an apparent threshold level of 0.400 mg/liter total phosphorus below which no kills were observed. A uniform frequency of occurrence of summer kills of 3% was noted when phosphorus levels exceeded 0.400 mg/liter. Physical factors, such as temperature, light and wind apparently become the controlling parameters in algal growth above this critical phosphorus value. Optimum weather conditions promote blooms that subsequently collapse when the conditions change, resulting in oxygen depletion and suffocation of fish populations. The fish kill response can be characterized as a rectangular distribution for kill risk assessment in conjunction with stochastic total phosphorus models. Such a representation of catastrophic lake responses provides a very effective means of quantifying the risk and levels of system improvement projected for management alternatives. This approach is particularly attractive in terms of minimal data requirements once the specific response function has been identified. A data base should be developed from a broad range of lakes to verify the applicability of the summerkill response function. (Baker-IVI)
W85-03836

TOXICITY OF COPPER TO THE MARINE AMPHIPOD AELORCHESTES COMPRESSA IN THE PRESENCE OF WATER- AND LIPID-SOLUBLE LIGANDS,
Australian Atomic Energy Commission Research Establishment, Sutherland.
M. Ahsanullah, and T. M. Florence.
Marine Biology, Vol. 84, No. 1, p 41-45, December, 1984. 2 Fig, 3 Tab, 19 Ref.

Descriptors: *Copper, *Toxicity, *Amphipods, Metals, Water pollution effects, Crustaceans, Aquatic animals, Water quality.

Acute toxicity tests were carried out on the marine amphipod Allorchestes compressa Dana using copper sulfate and some organocopper complexes. For copper sulfate, 96 h LC50 values of 0.11 and 0.5 mg Cu/liter were determined for the juveniles and the adults, respectively. Juveniles were about 4.5 times more sensitive to copper than adults. Organocopper complexes were tested on adults only. The three water soluble ligands nitrotriacetic acid, 8-hydroxyquinoline-5-sulfoic acid and tannic acid ameliorated copper toxicity by decreasing the concentration of free ionic copper while lipid-soluble ligands such as oxine and potassium ethylxanthogenate increased copper toxicity, presumably as a result of the complexes diffusing through the cell membrane and participating in injurious reaction. The copper complex with 2,9-dimethyl-1,10-phenanthroline was the most toxic complex tested. It is suggested that the presence of these ligands in the receiving water should be taken into consideration when establishing water quality criteria. (Author's abstract)
W85-03841

SANITARY QUALITY OF THE JORDAN RIVER IN SALT LAKE COUNTY, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W85-03908

WATER-QUALITY STUDY OF THE RUSSIAN RIVER BASIN DURING THE LOW-FLOW SEASON 1973-78, SONOMA AND MENDOCINO COUNTIES, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W85-03919

WATER-QUALITY ASSESSMENT OF THE ILLINOIS RIVER BASIN, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W85-03925

TERATOGENIC EFFECTS OF CHROMIUM (VI) IN ENVIRONMENT AS EVIDENCED BY THE IMPACT ON LARVAE OF AMPHIBIAN RANA TIGRINA: IMPLICATIONS IN THE ENVIRONMENTAL MANAGEMENT OF CHROMIUM,
Centre for Water Resources Development and Management, Calicut (India). Water Quality and Environment Div.
S. A. Abbase, and R. Soni.
International Journal of Environmental Studies, Vol. 23, p 131-137, 1984. 4 Fig, 3 Tab, 23 Ref.

Descriptors: *Chromium, *Toxicity, *Teratogens, *Frogs, Amphibians, Irrigation water, Heavy metals, Water pollution effects, Larvae.

Experiments on frog tadpoles exposed to chromium (VI) revealed a marked teratogenic effect from this element. The metal induced marked changes in the swimming pattern of tadpoles. Stressed tadpoles exhibited erratic fast and twisting movements accompanied by a decreased frequency of their movements toward the surface for air, followed by sluggishness and death. All concentrations of chromium caused loss of pigmentation in the animal skin and clustering of pigments on the dorsal side of the head. Eyes were broadened in 60, 80 and 100% of tadpoles in 2, 5, and 7 ppm chromium, respectively. If chromium containing waters are to be used in irrigation as per existing standards this may lead to reduction of the population or disturbances in the general health and normal growth of tadpoles. These levels may also adversely affect several other aquatic organisms which commonly occur with tadpoles, which may also affect the fish population which feed on these organisms. (Baker-IVI)
W85-04035

LIMNOLOGY OF A PERTURBED HIGHLY SALINE CANADIAN LAKE,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W85-04056

INTERACTIONS OF THE MOLLUSCICIDE 'BAYLUSCIDE' WITH DEVELOPMENT OF DINITROGEN FIXERS AND THEIR N2-ASE AND RESPIRATORY ACTIVITIES IN WATER,
Cairo Univ., Giza (Egypt). Faculty of Agriculture.
N. A. Hegazi, M. Monib, N. F. Emam, H. E. Makboul, and E. F. Khalil.
Archiv fur Hydrobiologie, Vol. 102, No. 1, p 105-115, November, 1984. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Water pollution effects, *Molluscicides, *Bayluscide, *Nitrogen fixing bacteria, Nitrogen fixation, Nitrogen cycle, Microorganisms, Pesticides.

Potential N2-fixation and total respiration were measured in water systems prepared from samples obtained from Bahr Yousef Canal, Fayoum, Egypt. Bayluside at 1 and 10 fold recommended dose relatively inhibited development and N2-ase activity of asymbiotic N2-fixers during early stages (1-4 days) of incubation. Such inhibition was diminished and stimulatory effects were developed after 2 weeks of incubation. Both doses of Bayluscide encouraged the development of Azotobacter, Azomonas, Azospirilla and N2-fixing bacilli and Gram negative short rods. Serious inhibition was attributed to application of as much as 100 fold recommended dose of Bayluscide. N2-fixing rods compared to other organisms relatively tolerated high concentrations of the compound. Rates of O2-uptake were followed during 6 days of incubation of water system and stimulatory effects were pronounced for both 1 and 10 fold doses. (Baker-IVI)
W85-04058

STUDIES ON THE TOXICITY OF PENTACHLOROPHENOL, SODIUM-PENTACHLOROPHENATE AND PHENOL TO A PULMONATE SNAIL LYMNAEA LUTEOLA (LAMARCK),
K.L.D.A.V. Coll., Roorkee (India). Dept. of Zoology.
P. K. Gupta, P. S. Rao, and V. S. Mujumdar.
Archiv fur Hydrobiologie, Vol. 102, No. 1, p 123-130, November, 1984. 4 Tab, 23 Ref.

Descriptors: *Toxicity, *Snails, *Pentachlorophenol, *Sodium pentachlorophenate, *Phenols, Industrial wastes, Water pollution effects.

The toxicity of pentachlorophenol (PCP), sodium pentachlorophenate (NaPCP) and phenol to a freshwater pulmonate snail, Lymnaea luteola was determined. Ninety-three percent mortality was noted after 24 hr of treatment at 0.70 g/l of PCP. In 0.60 mg/l concentrations, the same percentage of mortality occurred after 48 hr. At the end of 72 and 96 hr of exposures at 0.5 and 04 m/gl respectively, 100% mortality was observed. NaPCP recorded 90% death of snails at the end of 24 and 48 hr exposure in 1.40 and 1.30 mg/l, respectively. Median survival periods of snails for various concentrations of the three chemicals were observed increasing with the decreasing concentration. The order of toxicity for the three chemicals was PCP>NaPCP> phenol. As L. luteola is more sensitive to these chemicals than the fishes and other mollusks, it could be safely used for screening tests. (Baker-IVI)
W85-04059

EFFECTS OF PH ON TOXICITY OF AS, CR, CU, NI, AND ZN TO SELENASTRUM CAPRICORNUTUM PRINTZ,
Marshall Univ., Huntington, WV. Dept. of Biological Sciences.
C. J. Michnowicz, and T. E. Weaks.
Hydrobiologia, Vol. 118, No. 3, p 299-305, 1984. 2 Fig, 32 Ref.

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Descriptors: *Heavy metals, *Phytotoxicity, *Acidity, *Algal growth, Arsenic, Copper, Chromium, Nickel, Zinc, Hydrogen ion concentration,.

In tests designed to establish the effects of adjusted pH levels on the growth of S. capricornutum, the algae was cutured for 7 days at an initial pH of 4. The adjustment of pH to higher values had a marked effect is ameliorating pH shock to the cells. Growth was significantly enhanced at pH 6, 8, 10, and 12. Maximum growth occurred at pH 10. The addition of 0.20 mg/l As to the medium and readjustment of pH after 7 days culture produced somewhat different results. Growth was inhibited by As, over pH adjustment alone, at most pH values. Growth of cultures at pH 8 was significantly higher than that of both 7 and 14 day old pH 4 cultures. Treatment of S. capricornutum with Cr and pH adjustment resulted in a growth response which was depressed at all pH values tested. The effect of Cu on growth of S. capricornutum was similar to that resulting from As treatment. After readjustment of the pH after 7 days cultures and incubation for 7 additional days, growth at all pH levels above 4 was significantly enhanced. The addition of Ni to the medium and readjustment of pH afer 7 days culture resulted in significantly higher growth at some pH levels. The growth response of S. capricornutum to Zn was much like that resulting from Cr treatment. All metals significantly reduced growth of S. capricornutum over the control when the initial pH of 4 was readjusted to pH 10 during the incubation period. Growth was significantly higher for Cu than for the other metals. The most toxic spike, Zn, reduced growth to 31% of the control. At the concentrations tested, S. capricornutum was apparently most tolerant to copper. Growth of S. capricornutum, maintained at pH 4 for 14 days, was compared using metal spikes to the medium. At this low pH level, growth was not significantly depressed over the control for all metals tested. Growth for cultures with added Ni was significantly higher than that for cultures containing Cu spike. (Baker-IVI)
W85-04066

METHOD FOR MEASURING THE RESPONSE OF SEDIMENT MICROBIAL COMMUNITIES TO ENVIRONMENTAL PERTURBATIONS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W85-04067

AQUATIC ECOTOXICOLOGY,
Wisconsin Univ.-Milwaukee.
E. R. Christensen.
Schweizerische Zeitschrift fur Hydrologie, Vol. 46, No. 1, p 100-108, October, 1984. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Heavy metals, *Toxicity, *Aquatic life, *Organic compounds, Weibull transformation, Logit transformation, Probit transformation, Fish, Algae, Bioassay, Phenols.

The toxicity to aquatic organisms of heavy metals and organics can in some cases be estimated from their chemical and physical characteristics. More precise information must be obtained from bioassays which are classified according to the type of response obtained: quantal or continuous, and according to whether individual organisms originate from a single clone or have a tolerance distribution. For example, bioasays with fish are usually carried out such that there is a tolerance distribution for individuals, and the response, death, is quantal. In contrast, assays with algae from a pure culture are typically designed such that individual organisms come from a single clone, and the response, growth rate based on biomass, is continuous. Basic features of the probit, logit, and Weibull dose-response models for one toxic substance are considered. A version of the logit model is complementary to the Monod equation for the growth rate of microorganisms under substrate limitation. Multiple toxicity models can be of the non-interactive or competitive type. The standard water quality criterion for concentration addition is based on the assumption that the toxicants act on similar biological systems, and that the action tolerances are fully correlated. If, instead, the toxicants act on different biological systems and the action tolerances are uncorrelated, independent joint action is obtained. The application of the probit, logit, and Weibull models are demonstrated by considering the growth rate of the alga Scenedesmus suspicatus in the presence of various concentrations of 3,5-dichlorophenol. (Baker-IVI)
W85-04077

EFFECT OF TEMPERATURE AND SALINITY ON THE TOXICITY OF CHROMIUM TO THREE ESTUARINE INVERTEBRATES (CROPHIUM VOLUTATOR, MACOMA BALTHICA, NEREIS DIVERSICOLOR),
Stirling Univ. (Scotland). Dept. of Biology.
V. Bryant, D. S. McLusky, K. Roddie, and D. M. Newbery.
Marine Ecology - Progress Series, Vol. 20, No. 1/2, p 137-149, November, 1984. 8 Fig, 8 Tab, 21 Ref.

Descriptors: *Water pollution effects, *Estuarine environment, *Chromium, *Invertebrates, *Amphipods, *Polychaetes, *Mollusks, Metals, Toxicity, Salinity, Water temperature.

Effects of temperature and salinity on chromium toxicity were evaluated in a constant temperature room using species representing taxonomic diversity as well as ecological importance within the estuarine ecosystem. Acute toxicity of hexavalent chromium (as potassium dichromate) to 3 estuarine animals (Corophium volutator, Macoma balthica, Nereis diversicolor) was studied at 3 temperatures (5, 10, 15 C) and a range of salinities (5 to 40 0/00, in 5 0/00 increments), at time intervals of up to 384 h. From an analysis of variance, the significant factors and their interaction were included in separate response surface models for C. volutator and M. balthica. In general, toxicity increased with increased temperature and increased chromium concentration and decreased with an increase in salinity. In C. volutator there was a decrease in toxicity with an increase in salinity over the range 5 to 30 0/00, with evidence of increased toxicity caused by further salinity increases up to 40 0/00; effect of chromium on this species at concentrations above 64 ppm is so great that interactive effects are only significant at lower concentrations. The interactive effect of the variables has less influence on the median survival times of M. balthica; only the interactive effect of salinity and increasing chromium significantly decreased median period of survival. In N. diversicolor, an increase in toxicity occurred with increased temperature, however the effect of salinity was less marked than in the other two species. The range of toxicity values for a single species under a variety of environmental conditions exceeded the previously reported range of toxicity values for several species maintained in constant conditions. Due account should be made of environmental conditions when evaluating toxicity of chromium in the estuarine environment. (Collier-IVI)
W85-04083

EDTA CHELATION AND ZINC ANTAGONISM WITH CADMIUM IN SEDIMENT: EFFECTS ON THE BEHAVIOR AND MORTALITY OF TWO INFAUNAL AMPHIPODS,
Moss Landing Marine Labs., CA.
For primary bibliographic entry see Field 5B.
W85-04084

GROWTH OF JUVENILE MERCENARIA MERCENARIA AND THE EFFECT OF RESUSPENDED BOTTOM SEDIMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
V. M. Bricelj, R. E. Malouf, and C. de Quillfeldt.
Marine Biology, Vol. 84, No. 2, p 167-173, December, 1984. 3 Fig, 5 Tab, 26 Ref.

Descriptors: *Clams, *Animal growth, *Water pollution effects, *Suspended sediments, *Algae, *Great South Bay, *New York, Mollusks, Bottom sediments, Sediments.

The influence of silt on growth of juvenile hard clams Mercenaria mercenaria (L.) (9 mm in mean shell length) was investigated in the laboratory using mixed suspensions of algae (50,000,000 Pseudoisochrysis paradoxa cells/l) and fine-grained bottom sediments (0 to 44 mg/l). Growth rates, expressed as percent increase in ash-free dry tissue weight, were not significantly affected by sediment concentrations up to 25 mg/l. Significant reduction in growth (by 16% relative to controls fed only algae), and condition of clams, occurred at 44 mg silt/l. The results of the 3-week growth experiment agree well with predictions made in an earlier study by integrating results of short-term physiological measurements. Growth rates obtained with experimental algal-silt diets at 21 C (2.6 to 3.3% increase in dry tissue weight/d) were comparable to those determined at ambient concentrations of Great South Bay particulates at 20 C (0.9 to 4.0%/d). Levels of particulate inorganic matter in seawater from Great South Bay, New York, exhibited pronounced daily changes, and ranged from 6 to 126 mg dry weight/l. Growth enhancement by the addition of silt to an algal diet, reported in mussels, surf clams and oysters, was not found in M. mercenaria. It is suggested that these three species are better suited than hard clams for culturing efforts in inshore turbid waters above uncompacted, muddy bottoms. (Author's abstract)
W85-04085

EFFECT OF WATER REACTION (PH) ON INDIVIDUAL MEMBERS OF ZOOPLANKTON AND MACROBENTHOS IN CONNECTION WITH INDUSTRIAL POLLUTION OF WATER BODIES,
A. K. Dyga, and V. I. Zolotareva.
Water Resources, Vol. 10, No. 5, p 465-468, September-October, 1983. 31 Refs. Translated from Vodnye Resursy, No. 5, p 104-107, September-October, 1983.

Descriptors: *Zooplankton, *Water pollution effects, *Hydrogen ion concentration, Daphnia, Crustaceans, Oligochaetes, Midges, Toxicity.

Laboratory subacute experiments lasting more than 30 days were performed on crustaceans (Daphnia magna), oligochaetes (Limnodrilus hoffmeisteri, Tubifex tubifex), and larvae of a chironomid (Chironomus f.l. plumosus). The pH levels used in the current study were 3.45, 5.30, and 10.92. Daphnids endured pH levels of 5.30 to 10.92, but 3.45 proved lethal. At pH 10.92 the sexual maturation of the crustaceans slowed and the number of broods decreased. Chironomid larvae at pH 3.45 die, but endure pH 5.30 and 10.92. After the 24 hr stress of pH 10.92 the chironomid larvae, passing through all stages, die. The first to die in a strongly acid medium were oligochaetes, having delicate body covers, then the young and mature daphnids, and the chironomid larvae proved to be more resistant to the unfavorable factor of the medium. At pH 5.30 the first to die were young D. magna individuals, then adults and after almost the same time interval, death of the oligochaetes and chironomid larvae was noted. At pH 10.92 the sequence of death of the forms was the same as at pH 3.45. A strongly acid medium is more toxic for aquatic organisms than strongly alkaline, with respect to time of death of the first specimens by 1.5-3 times for oligochaetes, 3 times for young crustaceans, by more than 12 times for adults, and by 4 times for chironomid larave. (Baker-IVI)
W85-04133

BOTANICAL ASPECTS OF ACIDIC PRECIPITATION,
Manhattan Coll., Bronx, NY. Lab. of Plant Morphogenesis.
L. S. Evans.
Botanical Rexiew, Vol. 50, No. 4, p 449-490, October-December, 1984. 2 Fig, 189 Ref.

Descriptors: *Acid rain, *Water pollution effects, *Plants, Atmospheric deposition, Hydrogen ion concentration, Air pollution, Acid precipitation, Foliar injury, Leaching, Nutrients, Crops, Vegetation, Acidification, Fish, Air pollution.

Acidic precipitation can be characterized as wet or frozen atmospheric deposition with a hydrogen ion

concentration greater than 2.5 micro-eq/liter. Acidic precipitation is perceived as a significant air pollution problem derived chiefly from combustion of fossil fuels, smelting of sulfide metals, and other industrial processes. Precipitation data from the northeastern United States show a mean pH of between 4.0 and 4.2 with a range of from 3.0 to 6.0 among individual events. Although visible injury to plant foliage has been documented in a variety of studies only one case of visible foliar injury from the acidity in ambient rainfalls has been documented. Acidic precipitation can contribute nutrients to vegetation and could also influence nutrient leaching rates from vegetation. Although these processes occur, there are no data that show changes in nutrient levels in foliage that relate to crop or natural ecosystem productivity. Although no consistent patterns are presently known, acidic precipitation may affect host-plant pathogen interactions. Few experiments with field-grown crops or vegetation under natural conditions have been performed. Many of the studies are inadequate because they have been conducted with inadequate replication of treatments coupled with vigorous statistical analyses. Studies with field-grown crops are evaluated. Acidification of fresh waters of the northeastern United States is caused by acid deposition. Such regions in which this acidification occurs have in common, volume weighted mean H(+) concentrations of 25 micro-eq/liter or higher and slow weathering of granitic or Precambrian bedrock with thin soils deficient in minerals that provide buffering capacity. As freshwater acidification occurs, many plants, invertebrates, and vertebrates are progressively eliminated. Generally, fisheries are severely impacted when lake pH falls below 5.0. Fish are almost always eliminated when the lake pH is below 4.8. (Author's abstract)
W85-04176

PROBLEMS OF CAUSATION IN PRIVATE LEGAL REMEDIES FOR DAMAGE FROM ACID RAIN,
For primary bibliographic entry see Field 6E.
W85-04185

GUIDELINES ON THE USE AND ACCEPTABILITY OF OIL SPILL DISPERSANTS, 2ND EDITION.
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W85-04194

EARLY BIOTIC RESPONSES TO ADVANCING LAKE ACIDIFICATION,
G. R. Hendrey.
In: Acid Precipitation Series, Vol. 6, 1984. Butterworth Publishers, Boston. 173 p.

Descriptors: *Acid rain, *Acid streams, *Acidic water, *Air pollution effects, *Ecological effects, *Hydrogen ion concentration, *Lakes, Environmental effects, Microbial degradation, Plankton, Algae, Aquatic plants, Aquatic animals, Fish populations, Mathematical models, Model studies, Ecosystems, *New England, *Ontario, *Wisconsin, Sierra Nevada, *California.

This volume presents reports given at the American Chemical Society's symposium on acid precipitation held in Las Vegas in spring of 1982. Report topics include: the effect of lake pH on microbial decomposition of allochthonous litter, changes in the temporal behavior and size structure of plankton systems in acid lakes, pH-related changes in attached algal communities of software lakes, aquatic macrophytes and pH as controls of diversity for littoral cladocerans, acidification and changes over time in the chydorid cladocera assemblage of New England Lakes, responses of fish communities to acidic waters in Ontario, fish population responses to experimental acidification of a small Ontario Lake, pH relationships of fish species composition in Northern Wisconsin Lakes, and the potential for aquatic exosystem acidification in the Sierra Nevada, California.
W85-04198

CHANGES IN THE TEMPORAL BEHAVIOR AND SIZE STRUCTURE OF PLANKTON SYSTEMS IN ACID LAKES,
Environmental and Social Systems Analysts Ltd., Vancouver (British Columbia).
D. R. Marmorek.
In: Early Biotic Responses to Advancing Lake Acidification. Butterworth Publishers, Boston, 1984. Edited by George R. Hendry. p 23-41, 3 Fig, 3 Tab, 62 Ref.

Descriptors: *Acid rain, *Acidic water, *Hydrogen ion concentration, *Phytoplankton, *Zooplankton, *Lakes, *Aquatic populations, *Fertilizers, Temporal distribution, Population dynamics, Acidity, Biomass, Chlorophyll, *British Columbia.

The effects of gradual acidification, either with or without nutrient enrichment on zooplankton and phytoplankton community structure and biomasses were examined in eight limnocarrals in Eunice Lake, British Columbia. Fertilizer additions caused similar alkalinity reductions in treatments with fertilizer only and with acidification and fertilization. In corrals with acidification only, patterns of zooplankton community composition were virtually identical to controls. Fertilization increased mean live chlorophyll and phaeophytin content. Acidified lakes showed less plankton system stability than circumneutral lakes when both were enriched. More seasonal data are required for lakes of pH $<$ 5.5 before generalized patterns of temporal behavior of acid lakes can be confirmed.
W85-04199

EFFECT OF LAKE PH ON MICROBIAL DECOMPOSITION OF ALLOCHTHONOUS LITTER,
Brookhaven National Lab., Upton, NY. Terrestrial and Aquatic Ecology Div.
A. J. Francis, H. L. Quinby, and G. R. Hendrey.
In: Early Biotic Responses to Advancing Lake Acidification. Butterworth Publishers, Boston, 1984. Edited by George R. Hendry. p 1-21, 5 Fig, 7 Tab, 4 Ref.

Descriptors: *Microbial degradation, *Microbiological studies, *Acidic water, *Hydrogen ion concentration, *Organic matter, *Leaves, *Litter, *Lakes, Aquatic bacteria, Carbon, Nitrogen, Chlorophyll, Lake sediments, Adirondack Mountains, *New York, *Acid rain.

A brief review of the literature shows that increasingly acidic conditions in laboratory or field studies inhibit the microbial activity of natural waters. Studies were made of the decomposition rates of leaf litter in three Adirondack Mountain lakes of different pH. Sample bags of beech, sugar maple, red maple, red spruce and leather leaves were placed in the lakes for 7 days, 21 days, 8, 12, 18 or 24 months after which they were analyzed for dry weight, bacterial counts, carbon and nitrogen content, chlorophyll and phaeophytin content and other parameters. Increasing acidity of lake water decreased decomposition of the leaf litter samples. Sediment samples from all three lakes contained nitrate-oxidizing bacteria.
W85-04200

PH-RELATED CHANGES IN ATTACHED ALGAL COMMUNITIES OF SOFTWATER LAKES,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
P. M. Stokes.
In: Early Biotic Responses to Advancing Lake Acidification. Butterworth Publishers, Boston, 1984. Edited by George R. Hendry. p 43-61, 7 Fig, 6 Tab, 25 Ref.

Descriptors: *Acidic water, *Lakes, *Algae, *Acid rain, *Acidity, Chlorophyta, Chrysophyta, Desmids, Ecological effects, Aquatic populations, Hydrogen ion concentration, Population dynamics, Aquatic bacteria, Benthos, Phytoplankton, Benthic flora, Chlorophyll, *Ontario.

In south-central Ontario, softwater lakes on the Canadian Shield receive acidic precipitation and are susceptible to acidification. The present study investigates the responses of the attached algal community (periphyton or benthic algae) to changes in pH and alkalinity in four softwater lakes (Chub, Plastic, Red Chalk and Heney) of low alkalinity. Artificial substrates of Mylar were used to obtain quantitative data from between-site comparisons. In Chub Lake, the most acid site showed a negative correlation between growth and pH for both colonization and succession. The most acidic site was not consistently lower in bacterial numbers than the least acidic site. Enclosing the substrate in cages to prevent grazing resulted in a decreased periphyton weight, no change or an increase in species richness. Transplanting substrates from a less acidic to a more acidic lake site reduced the total number of taxa by 40%.
W85-04201

AQUATIC MACROPHYTES AND PH AS CONTROLS OF DIVERSITY FOR LITTORAL CLADOCERANS,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
K. H. Kenlan, G. L. Jacobson, and D. F. Brakke.
In: Early Biotic Responses to Advancing Lake Acidification. Butterworth Publishers, Boston, 1984. Edited by George R. Hendry. p 63-84, 5 Fig, 8 Tab, 29 Ref.

Descriptors: *Algae, *Hydrogen ion concentration, *Lakes, *Aquatic populations, *Acidic water, *Population dynamics, *Species diversity, Ecological effects, Acidity, *Acid rain, Chlorophyta, Diatoms, Aquatic plants, *Maine.

The relative importance of habitat and pH on chydorid populations of three Maine lakes - Unnamed Pond, Crystal Pond and Loon Pond - was studied. Macrophytes collected on plant beds, Astroturf and cocoa mat artificial substrates were sampled periodically from the lakes throughout the ice-free season. The pooling of all collections made throughout the sampling season, over both artificial substrate type and over plant bed type, indicated increasing species richness with increasing pH. If the aquatic macrophyte bed types are considered separately, pooling over season and artifical substrate type, an increase in chydorid species richness is again observed with increased pH in each of the plant bed types common to all three lakes as well as in the species unique to each lake. The principal components of the epiphytic community on substrates in all plant types and in all three lakes appeared to be green filamentous algae and diatoms.
W85-04202

ACIDIFICATION AND CHANGES OVER TIME IN THE CHYDORID CLADOCERA ASSEMBLAGE OF NEW ENGLAND LAKES,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
D. F. Brakke, R. B. Davis, and K. H. Kenlan.
In: Early Biotic Responses to Advancing Lake Acidification. Butterworth Publishers, Boston, 1984. Edited by George R. Hendrey. p 85-104, 13 Fig, 5 Tab, 26 Ref.

Descriptors: *Acidification, *Lakes, *Hydrogen ion concentration, *Aquatic animals, *Altitude, *Elevation, *Species composition, *Species diversity, *Lake sediments, Crustaceans, Acidic water, Heavy metals, Ecological effects, Population dynamics, *New England, *Maine.

The distribution of sedimentary remains of chydorid Cladocera across pH and altitude gradients in New England Lakes and the changes in sedimentary assemblages of three Maine lakes with acidification were examined during the summers of 1978-1980. With increasing pH, the number of species represented and species diversity increased. Above pH 6.2 and at elevations $<$ 500-750 meters above sea level (SASL), chydorid communities were more diverse. At elevations $>$ 500 MASL, diversity did not increase with pH. Sediment core samples of Ledge, Speck and Tumbledown ponds revealed that acidification began about 1905, 1920 and 1938, respectively. Buildup of heavy metals in the sediments of these lakes preceded pH change by several decades. At Speck Pond, the numerical-

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ly most important changes in the chydorid assemblages coincided with the onset of pH declines. At Tumbledown Pond, the change in the chydorid assemblage preceded acidification while in Speck Pond, the species diversity increased for a couple of decades after the initial pH decline.
W85-04203

RESPONSES OF FISH COMMUNITIES TO ACIDIC WATERS IN ONTARIO,
Fisheries and Marine Service, Sault Ste. Marie (Ontario). Great Lakes Biolimnology Lab.
J. R. M. Kelso, and J. M. Gunn.
In: Early Biotic Responses to Lake Acidification. Butterworth Publishers, Boston, 1984. Edited by George R. Hendrey. p 105-115, 3 Fig, 3 Tab, 30 Ref.

Descriptors: *Acidification, *Acidic water, *Hydrogen ion concentration, *Fish, *Lakes, *Acid rain, Heavy metals, Minerals, Chemical properties, Physical properties, Ontario, Trout, Sucker, Fish populations, Alkalinity, Ecological effects, Organic compounds, *Ontario.

A survey program was carried out in 1980 on Ontario lakes to assess the relation between chemical and physical lake properties and fish catch per unit effort. Alkalinity, conductivity, Ca, Mg, S04, Al and Pb were strongly correlated with pH. Catch was strongly influenced by drainage basin area, pH, conductivity, alkalinity, Ca, and Mg. Factors most strongly affecting presence or absence of fish were pH, alkalinity, and watershed area. In lakes where the exogenous metal levels are relatively low, severly affected fisheries occur at pH $<$ 5.5 and the affected fish communities may be classified as extinct, tolerant species only, or mixed communities with recruitment failures in some species. The fish communities from Chinigu-chi, Bowland and Laundrie Lakes are respective examples of each to these types. The amount of Pb in whole fish samples of white sucker was significantly related to Ca and total Al, both which tend to change in concert with pH. No significant correlation was found between organic compounds in fish flesh and lake pH.
W85-04204

FISH POPULATION RESPONSES TO EXPERIMENTAL ACIDIFICATION OF A SMALL ONTARIO LAKE,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
K. H. Mills.
In: Early Biotic Responses to Lake Acidification. Butterworth Publishers, Boston, 1984. Edited by George R. Hendrey. p 117-131, 7 Fig, 2 Tab, 34 Ref.

Descriptors: *Acidification, *Acidic water, *Hydrogen ion concentration, *Fish populations, *Lakes, Fish, Chemical properties, *Acidic water, Acid rain, *Ontario, Ecological effects, Species composition, Population dynamics.

Electrolyte-grade H2S04 was applied to lower the pH of Lake 223, an Ontario lake, each spring from 1976 to 1981 to assess the effects of acidification on fish populations. Biweekly acid treatments which produced pH levels ranging from 5.10 to 6.79 increased water transparency, rates of hypolimnetic heating and thermocline deepening. Concentrations of Mn, Na, Zn, H(+), S04(2-), Al and chlorophyll increased while suspended C, total dissolved N, Fe, and Cl decreased. The fathead minnow population declined rapidly and almost disappeared in 1979 (pH 5.6). The pearl dance population rapidly expanded to become the major minnow species in 1980 (pH 5.4). The first year class failure of lake trout occurred in 1980 (pH 5.4) while the first year class failure of white sucker occurred in 1981 (pH 5.1).
W85-04205

SPECIES COMPOSITION OF FISH COMMUNITIES IN NORTHERN WISCONSIN LAKES: RELATION TO PH,
Columbia National Fisheries Research Lab., La Crosse, WI. Field Research Station
J. G. Wiener, P. J. Rago, and J. M. Eilers.
In: Early Biotic Responses to Advancing Lake Acidification. Butterworth Publishers, Boston, 1984. Edited by George R. Hendrey. p 133-146, 3 Fig, 6 Tab, 25 Ref.

Descriptors: *Acidification, *Acidic water, *Hydrogen ion concentration, *Fish populations, *Species composition, *Species diversity, *Lake, *Comparison studies, Population dynamics, Chemical properties, Ecological effects, *Acid rain, *Wisconsin, Fish.

Differences in fish communities between two groups of Wisconsin lakes, one group with pH 6.7-7.5 (circumneutral) and the other group acidic (pH 5.1-6.0) were compared and discussed in terms of pH-related effects. Species richness was lower in the acidic lakes than in the circumneutral lakes. The Pearson correlation coefficient between species richness and lake pH revealed a positive relationship between the two variables. Minnows and darters were either absent or rare in acidic lakes, but were generally well represented in the circumneutral lakes. The differences in species composition and richness of fish communities between acidic and circumneutral lakes did not appear to be related to differences in physical habitat characteristics, past fish migrations, or productivity between the two lake groups.
W85-04206

POTENTIAL FOR AQUATIC ECOSYSTEMS ACIDIFICATION IN THE SIERRA NEVADA, CALIFORNIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
K. A. Tonnessen.
In: Early Biotic Responses to Advancing Lake Acidification. Butterworth Publishers, Boston, 1984. Edited by George R. Hendrey. p 147-169, 16 Fig, 3 Tab, 25 Ref.

Descriptors: *Acidification, *Lakes, *Hydrogen ion concentration, *Acidic water, *Ecosystems, *Phytoplankton, *Zooplankton, Minerals, Heavy metals, Ecological effects, *Acid rain, Aquatic populations, Lake sediments, Chemical properties, Population dynamics, *California.

A survey of the water quality of 40 western slope, subalpine lakes of the Sierra Nevada was conducted in 1979-1981 during the ice-free season to assess the effects of acidification on aquatic ecosystems. Microcosm laboratory studies involving the addition of HNO3 to unfiltered water and sediments collected from two Sierra lakes were also carried out. Levels of Ca and Mg in surface water samples and microcosm samples were strongly correlated with alkalinity. In laboratory tanks, Al, Mn and Fe increased significantly after acidification of water from test lakes with and without added sediments. Zooplankton population growth was negatively affected by acid treatment in both experiments. In the Mosquito Lake microcosms, negative effects of acidification were observed within the green, blue-green and golden algae in tanks without sediment. In the Teneya Lake microcosms, chlorophyte populations increased in all tanks and cryptomonads increased in tanks with sediments upon acidification.
W85-04207

WATER-RELATED DISEASE OUTBREAKS ANNUAL SUMMARY, 1982.
Centers for Disease Control, Atlanta, GA.
HHS Publication (CDC) 83-8385, August, 1983. 15 p, 8 Tab, 14 Ref.

Descriptors: *Enteric bacteria, *Enteroviruses, *Epidemiology, *Water analysis, *Water pollution, *Waterborne diseases, Coliforms, Giardia lamblia, Shigella, Yersinia pestis, Hepatitis A.

Since 1971 the Centers for Disease Control (CDC) have tabulated foodborne and waterborne disease outbreak data separately and reported these data in annual reports. The Water-related Diseases Activity has set up the following topics for coverage in these reports: 1) to determine the frequency of epidemics of water-related diseases in the United States, 2) to characterize the epidemiology of water-related diseases, 3) to disseminate information on prevention and control of water-related diseases to appropiate public health personnel, 4) to train federal, state, and local health department personnel in epidemiologic techniques for the investigation of water-related disease outbreaks, and 5) to collaborate with local, state, and other federal and international agencies in initiatives concerning prevention of water-related diseases. The number of waterborne disease outbreaks reported to CDC and EPA clearly represents a fraction only, of the total number that occur. These data are helpful, however, in revealing the etiologies of reported waterborne disease outbreaks, the seasonality of outbreaks, and the deficiencies in water systems that most frequently result in outbreaks. As in the past, the pathogens responsible for many outbreaks in 1982 were not determined. However, in 1982, data revealed that Colorado reported more outbreaks than any other state. Nationwide, 60% of the outbreaks were caused by Giardia lamblia (12 outbreaks), Norwalk agent (4 outbreaks), chemical (2 outbreaks), Hepatitis A (3 outbreaks), Shigella (2 outbreaks) and Yersinia (1 outbreak). Evidence of contamination (presence of coliforms or pathogens) was found in 89% of water samples reported as nonchemical outbreaks.
W85-04220

STATUS OF HEALTH AND ENVIRONMENTAL RESEARCH RELATIVE TO COAL GASIFICATION 1976 TO THE PRESENT.
Argonne National Lab., IL.
Available from the National Technical Information Service, Springfield, VA 22161. Price codes: A07 in paper copy, A01 in microfiche. Report DOE/ER-0149, October, 1982. 118 p, 2 Fig, 3 Tab, 69 Ref. Contract/Grant No. DE-AC04-76EV01013.

Descriptors: *Gasification, *Ecological effects, *Industrial wastewater, Environment control, Risks, *Coal gasification, Toxicological characterization, Pilot plants, Environmental effects, Chemical analysis, Process water.

Health and enviromental research relative to coal gasification conducted by Argonne National Laboratory, the Inhalation Toxicology Research Institute, and Oak Ridge National Laboratory under DOE sponsorship is summarized. The studies have focused on the chemical and toxicological characterization of materials from a range of process streams in five bench-scale, pilot-plant and industrial gasifiers. They also address ecological effects, industrial hygiene, environmental control technology performance, and risk assessment. Following an overview of coal gasification technology and related environmental concerns, integrated summaries of the studies and results in each area are presented and conclusions are drawn. Needed health and environmental research relative to coal gasification is identified.
W85-04227

STATUS OF HEALTH AND ENVIRONMENTAL RESEARCH RELATIVE TO SOLID WASTES FROM COAL CONVERSION,
Oak Ridge National Lab., TN.
C. W. Francis, and F. J. Wobber.
Dept. of Energy, Report DOE/NBB-0008, January, 1982. 103 p, 18 Fig, 29 Tab, 32 Refs.

Descriptors: *Solid wastes, *Coal, *Mine wastes, *Toxicity, *Health, *Environmental effects, Environmental quality, Environment, Research priorities, Research, Pollutants, Sorption, Landfills, Dissolution, Mutagenicity, Coal conversion.

This document evaluates the status of health and environmental research relative to solid wastes from coal conversion. It also had identified some future needs in related health and environmental research. The overall conclusions resulting from the review of past research and on-going research on coal conversion solid wastes are that (1) research is fragmented among a variety of research projects, (2) research has been near-term oriented confined to assessing the wastes regulatory status under RCRA and their immediate toxicity-mutagenicity characterization. The authors have determined that a research program is needed to resolve

e potential health risks and long-term environental concerns associated with coal conversion olid wastes. The health related research should etermine the general toxicological effects of inaled, sorbed, and ingested solid waste materials, nd the environmental research should determine e fate and effect of contaminants emanating from ndfills containing coal conversion wastes. This rogram should also develop the capabilities to redict rates of transport and fate of contaminants. should evaluate the dissolution and sorption elative to landfill configuration and managements ith the overall objective of determining the longrm health and environmental consequences of ack-to-pit/landfill disposal practices.
785-04229

FFECTS OF CARCINOGENS, MUTAGENS, ND TERATOGENS ON NON-HUMAN SPEIES (AQUATIC ANIMALS),
nvironmental Research Lab., Gulf Breeze, FL.
A. Couch, and W. P. Schoor.
econd Annual Report, NCI/EPA Collaborative rogram, Fiscal Year 1980. 44 p, 3 Tab, 71 Ref.

)escriptors: *Carcinogens, *Fish, *Assay, *Assay ystems, *Trifluralin, Minnow, Trout, Epizootiology, Fish pathology, Fish diseases, Tumors, Hydrocarbons, Aquatic organisms, Enzymes, *Florida.

The 2nd Annual Report of the Gulf Breeze Laboatory Aquatic Carcinogen Program, contains inormation on advances and progress in both inouse efforts and extramural cooperative projects. Flexible fish carcinogen assay systems with optinal modes of exposure of both freshwater and narine fishes and invertebrates have been developed and tested for efficiency. Results of Trifluran (herbicide, suspect carcinogen) versus sheepshead minnow, indicate that the system is valid for arcinogen tests. Another experimental assay ystem for rainbow trout has been developed and ested through the cooperative agreement at Oregon State University, while further work has been completed on the freshwater catfish system at he University of Southern Mississippi. The field collection phase of the epizootiology of tumors nd cellular diseases in fish and shellfish in relation o human pollutant activity has been completed. Early trends indicate a positive relationship beween disease frequency and pollutant activity, but nuch analysis of data is incomplete. Analytical dvances in the resolution and identification of olycyclic aromatic hydrocarbons and their metaolites in aquatic organisms have been made at Gulf Breeze. Work is progressing on characterizng the responses of liver enzyme systems in severl fishes from both freshwater and marine waters. New cooperative agreements on studies of natural opulations of fishes and salamanders with relatively high prevalences of tumors has begun in FY 80.
W85-04230

AMMONIUM PHOSPHATES, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
March, 1984. 62 p, 19 Fig, 5 Tab, 104 Ref.

Descriptors: *Ammonium compounds, *Phosphorus compounds, *Aquatic life, *Chemical spills, Environmental quality, Pollutants, Toxicity, Cleanup, Sediments, Dredging, Contamination, *Ammonium phosphates, Phosphates.

Technical and environmental information concerning problem spills from ammonium phosphates are presented. Ammonium phosphates are white granular or powdered solids, odorless or with only faint odors. They are harmful to aquatic life in high concentrations. Ammonium phosphates are nutrients in waters. Spills of ammonium phosphates can stimulate algal blooms and may alter species population balances in the aquatic environment. There is no potential for bioaccumulation or food chain contamination. For spill control, access to the site must be restricted. The fire department and the manufacturer need to be notified. It is important to keep the contaminated water from entering sewers or watercourses. Emergency control procedures in water include: containment by damming, water diversion or natural barriers. A dredge or vacuum pump can remove contaminants, liquids, and contaminated bottom sediments.
W85-04231

IMPACT OF COMBINED SEWER OVERFLOWS FROM SAN FRANCISCO ON THE WESTERN SHORE OF CENTRAL SAN FRANCISCO BAY,
Arco Alaska, Inc., Prudhoe Bay.
R. W. Hoffman, and R. B. Meighan.
Journal of the Water Pollution Control Federation, Vol. 56, No. 12, p 1277-1285, December, 1984. 5 Fig, 3 Tab, 24 Ref.

Descriptors: *Combined sewer overflows, *Water pollution effects, *San Francisco Bay, *California, Environmental effects, Water quality, Overflows.

During the winter of 1979 a study was conducted to assess the impacts of the combined sewer overflows (CSO) from San Francisco on receiving waters and associated estuarine communities. Accumulated effects of CSOs along San Francisco Bay have contributed strongly to degraded sediment chemistry with a resultant loss of benthic infauna and fish. The impacts on water quality and shellfish, however, were transient and minor. Because affected areas were small, and the impacts were a result of accumulated overflows and not single events, the City of San Francisco was allowed 8 overflows per year at Misson, Islais, and Yosemite Creeks. This resulted in a savings of many millions of dollars. Tailoring wastewater facilities to specifically meet local needs based upon local impacts has been recognized as a legitimate strategy to prevent construction of unnecessary facilities. (Baker-IVI)
W85-04292

EFFECT OF WATER HARDNESS ON THE TOXICITY OF CADMIUM TO MICRO-ORGANISMS,
Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, and A. U. Khan.
Water Research, Vol. 18, No. 12, p 1487-1491, 1984. 2 Fig, 2 Tab, 26 Ref.

Descriptors: *Hardness, *Toxicity, *Cadmium, *Bacteria, Biochemical oxygen demand, Sulfates, Heavy metals.

A study was made of the effect of water hardness at different concentrations (viz. 0, 80, 120, 160, 240, 320, 400, and 480 mg/l as CaCO3) on the toxicity of cadmium metal (5 mg/l) as sulfate to saprophytic and nitrifying bacteria, with respect to the rate constant (K) and ultimate biochemical oxygen demand (L) which were calculated from BOD data (15 days) using the Thomas Graphical Method. Glucose was used as a source of carbon for microorganisms. It was observed that the toxicity of cadmium to microorganisms (both saprophytic and nitrifying) decreased with increasing hardness and reached a maximum at 320 mg/l as CaCO3 for nitrifying and 400 mg/l as CaCO3 for saprophytic bacteria. After these hardness levels, the ultimate BOD (L) and rate constant (K) showed a decrease. Nitrifying bacteria were found to be more sensitive to the metal as well as to its complexation with calcium or with other ions as they retained their normal activity at a lower hardness level as compared to saprophytic bacteria. (Author's abstract)
W85-04295

FACTORS AFFECTING AQUATIC MACROINVERTEBRATES BELOW A FLY ASH POND DISCHARGE,
American Electric Power Service Corp., Columbus, OH. Environmental Engineering Div.
J. H. Van Hassel, and K. V. Wood.
Journal of Freshwater Ecology, Vol. 2, No. 6, p 571-585, December, 1984. 2 Fig, 3 Tab, 42 Ref.

Descriptors: *Invertebrates, *Aquatic animals, *Fly ash pond, *Water pollution effects, Effluents, Aquatic habitat, Spatial distribution, Currents, Detritus, Substrate, Water quality.

The study site was the 31.4 ha fly ash pond of the Cardinal coal-buring electric generating plant located on the Ohio River near Brilliant, Ohio. Fly ash pond overflow was discharged to the west branch of Blockhouse Hollow Run. The east branch of blockhouse Hollow Run joined the effluent approximately 50 below the pond outfall. The effluent stream was characterized by less diverse habitat and food resources and a less complex substratum compared with the adjoining stream unaffected by the effluent, and supported a less diverse macroinvertebrate fauna dominated by physicochemically tolerant, fine particle-consumers. A sampling site in the unaffected stream contained large numbers of shredders and generally exhibited greater macroinvertebrate abundance than two sites in the effluent. Specific factors implicated in determining the observed macroinvertebrate distribution were increased current velocities, decreased substrate heterogeneity, and decreased leafy detritus abundance, all of which supported a less taxonomically diverse and numerically diminished fauna at the sites in the effluent stream compared to the unaffected stream. Water quality factors were less important influences on spatial macroinvertebrate distribution, but suspended solids, pH, and various trace elements may have contributed to temporal variability in the abundance of certain taxa at individual sampling sites. Decreased diversity and abundance of aquatic macroinvertebrates in the coal fly ash pond effluent compared to an adjoining free-flowing stream was mainly attributable to effluent modification of habitat and food resources, with pond water chemistry of apparent lesser significance. (Moore-IVI)
W85-04314

CAUSE OF CONTINUED HYPOLIMNETIC ANOXIA IN LONG LAKE, WA, FOLLOWING ADVANCED WASTEWATER TREATMENT BY THE CITY OF SPOKANE,
Eastern Washington Univ., Cheney. Dept. of Biology.
W. H. Wagstaff, and R. A. Soltero.
Journal of Freshwater Ecology, Vol. 2, No. 6, p 615-630, December, 1984. 3 Fig, 5 Tab, 30 Ref. State of Washington Department of Ecology contract 83-031.

Descriptors: *Anoxia, *Hypolimnion, *Long Lake, *Washington, *Advanced wastewater treatment, *Spokane River, Oxygen demand, Biochemical oxygen demand, Chemical oxygen demand, Sediment oxygen demand, Phosphorus removal, Chlorophyll a, Phytoplankton, Primary productivity.

Long Lake, an impoundment of the Spokane River, was eutrophic prior to 1978. Extensive hypolimnetic anoxia, excessive summer algal growth and limited water clarity existed as a result of nutrient loading from the City of Spokane's primary sewage treatment plant. Advanced wastewater treatment (AWT) began in the fall of 1977 with a process for 85 percent phosphorus removal. Investigations during post-AWT years (1978-1981) have shown significant reductions in phosphorus loading with corresponding declines in chlorophyll a, phytoplankton biovolume, primary productivity and increased water clarity to levels characteristic of mesotrophy. However, anoxia has continued to exist, although the degree of anoxia has been considerably less. The purpose of this study was to investigate the relationship between various measures of oxygen demand and the phytoplankton community on Long Lake with AWT 'on-line'. Biochemical oxygen demand, chemical oxygen demand and sediment oxygen demand were determined. Sediment oxygen demand was measured under stationary and dynamic conditions with a Gilson Differential Respirometer. In addition, the areal hypolimnetic oxygen demand (AHOD) for all study years (1972-1975, 1977-1981) was determined. The AHOD calculated for 1981 was less than those calculated for previous study years. Post-AWT mean AHOD was significantly less than pre-AWT mean AHOD. Chlorophyll a, phytoplankton biovolume and primary productivity were positively correlated with AHOD on a volume and areal basis. The phytoplankton com-

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mumity was correlated with oxygen demand, both within the water column and at the sediment-water interface, and is thought to be a primary factor in the seasonal decline of dissolved oxygen levels in Long Lake. (Author's abstract)
W85-04317

INFLUENCE OF SALINITY AND SULFATE ON THE TOXICITY OF CHROMIUM(VI) TO THE ESTUARINE DIATOM THALASSIOSIRA PSEUDONANA,
Harbor Branch Inst., Inc., Fort Pierce, FL.
G. F. Riedel.
Journal of Phycology, Vol. 20, No. 4, p 496-500, December, 1984. 3 Fig, 1 Tab, 42 Ref.

Descriptors: *Chromium, *Toxicity, *Salinity, *Sulfates, *Diatoms, *Estuarine environment, Algae, Chromate, Growth, Water pollution effects.

The acute toxicity of Cr (VI) to the diatom Thalassiosira pseudonana (Hasle and Heimdal) clone 3H was determined in artificial media of 3.2 and 0.32 ppt salinity and with variations of sulfate concentration in the media independent of salinity. Inhibitory concentrations of Cr(VI) ranged from 6.6 micro M for growth rate and 4.9 micro M for cell yield at 3.2 ppt salinity and 2.8 mM sulfate to 0.04 micro M for growth rate and 0.02 micro M for cell yield at 0.32 ppt salinity and 0.019 mM sulfate. The inhibition by Cr(VI) was a function of the ratio of Cr(VI) to sulfate. Inhibition occurred when the ratio exceeded about 500:1. It is suggested that the mechanism for the toxicity of Cr(VI) to diatoms and perhaps other aquatic organisms involves a site at which sulfate and chromate compete. (Author's abstract)
W85-04319

OXYGEN CONSUMPTION RATES OF GRUNION (LEURESTHES TENUIS) EMBRYOS EXPOSED TO THE PETROLEUM HYDROCARBON, BENZO(A)PYRENE,
University of Southern California, Los Angeles. Dept. of Pathology.
J. E. Hose, and H. W. Puffer.
Environmental Research, Vol. 35, No. 2, p 413-420, 1984. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Water pollution effects, *Grunion, *Benzopyrene, *Embryonic growth stage, *Hydrocarbons, Fish physiology, Fish eggs, Respiration, Bioconcentration.

Newly fertilized eggs were obtained from manually spawned grunion (Leuresthes tenuis) collected at Redondo Beach, California, and immediately exposed to benzo(a)pyrene (BaP) dissolved in seawater. Bioconcentration of labeled BaP and effects of unlabeled BaP accumulation on the routine oxygen consumption of the embryonic grunion were studied. Despite decreases in the levels of dissolved BaP throughout the 14 day experiment, body burdens of BaP and its metabolites in embryonic grunion eggs generally remained constant after Day 3 at levels ranging from 0.51 to 12.80 ppm wet wt. At day 15, bioconcentration factors over dissolved BaP levels ranged from 249 to 466. Weight-specific respiration rates at days 14-15 were significantly increased ($P < \text{or} = 0.05$) at mean BaP body burden of 0.51 ppm wet wt. Oxygen consumption rates of embryos containing 0.07 to 12.80 ppm BaP were not significantly different from control rates. The nonlinear physiological dose response of grunion embryos to BaP is consistent with observed morphologic and developmental changes induced by petroleum hydrocarbons. BaP levels in polluted regions such as the Los Angeles Harbor (California) may be sufficient to affect the metabolism, development, and survival of grunion embryos. (Collier-IVI)
W85-04341

CHROMOSOMAL ABERRATIONS IN ONION (ALLIUM CEPA) INDUCED BY WATER CHLORINATION BY-PRODUCTS,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
K. Al-Sabti, and B. Kurelec.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 1, p 80-88, January, 1985. 2 Fig, 4 Tab, 25 Ref.

Descriptors: *Mutation, *Chlorination, *Onions, Water treatment, Water pollution effects, Benzidine, Toxicity.

Chromosomal aberration (CA) in Allium was chosen for the detection of mutagenic potential of water in a polluted river before and after under breakpoint chlorination. The following minimal types of aberrations were distinguishable: breaks and framgents, ring chromosomes and dicentric chromosomes. The control group had aberrations only in 100 out of 498 metaphases evaluated. Bulbs exposed to the chlorinated water showed an increased number of aberrations after a 2 hr exposure. After 48 hr, their frequency was above 10%. Chlorination of the river water induced aberrations in a dose response manner with respect to both kinds of doses; concentration of the chlorinated substances and the exposure time. Even the lowest concentration of 1 mg Cl/liter induced a higher number of aberrations than the unchlorinated river water. In further tests a series of Allium were exposed to the known mutagen and carcinogen benzidine for 2 and 5 days. Benzidine induced CA in a dose-response manner even in the dark. The number of CA was higher than that induced by the corresponding concentrations of the chlorine used within 2 days of exposure. After 5 days of exposure to a concentration of 10 mg of benzidine/liter, the CA reached 122 aberrated metaphases out of 185. (Baker-IVI)
W85-04348

TOXICITY OF A NEW PYRETHROID INSECTICIDE, WL85871, TO RAINBOW TROUT,
Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.
S. W. Shires.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 1, p 134-137, January, 1985. 3 Tab. 9 Ref.

Descriptors: *Pyrethroids, *Trout, *Toxicity, *Pesticide toxicity, Water pollution effects, Organic compounds, Fish, Insecticides.

The effects of different dose rates of the new pyrethroid insecticide WL85871, on rainbow trout maintained under field conditions were examined. Different volumes of a diluted emulsion concentrate formulation of WL85871 were applied with a small hand-held single nozzle sprayer onto the water surface of seven different enclosures to give a logarithmic series of dose rates ranging from 5 to 500 g ai/ha. Dissolved oxygen, pH, conductivity, temperature, suspended solids and chlorophyll a were measured at frequent intervals during the study. Water quality parameters in all enclosures remained at suitable levels to support unstressed fish life throughout the trial period. The concentration of WL85871 in water samples attained peak levels at about 4 to 124 hours afer application and thereafter remained fairly stable until the end of the study. Between 40 to 80% of the nominal applied dose was accounted for by the concentrations detected in water at 24 hr post-treatment. No fish deaths occurred in the untreated control enclosures or in those treated with WL85871 at or below 50 g ai/ha. All fish were killed in enclosures treated at or above 100 g ai/ha. With the exception of a few fish in the WL85871 650 g ai/ha treated enclosure, all of the live fish removed at the end of the study appeared to be unaffected by the insecticide application. (Baker-IVI)
W85-04353

TOXICITY OF ADJUVANTS TO BLUEGILL,
Florida Univ., Gainesville. Center for Aquatic Weeds.
C. E. Watkins, II, D. D. Thayer, and W. T. Haller.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 1, p 138-142, January, 1985. 2 Tab, 9 Ref.

Descriptors: *Toxicity, *Bluegills, *Herbicides, *Adjuvants, Organic compounds, Water pollution effects, Fish, Bioassay, Alkalinity.

Spray additives, or adjuvants, have been developed to aid the effectiveness of herbicides. An acute static bioassay was conducted for nine adjuvants commonly used in conjuction with aquatic herbicides using bluegill as the test organism. The 24 hr LD-50 ranged from 1.9 to 150 mg/l and the 96 hr LD-50 ranged from 0.96 to 8100 mg/l. Polysar and Herbex, the two spray additives which produced opaque solutions were the least toxic. With the exception of Herbex, which slightly elevated alkalinity and pH, all adjuvants appear to have a minor effect upon alkalinity and pH. The alkalinity and pH values recorded for all adjuvants were well within the tolerable range for this species. Currently the final concentration of spray additives are dependent upon depth. Application of Spra-mate, the most toxic spray additive, at a depth of 1.5 meter or less, may result in median lethal concentrations toxic to bluegill within 96 hr. Toxicitie of these adjuvants may be affected by external factors in natural surroundings. With the exception of Spra-mate, all other spray adjuvants applied at the suggested application rates, would not be toxic to juvenile bluegill. (Baker-IVI)
W85-04354

HEAVY METAL UPTAKE AND INTRACELLULAR BINDING IN ISOLATED GILL PREPARATIONS OF MYTILUS GALLOPROVINCIALIS L.,
University Coll., Dublin (Ireland). Dept. of Zoology.
C. Nolan, E. Duke, G. Lorenzon, E. Sabbioni, and E. Marafante.
Science of the Total Environment, Vol. 40, p 83-92, December, 1984. 3 Fig, 1 Tab, 30 Ref.

Descriptors: *Mussels, *Heavy metals, *Animal tissues, *Gills, *Water pollution effects, Cadmium, Zinc, Mercury, Vanadium, Chrome, Tellurium, Arsenic, Technetium, Proteins.

An in vitro study was performed on the uptake and subsequent binding to protein of heavy metals in isolated gill preparations of Mytilus galloprovincialis. The metals used in the study were Cd, Zn, Hg, V, Cr, Te, Tl, As and Tc. Experiments were conducted for one hour and the disappearance of metals from the water correlated with final gill-metal concentrations. Distribution of metal between 105,000 g cytosol and pellet was determined, as was the association of each metal with cytosol protein following gel-filtration chromatography. Significant amounts of all metals are associated with the soluble fraction of the tissue. Although very different uptake rates are noted for each metal, the amount of each metal found in the cytosol fraction after exposure is very similar and in most cases the difference in uptake can be attributed to the binding of metal to the pellet fraction. The uptake of the Group IIB metals (Cd, Zn, Hg) is linear and practically identical for all three; it is likely that they interact with the gill tissue in the same way and that similar uptake mechanisms operate. Thallium shows little or no interaction with the gill tissue. The biphasic uptake kinetics of chromium, vanadium, and tellurium indicate a probable initial interaction of these metals with availiable binding surfaces on the gill surface, followed by transport processes across the gill membrane. Technetium(VII) shows greater loss from water than Tc(IV) of which only 25% disappears. Uptake into and onto the gill tissue decreases in the order Hg > Zn, Cd, Cr > V, Te > As(III) > As(V) > Tl. The amount of Tc(IV) in the tissue was three times that of Tc(VII), correlating well with the disappearance of the metal from the water. The technique described can be useful in the rapid evalution of the uptake characteristics of metals from seawater by Mytillus and their subsequent interaction with protein fractions in the cytosol. (Collier-IVI)
W85-04358

GLUTATHIONE S-TRANSFERASE IN AQUATIC MACRO-INVERTEBRATES AND ITS INTERACTION WITH DIFFERENT ORGANIC MICROPOLLUTANTS,
Institut d'Hygiene et d'Epidemiologie, Brussels (Belgium).
P. J. Dierickx.

cience of the Total Environment, Vol. 40, p 93-02, December, 1984. 4 Fig, 2 Tab, 18 Ref.

)escriptors: *Glutathione S-transferase, *Enymes, *Detoxification, *Macroinvertebrates, Vater pollution effects, Animal physiology, Tubicids.

n higher organisms, glutathione S-transferase GST) plays a key role in the detoxification of a rge number of xenobiotics. In the present work ie presence of GST in aquatic macro-invertetrates and its possible significance as a detoxificaon mechanism of organic micropollutants in the quatic environment is investigated. So far, GST as been found in 20 macro-invertebrates (in adults s well as in larvae) and in insects as well as in ther animal groups. The GST activities were elatively high, ranging from 10 to 600% of the ctivity found in rat liver. The interaction of quinnes, o-chloranil and chlorophenoxyalkyl acids vith the GST activity, in extracts from three different macro-invertebrates, revealed an inhibition vhich was quite similar to that previously found or rat liver GST. In Tubifex tubifex extracts at east three different GST isoenzymes could be lemonstrated. These partially purified isoenzymes vere used for the kinetic analysis of GST inhibiion by 2,4-dichlorophenoxyalkyl acid and 1,4-benoqdinone, using Lineweaver-Burk plots. The ame kinetic patterns were observed as for rat liver GST. The results demonstrate that the interactions of the compounds investigated with aquatic macronvertebrate and with rat liver GST are in very good agreement. It is concluded that macro-inverebrate GST can play a key role in the detoxificaion of organic micro-pollutants in the aquatic environment. (Author's abstract)
W85-04359

UPTAKE AND CLEARANCE RATES FOR KEPONE IN TWO MARINE FISH SPECIES,
Virginia Inst. of Marine Science, Gloucester Point.
M. H. Roberts, Jr., and D. J. Fisher.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 1, p 1-6, January, 1985. 2 FIg, 3 Tab, 13 Ref.

Descriptors: *Kepone, *Toxicity, *Fish, Organic compounds, Water pollution effects, Pesticide toxicity, Marine environment.

Uptake and clearance rates of kepone from water by marine fishes were investigated using the theoretical model of Hamelink (1977. Current bioconcentration test methods and theory. pp 149-161. In: Mayer, FL and Hamelink, JJL (eds) Aquatic Toxicology and Hazard Evaluation, ASTM Spec Tech Publ 634, Philadelphia, PA). Acute toxicity was also determined as an aid in the selection of exposure levels for the uptake studies. A 50% mortality in the test population was achieved at a concentration of 17.4 micro-g kepone/liter for Brevoortia tyrannus and 28.8 micro-g/L for Menidia menidia. Estimated rate constants for uptake of kepone were 280 and 293/day for menhaden and 102 and 238/day for silversides. The rate constants for clearance were estimated to be 0.03 and 0.13/day for menhaden and 0.002 and 0.01/day for silversides. Based on these rates of uptake and clearance, the equilibrium bioconcentration factor is estimated to lie between 2300 and 9750 for menhaden and 21700 and 60200 for silversides. (Baker-IVI)
W85-04364

ACUTE TOXICITY OF SOME CHLORINATED PHENOLIC COMPOUNDS TO SELENASTRUM CAPRICORNUTUM AND PHYTOPLANKTON,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
K. Kuivasniemi, V. Eloranta, and J. Knuutinen.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 1, p 43-49, January, 1985. 2 Fig, 3 Tab, 35 Ref.

Descriptors: *Chlorinated phenols, *Toxicity, *Phytoplankton, *Selenastrum, Water pollution effects, Organic compounds, Pulp wastes, Algae, Phenols, Guaiacols, Catechols, Chlorosyringol.

The acute toxicity of different chlorinated phenolic compounds detected in wastewaters of bleached pulp were determined using the Selenastrum capricornutum screening-test. Five of the phenolic compounds were chlorocatechols, four were chloroguaiacols and one was chlorosyringol. Cell counting and phytoplankton C-14 uptake were used to measure the response of Selenastrum capricornutum to the chemicals. Di-, tri- and tetrachlorocatecholes inhibited algal growth in lower concentrations than guaiacols at equal chlorine substituent levels. The position of the chlorine substituents on the phenol ring affected the toxicity of the compound. The differences were caused by their different lipophilicity and pKa values. In studies of the toxic effect of the chemicals on the C-14 uptake on indigenous phytoplankton, in .01 mM solutions, all compounds except 4,5-dichloroguaiacol and 4,5,6-trichloroguaiacol inhibited C-14 uptake extremely. The situation in phytoplankton assays is more complicated than in Selenastrum assays in that the C-14 uptake of phytoplankton can decrease due to the toxicity of compounds but also due to changes in illumination, pH, and heterotrophic activities affecting nutrient availability. When comparing the toxicity of the chemicals on the basis of toxic units, the relation between the amounts of different compounds detected in wastewaters, and the EC50-values for Selenastrum, the chlorinated guaiacols are more toxic than chlorinated catechols. The reason for this is that chlorinated guaiacols were dominant in spent bleach liquors. The concentration of chlorinated phenolics are not stable. They differ to a great extent between paper mills and even within the same mill at different times, which means that toxic units change also. (Baker-IVI)
W85-04366

EFFECT OF SOME MOLLUSCICIDES ON THE RATE OF SURVIVAL AND OXYGEN CONSUMPTION OF A FRESHWATER LEECH, POECILOBDELLA VIRIDIS (BLANCHARD),
Marathwada Univ., Aurangabad (India). Dept. of Zoology.
G. K. Kulkarni, A. B. Rao, and C. S. K. Anand.
Proceedings of the Indian Academy of Sciences, Vol. B50, No. 1, p 32-36, 1984. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Wood preservatives, *Toxicity, *Molluscicides, *Leeches, Organic compounds, Water pollution effects, Sodium pentachlorophenate, Mercuric chloride, Pesticide toxicity.

The toxicity of widely used molluscicides, sodium pentachlorophenate (NaPcP) and mercuric chloride (HgCl2) towards fresh water leech, Poecilobdella viridis, was examined by static bioassay at organismic level. Both NaPcP and HgCl2 are widely used as molluscicides in curbing the populations of freshwater snails which are vectors of trematode of medical importance. The LC50 values were 3.5 ppm for NaPcP and 1.5 ppm for HgCl2. After exposure to NaPcP at concentrations of 1 ppm for 4-24 hr, 2 ppm for 1-24 hr, and 3 ppm for 2 hr the oxygen consumption of Poecilobdella viridis increased. Significant decreases in oxygen consumption were noted after exposure to 3 ppm of NaPcP for 24 hr and 1 ppm Hg2Cl for 24 hr. (Baker-IVI)
W85-04376

EFFECT OF DIMECRON, ROGOR AND CUMAN L ON ACHE AND PHOSPHATASES IN FRESH WATER MUSSEL, LAMELIDENS MARGINALIS (LAMARCK.),
Kakatiya Univ., Warangal (India). Dept. of Zoology.
K. V. K. Vijayendra Babu, and T. Vasudev.
Current Science, Vol. 53, No. 17, p 935-936, September 5, 1984. 1 Tab, 17 Ref.

Descriptors: *Toxicity, *Dimecron, *Rogor, *Cuman L, *Pesticides, *Mussels, Pesticide toxicity, Water pollution effects, Alkaline phosphatase, Enzymes, Acetylcholine esterase, Organic compounds.

Mussels were exposed to sub-lethal concentrations (5 ppm) of dimecron, rogor and cuman L. A reduction in AChE activity and accumulation of ACh content was noted. Dimecron caused higher depression of AChE activity than rogor. Cuman L, a carbamate, caused least effect on ACh-AChE system. Concomitant with AChE inhibition, there is an accumulation of ACh in the tissues of dimecron and rogor treated mussles. A significant increase in both acid and alkaline phosphatase activity by dimecron, rogor and cuman L was noted. Rogor caused greater elevation than cuman L. The increase in acid phosphatase activity may indicate release of these enzymes into the cellular environment due to disruption of lysosomal membrane since biocides are known to produce cytotoxic action and alterations in membrane fragility. The increase in alkaline phosphatase activity was significant, indicating perhaps an increased uptake of certain metabolites and ions since these enzymes are reported to be involved in this process. This could also indicate changes in the energy supply metabolism. (Baker-IVI)
W85-04377

EFFECT OF TREATMENT WITH RESERPINE ON THE CHANGES IN FILTRATION RATE OF MYTILUS EDULIS SUBJECTED TO DISSOLVED COPPER,
Newcastle upon Tyne Univ. (England). Dept. of Zoology.
R. Howell, A. M. Grant, and N. E. J. Maccoy.
Marine Pollution Bulletin, Vol. 15, No. 12, p 436-439, 1984. 2 Fig, 15 Ref.

Descriptors: *Copper, *Reserpine, *Mussels, Water pollution effects, Filtration, Heavy metals, Toxicity.

The mechanism behind the effect of low levels of copper on the filtration rate of Mytilus was examined. Adult specimens were exposed to the following concentrations of copper as copper sulfate in 100% seawater: 0.05, 0.1, 0.2, 0.4, and 0.8 mg/liter. After exposure for 30 min the filtration rate was determined. A group of 30 mussels was injected into the posterior adductor muscle with reserpine to deplete the monoamine content. After 48 hr the animals were divided into six groups and the effect of the different concentrations of copper on the filtration rate was then determined. A marked reduction in filtration rate was observed in animals before treatment with reserpine. The copper concentration leading to a reduction of 50% in the filtration rate was about 0.094 mg/liter. Animals exposure to copper after injection with reserpine showed no marked fall in the filtration rate, although there appeared to be a small increase in the measured filtration rate of the control group exposed to normal seawater. Effects on isolated gill preparations showed that even the most concentration solution used (0.8 mg/liter copper) failed to cause a noticeable reduction in the rate of ciliary beating. Exposure of isolated gill preparations to copper following reserpine treatment had no effect on the rate of ciliary beating, but there was a significant increase in the rate of the control group. (Baker-IVI)
W85-04378

SHORT-TERM CADMIUM EFFECTS ON GILL TISSUE METABOLISM,
Universidad Autonoma de Barcelona (Spain). Faculty of Sciences.
L. Tort, P. Torres, and J. Hidalgo.
Marine Pollution Bulletin, Vol. 15, No. 12, p 448-450, 1984. 3 Fig, 31 Ref.

Descriptors: *Cadmium, *Toxicity, Water pollution effects, Fish, Heavy metals, Metabolism, Gills.

The gills are the first barrier a dissolved metal reaches when entering fish; disturbances in the gills are important as they produce serious impairment to the oxygen transfer to the blood system and the respiratory physiology. ATP, lactate and respiratory rate in dogfish gill tissue were analyzed after 50 ppm of cadmium treatment. After 24 hr, ATP levels showed no differences, but significant decreases were noted after 2 days. Results found after 3, 4, and 6 days showed a return to the control levels and no significant differences were found between control and 3, 4, and 6 days treatment. Lactate levels were quickly and strongly increased at 24 hr. From the third day a progressive decrease took place and control levels were recovered

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about day 6. At day 2 a lower rate of oxygen consumption was noted (49% of controls) but only a slight difference was noted at day 6 (82% of controls). (Baker-IVI)
W85-04381

IMPACT OF THE TIHANGE NUCLEAR POWER PLANT ON THE PERIPHYTON AND THE PHYTOPLANKTON OF THE MEUSE RIVER (BELGIUM),
Liege Univ. (Belgium). Dept. of Botany.
J. P. Descy, and C. Mouvet.
Hydrobiologia, Vol. 119, No. 2, p 119-128, December, 1984. 8 Fig, 1 Tab, 16 Ref. E.E.C. contract CCE-IHE 258 BIO-B.

Descriptors: *Periphyton, *Phytoplankton, *Thermal pollution, *Nuclear powerplants, *Meuse River, *Belgium, Low flow, Diatoms, Dissolved oxygen, Biomass, Species composition.

A survey was made from 1976 to 1981 of the possible effects of Tihange nuclear power plant on the Meuse river. Phytoplankton and periphyton were affected only during low water flow. Both decreases and increases of biomass were recorded for phytoplankton but, for periphyton, only increases. The structure of diatom communities is affected downstream of the plant during low water flow, because sensitive species are replaced by more tolerant ones. In the reach downstream of the plant, the maximum observed temperature increase is 4.2 C and the maximum decrease in dissolved oxygen is 15%. Except for these two parameters immediately below the plant, any changes observed cannot be attributed solely to the nuclear power plant, but rather to the combination of thermal effects with effluents from other industries which together contribute to the more significant changes observed further downstream. (Author's abstract)
W85-04388

ECOLOGICAL EFFECT OF ACID CONDITIONS AND PRECIPITATION OF HYDROUS METAL OXIDES IN A ROCKY MOUNTAIN STREAM,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W85-04389

5D. Waste Treatment Processes

ON-SITE TREATMENT OF LEACHATE USING AEROBIC BIOLOGICAL TECHNIQUES,
Aspinwall and Co., Shrewsbury (England).
H. Robinson.
Quarterly Journal of Engineering Geology, London, Vol. 17, No. 1, p 31-37, 1984. 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Biological treatment, *Leachates, *Landfills, *Wastewater treatment, Aerobic conditions, Design criteria, Construction, Water treatment facilities.

The technology of aerobic biological treatment of leachates is sufficiently advanced to allow full-scale treatment facilities to be designed and operated. As individual sites become larger in the United Kingdom, with many landfills being designed to have lives of from 20-30 years and to accept many million of tons of wastes, on site leachate treatment plants will become more widespread. An important consideration in the aerobic biological processes used to treat landfill leachates will be what treatment charges are to be levied by the regional water authority. These usually use standard trade effluent formulae and relate to chemical oxygen demand and to a lesser extent to suspended solids in the leachate. An important part of most large leachate treatment systems is the secondary lagoon, often having a surface area of several thousand sq m, which may be equipped with a surface aerator for use if the quality of effluent deteriorates. Such processes will necessarily have to be considered in the selection of a site and the construction of full-scale facilities. (Baker-IVI)
W85-03769

CONTROLS ON CONTAMINANT MIGRATION AT THE VILLA FARM LAGOONS,
Institute of Geological Sciences, Nottingham (England). Fluid Processes Unit.
G. M. Williams, C. A. M. Ross, A. Stuart, S. P. Hitchman, and L. S. Alexander.
Quarterly Journal of Engineering Geology, London, Vol. 17, No. 1, p 39-55, 1984. 14 Fig, 7 Tab, 6 Ref.

Descriptors: *Groundwater pollution, *Water pollution sources, *Waste disposal, *Aquifer characterisics, Sand aquifer, Unconfined aquifers, Solvents, Heavy metals, Wastewater lagoons.

The lagoons at Villa Farm near Coventry, England are an example of the potentially most unfavorable case for the movement of contaminants at a waste disposal site. Liquid wastes containing heavy metals and organic solvents are discharged into lagoons excavated to beneath the water table in a shallow, unconsolidated sand aquifer, resulting in local groundwater pollution. The development of the pollution plume appears to be controlled by the morphology of the aquifer, the distribution of permeability within it and the head distribution in the vicinity of the lagoons. On the basis of redox reactions three geochemical zones have been identified down hydraulic gradient in the transition from strongly reducing conditions near the lagoon and at the base of the aquifer to oxidizing conditions in natural groundwater. Heavy metals are attenuated within a short distance of the lagoons, probably as a result of precipitation as sulfides and carbonates, but organic wastes have been found in excess of 300 m from the site. With increasing distance from the lagoons changes in bacterial populations and the character of organic compounds present at the base of the aquifer suggest that organic transformations are occurring despite little change in the concentration of total organic carbon, although ultimately biodegradation to methane and carbon dioxide takes place. (Baker-IVI)
W85-03770

WASTEWATER RECYCLING IN MUSKEGON COUNTY,
Metcalf and Eddy, Inc., Arlington Heights, IL.
C. E. Pound, Y. A. Demirjian, and W. H. Waggy.
BioCycle, Vol. 25, No. 8, p 46-51, November/December, 1984. 3 Fig, 5 Tab, 7 Ref.

Descriptors: *Michigan, *Muskegon County, *Irrigation, *Wastewater treatment, Water supply, Recycling, Water reuse.

Wastewater treatment services are currently provided by Muskegon County, Michigan, on a regional basis by two facilities. A combined domestic-industrial wastewater is received and treated at both facilities. The Metro facility, is designed for a capacity of 42 mgd; the facility minimizes release of treated wastewater to surface waters through the application of that water to farm land as irrigation water. Wastewater arriving at the treatment plant enters through an open channel permitting the use of three aerated lagoons in either parallel, series or combination thereof for pretreatment of the water. The water can then either enter directly into storage lagoons or may pass first through a settling lagoon and directly to an outlet lagoon for pumping to the irrigation system. An extensive drainage system is provided to collect renovated wastewater from the irrigated areas and from lagoon seepage for discharge to receiving waters. This system consists of a combination of underdrains, wells, and interception ditches discharging into two main collector drains. The facility has successfully provided high levels of wastewater treatment, however, one problem is that several of the irrigated areas are inadequately drained and the result is standing water when it is applied at its prescribed application rate. A second problem is that while the Metro system is exceeding all of its required effluent standards, there is a steady increase in phosphorus concentration in the interception ditch waters, in both the north and south ditches. As for the condition of the crops, there has been no uptake of man-made organics from wastewater by the corn crops. (Baker-IVI)
W85-03796

NO MORE ALKALINITY BURNOUT,
R. L. Case.
Water Engineering and Management, Vol. 131, No. 12, p 26-27, November, 1984. 1 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Dissolved oxygen, *Nitrification, *Acidity, Alkalinity, Bacteria, Fungi.

In the past when alkalinity burnout has occurred at any extended aeration plant, operators have added sodium bicarbonate or sodium hydroxide constantly or intermittently. The severity of the alkalinity and pH reduction can equate to an inferior water quality effluent because of the inability of the process to hold solids in the clarifier. Bench experiments and full scale testing at a New England wastewater treatment plant revealed that reduction and control of dissolved oxygen levels could prevent alkalinity burnout in the nitrification process and the subseqent discharge of low pH effluent. (Baker-IVI)
W85-03798

USE OF PEAT FOR ON-SITE WASTEWATER TREATMENT: I. LABORATORY EVALUATION,
Maine Univ. at Orono. Dept. of Civil Engineering.
C. A. Rock, J. L. Brooks, S. A. Bradeen, and R. A. Struchtemeyer.
Journal of Environmental Quality, Vol. 13, No. 4, p 518-523, 1984. 2 Fig, 2 Tab, 41 Ref. EPA grant R-808069-01.

Descriptors: *Wastewater treatment, *Peat, *Filtration, Municipal wastewater, Industrial wastes, Peat soils, Septic wastewater.

Laboratory columns were used to determine the treatment capacity of sphagnum peat at varying hydraulic and organic loadings of municipal and industrial wastewaters. Excellent BOD5 and TSS removals were obtained at hydraulic loadings up to 8.1 cm/d of septic tank effluent with an initial BOD5 of 150 mg/l and TSS or 73 mg/liter. Cold temperatures decreased treatment efficiency. While poor P removal was measured, significant N reduction can be achieved via biological denitrification. Results indicate that peat can provide excellent fecal coliform reduction without auxiliary disinfection. The lab performance of peat columns suggests that a peat filter can be designed for either subsurface or overboard discharge. Each application will influence the recommended design criteria differently. The hydraulic loading should be kept at or below 4.1 cm/d for typical strength STE. This would result in an organic loading of 10 kg BOD5/1000 sq m per day. The filter should have at least 30 cm of lightly compacted sphagnum peat (0.10-0.12 Mg/cu m) below the distribution pipes. (Baker-IVI)
W85-03853

USE OF PEAT FOR ON-SITE WASTEWATER TREATMENT: II. FIELD STUDIES,
Maine Univ. at Orono. Dept. of Civil Engineering.
J. L. Brooks, C. A. Rock, and R. A. Struchtemeyer.
Journal of Environmental Quality, Vol. 13, No. 4, p 524-530, 1984. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Wastewater treatment, *Peat, *Filtration, Septic wastewater, Municipal wastewater, Industrial wastes, Fecal coliforms, Phosphorus, Biochemical oxygen demand, Nitrates, Suspended solids.

Three full size sphagnum peat filter fields were monitored to determine the treatment levels after application of septic tank effluent (STE). Systems I and II were designed with a liner and had overboard discharges, whereas system III was constructed with a subsurface discharge. Gravity feed, dosed feed, and pressure distribution systems all provided excellent organic and 99% fecal coliform removal without additional disinfection. Phosphorus concentrations were partially reduced, however, they remain high for discharge to nutrient sensitive waters. When considering the hydraulic rate for design of the system, it is advantageous to also consider the strength of the septic tank effluent

to be applied to the individual bed. Although the precipitation is not normally considered when designing a bed for hydraulic loading, this should be taken into account in areas subject to precipitation extremes. These beds were found to function equally well with and without snow cover and at low temperatures. (Baker-IVI)
W85-03854

IRRIGATION OF MONTEREY PINE WITH WASTEWATER: EFFECT ON SOIL CHEMISTRY AND GROUNDWATER COMPOSITION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div of Forest Research.
R. N. Cromer, D. Tompkins, N. J. Barr, and P. Hopmans.
Journal of Environmental Quality, Vol. 13, No. 4, p 539-542, 1984. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Wastewater irrigation, *Forests, *Soil chemistry, *Wastewater disposal, Chemical analysis, Nitrogen, Sodium, Nitrification, Groundwater analysis, Acidity, Potassium, Electrical conductivity.

Fifteen year old Monterey pine was irrigated for 3 yr with wastewater derived from industrial and municipal sources. The wastewater contained high concentrations of Na(2+) and HCO3(-) and was quite alkaline. Irrigation caused substantial increases in exchangeable Na(2+), extractable P, exchangeable K, pH, and the electrical conductivity of the soil solution. Highly colored organic compounds derived from pulp-mill effluent apparently combined with inorganic N from municipal effluent to form organic N compounds. Nitrogen remained largely in the organic form and became concentrated in the groundwater with colored humic compounds. The greatest environmental hazard in the use of such blended wastewaters for irrigation is the contamination of drainage water with colored, saline water containing high concentrations of organic N. The organic compounds appeared to inhibit nitrification in the groundwater. (Baker-IVI)
W85-03855

DESIGN, START-UP, AND OPERATION OF AN OZONE DISINFECTION UNIT,
Process Applications, Inc., Fort Collins, CO.
K. L. Rakness, E. L. Stover, and D. L. Krenek.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1152-1159, November, 1984. 8 Fig, 5 Tab, 9 Ref.

Descriptors: *Disinfection, *Ozonation, *Chlorination, *Wastewater treatment, *Vail, *Colorado, Economic aspects, Design criteria.

The Vail, Colorado Water and Sanitation District (VWSD) uses an ozone disinfection unit in its treatment of wastewater. The process has performed very reliably due to good design and construction features, the good attitude of the plant staff and the approach taken to operation of the process. Excellent air pretreatment and contact basin performance are key elements. The ozone dosage required to meet fecal coliform permit criteria is about 1.5 mg/L, much less than the design dosage of 5.6 mg/L. Existing equipment at the plant was energy-intensive at the lower production requirements. Proposed modifications to the air compressors and ozone generators together with use of off-gas ozone concentration for process control is projected to reduce energy consumption by 35%. Further, better disinfection control is expected because of the immediate response of off-gas concentration to changes in wastewater quality and ozone demand. The ozone and chlorine disinfection system performed equally well with respect to fecal coliform removal. The ozone system is preferred, however, because of the safety issues related to storage of chlorine and the asthetic value of the sparkle the ozone system gives the effluent. While the ozone system capital and operating costs were about twice those for the chlorination/dechlorination system, both processes represented a relatively small part of the total plant costs. (Baker-IVI)
W85-03866

TREATMENT OF A HIGH-STRENGTH INDUSTRIAL WASTE IN A CONTINUOUSLY FED, INTERMITTENTLY OPERATED, ACTIVATED SLUDGE SYSTEM,
George Washington Univ., Washington, DC. Dept. of Civil, Mechanical, and Environmental Engineering.
B. A. Bell, and G. J. Hardcastle.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1160-1164, November, 1984. 2 Fig, 7 Tab, 9 Ref. US Army contract DAMD 17-81-C-1118.

Descriptors: *Wastewater treatment, *Activated sludge process, *Industrial wastewater, Nitrification, Denitrification, Organic compounds, Solvents, Dissolved oxygen, Oxygen uptake.

A bench-scale continuously fed, intermittently operated activated sludge system was operated treating a high-strength industrial waste containing organic solvents for more than 30 months. Various operating protocols were used. Organic removal was consistently high and nitrification and denitrification were essentially complete. Because of the light nitrogen loading, nitrification and denitrification rates were minimum. Solids separation was good throughout the study when dissolved oxygen was sufficient during aerobic periods. The system therefore seems to be highly suitable for the treatment of high strength industrial wastes containing organic solvents. Complete nitrification and denitrification was achieved. Specific oxygen uptake rate variations were high. The system was highly stable and extremely tolerant of changes in operating conditions, including shocks from power outages, mixer failure, and accidental overfeeds. (Baker-IVI)
W85-03867

ALUMINUM HYDROLYSIS EFFECTS ON PHOSPHORUS REMOVAL FROM WASTEWATERS,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
E. Diamadopoulos, and A. Benedek.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1165-1172, November, 1984. 16 Fig, 1 Tab, 16 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Aluminum hydrolysis, Industrial wastewater, Phosphorus, Acidity, Coagulants, Sludge dewatering, Suspended solids, Settling rate.

The role of aluminum hydrolysis products in phosphorus precipitation under conditions usually met in practice is reviewed. The effect of aluminum hydrolysis on other parameters such as settling rate, supernatant suspended solids concentration, and sludge filtrability was also addressed. The removal of organics by the hydrolysis products of aluminum was compared with the removal of phosphates. Chemical precipitation was brought about through complex formation. The degree of phosphorus removal depends on the degree of hydrolysis of the coagulant and its concentration, the presence and the concentration of other ions, and the pH. For conditions usually found in practice, the higher the basicity, the smaller the ability of the coagulant to precipitate the phosphates. The most important factors affecting the optimum pH range were the Al:P ratio, the OH:Al ratio, and the presence and concentration of other ions. The presence of sulfate had a beneficial effect on the removal, especially at lower pH values. With domestic wastewaters, the various coagulants gave results similar to those in synthetic wastewater. The efficiencies, however, were smaller because of the presence of condensed phosphates and other ionic species. The hydrolysis of aluminum also affected the supernatant suspended solids concentration, the settling rates, and the dewaterability of the sludge. The pH, the nature, and the dosage of the coagulants affected the removal of organics from an industrial wastewater. The removal of organics by aluminum does not follow the same pattern as the removal of phosphorus. This indicates that a complexation and precipitation mechanism alone cannot be adequately applied to explain the observed trends. (Baker-IVI)
W85-03868

AEROBIC AND ANAEROBIC INTERMEDIATE STORAGE OF ACTIVATED SLUDGE: EFFICIENCY STUDY,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
S. Gonzalez-Martinez, and M. Norouzian.
Journal Water Pollution Control Federation, Vol. 56, No. 11, p 1173-1177, November, 1984. 9 Fig, 15 Ref.

Descriptors: *Activated sludge process, *Efficiency study, *Aerobic conditions, *Anaerobic conditions, Sludge storage, Sludge, Wastewater treatment, Aeration.

Aerobic-aerobic and aerobic-anaerobic cyclic operation of a multi-aeration tank activated sludge process were studied to optimize operation. In the aerobic-aerobic operation the number of aeration tanks receiving wastewater was determined according to the organic loading to the plant. The aerobic-anaerobic operation was similar to the aerobic-aerobic operation, except that air to those aeration tanks not receiving wastewater was interrupted. The results show that a very significant microbial population shift occurred in both aerobic-aerobic and aerobicanerobic operation. Neither aerobic-aerobic nor aerobic-anaerobic operation had a negative impact on sludge activity. The COD/DOC ratio stayed constant during the aerobic-anaerobic operation, which indicated that the nature of the metabolic products was not affected in this operation. Metabolic products of the anaerobic cycle were easily biodegradable under aerobic conditions. This was not the case with the aerobic-aerobic operation. Sludge activity was slightly higher at the end of aerobic-anaerobic operation than at the beginning. Aerobic-anaerobic operation was superior to aerobic-aerobic operation. (Baker-IVI)
W85-03869

RAPID AEROBIC BIOSTABILIZATION OF HIGH-STRENGTH INDUSTRIAL LANDFILL LEACHATE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
E. S. Venkataramani, and R. C. Ahlert.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, November, 1984. 10 Fig, 2 Tab, 18 Ref. EPA contract CR807805010.

Descriptors: *Wastewater treatment, *Leachates, *Landfills, *Industrial wastewater, Microbial degradation, Wastewater disposal, Groundwater pollution, Organic compounds.

This study was designed to show that an activated sludge biomass can be used to develop microbial populations capable of metabolizing organic compounds found in industrial landfill leachate. The kinetic parameters of the acclimated populations were measured to assess the feasibiliy of removing synthetic organic compounds by aerobic biostabilization. The high-strength complex industrial landfill leachate used in these studies was the aqueous phase of a raw oil/water leachate mixture. The results showed that a mixed microbial population, acclimated to leachate, degraded about 80% of the organic species in the industrial landfill leachate, in the presence or absence of glucose and other nutrients. There is strong evidence that organic matter present in the leachate was oxidized to carbon dioxide and water. Loss of dissolved organic carbon is not from stripping, evaporation, or sorption. Removal of the organic matter took place over 14 to 70 hours. The remaining organic carbon, about 20% of the original concentrations, can be removed by physical-chemical treatment processes. (Baker-IVI)
W85-03870

BENTHAL STABILIZATION OF ORGANIC CARBON AND NITROGEN: THE DEVELOPMENT OF INTERSTITIAL PROFILES,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
C. W. Bryant, and L. G. Rich.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1199-1203, November, 1984. 6 Fig, 3 Tab, 26 Ref.

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Descriptors: *Wastewater treatment, *Activated sludge process, Anaerobic conditions, Benthic environment, Methanogenesis, Carbon, Nitrogen, Ammonia.

Attempts were made to measure depth profiles of major interstitial carbon and nitrogen species in a set of consolidating deposits of waste activated sludge (WAS) solids; determine the solubilization rate of WAS solids under anaerobic conditions; and estimate the stoichiometry of the acid formation step of the stabilization process. The study demonstrated that a benthal mechanism significantly reduces the quantity of dissolved ammonia released during solids stabilization. Further study is needed to determine whether inhibition of protein deamination or time-dependent ammonia adsorption by organic solids explains the phenomenon. For the benthal stabilization of organic carbon and nitrogen in biomass solids, the rate limiting step is most likely cell death and lysis. The measured rate of 0.07/day was below the average of the range of values for solids decay in previous anaerobic digestion research. Batch stoichiometric measurements indicated that lipid material was not solubilized prior to acetate methanogenesis. (Baker-IVI)
W85-03873

RECOVERY OF ACID FROM WASTEWATER BY ELECTRODIALYSIS,
Yokohama National Univ. (Japan).
K. Urano, T. Ase, and Y. Naito.
Desalination, Vol. 51, No. 2, p 213-226, August, 1984. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Electrodialysis, *Acid recovery, *Wastewater treatment, Membrane processes, Iron, Membranes, Industrial wastes, Steel industry.

The optimum operating conditions for electrodialysis using a newly developed membrane were studied for recovery of acid from acidic wastewater released from the iron and steel industry. By using this anion-exchange membrane with a very small transport number for hydrogen ion, the acid can be efficiently concentrated by electrodialysis. Changes of limiting electric current density and current efficiency of the electrodialysis with operating conditions were investigated to determine the optimum operating conditions. Fouling of the cation exchange membrane with coexisting iron (II and III) ions was also investigated. Calculations for the plant design and the cost estimate were attempted from the experimental results obtained. (Baker-IVI)
W85-03977

WATER QUALITY MANAGEMENT IN THE CHEMICAL INDUSTRY - BASF'S LUDWIGSHAFEN COMPLEX AS AN EXAMPLE - INVESTIGATIONS, DESIGN, OPERATION,
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
H. Engelhardt, W. G. Haltrich, and W. Weisbrodt.
Water Science and Technology, Vol. 16, No. 12, p 583-608, 1984. 17 Fig, 2 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Ludwigshafen, *Germany (Federal Republic), Chemical industry, Denitrification, Aeration, Water quality control.

The BASF works at Ludwigshafen (Federal Republic of Germany) is the largest integrated chemical complex in Europe. Through a reorganization of its wastewater management the complex has achieved a reduction of the substance load discharged to the Rhine by about 98% in terms of BOD5 and by about 94% for COD and TOC. The treatment system developed according to tests in pilot plant operations includes high rate primary sedimentation to avoid activated sludge with poor settling properties, followed by an aeration stage in form of a circular basin according to the carousel system, followed by a denitrification zone of variable volume. The sludge volume index is 50 ml/g. In spite of varying nitrate concentrations the denitrification is working without problems. In the central treatment plant BOD5 is degraded by 96%, COD as well as TOC by about 80-85%, while nitrate is eliminated by 95%. There are numerous decentralized measures regarding the treatment of concentrated wastewaters or waters containing poorly degradable substances like halogenated hydrocarbons and heavy metal compounds. (Baker-IVI)
W85-04008

SEWAGE TREATMENT IN ABU DHABI,
Taylor (John) and Sons, London (England).
P. N. Paul, and L. J. Smith.
Water Science and Technology, Vol. 16, No. 12, p 609-620, 1984. 3 Tab.

Descriptors: *Wastewater treatment, *Abu Dhabi, Activated sludge process, Sulfides, Nitrification, Alkalinity, Biological wastewater treatment, Oxygen demand.

The first sewerage and sewage treatment facilities to serve the City of Abu Dhabi were commissioned in 1973. The history of sewage treatment in Abu Dhabi since 1973 is briefly reviewed. Per capita sewage flow is approximately 280 l/d, BOD is 63 g/d and suspended solids, 55 g/d. Full nitrification resulted in a reduction in alkalinity from 300 mg/l to 46 mg/l as calcium carbonate and a fall in pH from 7.6 to 7.1. After chlorination with a dose of 5 mg/l chloride, alkalinity reduced further to 27 mg/l and pH to 6.8. With pre-seeding of the aeration tanks to establish nitrifying organisms the new sewage treatment works produced a fully nitrified effluent within 10 days of receiving crude sewage flows. High sulfide concentrations in the crude sewage had no adverse effects on biological treatment or the attainment of nitrification. The interpretation of oxygen demand data for Middle East sewages requires further study. (Baker-IVI)
W85-04009

OCCURRENCE AND DISTRIBUTION OF PERSISTENT ORGANOCHLORINE COMPOUNDS IN U.K. SEWAGE SLUDGES,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
A. E. McIntyre, and J. N. Lester.
Water, Air, and Soil Pollution, Vol. 23, No. 4, p 397-415, November, 1984. 8 Fig, 3 Tab, 48 Ref.

Descriptors: *Pollutant identification, *Sludge, *Organochlorine compounds, *United Kingdom, Aldrin, Dieldrin, Polychlorinated biphenyls, Insecticides, Hexachlorocyclohexane, Endrin, Wastewater.

A total of 444 sewage sludges, sampled from sewage treatment works in the United Kingdom were analyzed for polychlorinated biphenyls (PCB) and the organochlorine insecticides gamma-hexachlorocyclohexane, aldrin, dieldrin, and endrin. PCB, gamma-HCH and dieldrin occurred more frequently and at higher concentrations than aldrin and endrin. Three sewage treatment works were sampled at monthly intervals over an 18 mo period. PCB, gamma-HCH and dieldrin were against most frequently detected. Aldrin and endrin were sporadically detected. In a number of cases, the occurrence of these elevated concentrations may be related to known industrial uses of certain compounds such as dieldrin for mothproofing in the textile industry. It appears that a significant proportion of persistent organochlorine residues in raw sewage and subsequently sewage sludges may arise from domestic uses and human excretion. The findings indicate the concentrations of persistent organochlorine residues in sludge from the United Kingdom are generally comparable with the ranges in concentration reported from surveys in other countries. (Baker-IVI)
W85-04012

POLISHING TREATMENT OF COAL LIQUEFACTION WASTEWATERS,
Oak Ridge National Lab., TN.
C. H. Brown, Jr., M. T. Harris, and R. D. Roop.
Environmental Progress, Vol. 3, No. 4, p 228-237, November, 1984. 9 Fig, 9 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Coal liquefaction, Industrial wastewaters, Ozonation, Reverse osmosis, Activated carbon, Adsorption, Pilot plants.

A detailed description is offered of a mobile wastewater treatment pilot plant with application to actual coal liquefaction wastewaters. Treatability studies were performed on the wastewater streams using the unit processes of carbon adsorption, ozonation, and reverse osmosis (RO) which were contained in the transportable unit. Carbon adsorption treatment of the equalization basin wastewater was performed using regenerated Darco activated carbon. Results of the ozonation tests indicated that 14% of total organic carbon and 3% of chemical oxygen demand can be removed from the equalization basin water by air-stripping in 30 min. A spiral wound cellulose acetate RO membrane was tested on equilization basin water both before and after carbon adsorption treatment and on water from a clarifier. A hollow-fiber cellulose acetate module was tested on carbon adsorption treated equalization basin wastewater. Operation of both units on carbon adsorption effluent was satisfactory at feed recoveries up to 75%, with a total dissolved solids rejection of about 92% and a total organic carbon rejection of 72 to 86%. Chemical analysis of the cleaning solutions and microscopic inspection of the membrane surface indicate that a wide variety of inorganic constituents are deposited on the membrane. (Baker-IVI)
W85-04036

BENCH-SCALE TREATMENT OF LURGI GASIFIER AND H-COAL WASTEWATERS BY THE PACT SYSTEM,
Zimpro, Inc., Rothschild, WI.
T. L. Randall, P. J. Canney, C. L. Berndt, R. M. Rollins, and C. L. Soukup.
Environmental Progress, Vol. 3, No. 4, p 237-247, November, 1984. 9 Fig, 11 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Coal gasification, *Industrial wastewaters, Coal gasification, Economic factors, Synfuel production, Nitrification.

A progress report is offered on the continuing effort to develop a cost-effective process for the production of synfuels by the coal-gasification route. The PACT system consistently nitrified the wastes in both single and two stage flow schemes, providing effluent ammonia-nitrogen concentrations less than 1.0 mg/liter. The two stage PACT systems demonstrated the best overall removal of total organic compounds and should be considered where total organic removal is required for wastewater reuse. Stress testing performed on the H-Coal sour water verified that treatment with the PACT system provides continuous, reliable treatment resistant to synfuels production facility upset or process failures. Following each stress test, the PACT system returned to optimum treatment within 2 to 4 days. (Baker-IVI)
W85-04037

BIOOXIDATION OF COAL GASIFICATION WASTEWATERS,
Oak Ridge National Lab., TN.
T. L. Donaldson, G. W. Strandberg, J. D. Hewitt, and G. S. Shields.
Environmental Progress, Vol. 3, No. 4, p 248-253, November, 1984. 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Coal gasification, *Biological wastewater treatment, *Industrial wastewater, *Biooxidation, Fluidized beds, Ammonia, Suspended solids, Synfuel production, Phenols.

Fixed-film, fludized bed bioreactors have been used successfully to treat dilute synthetic wastewaters on a continuous basis for more than 1 year and dilute actual wastewaters for 9 months. The bioreactors have exhibited stable biological activity, and no difficult operational problems have been encountered. Effluent phenol concentrations of less than 0.001 kg/cubic m are readily achievable in lab scale bioreactors with a synthetic wastewater containing 0.03-0.04 kg/cu m of phenol at a hydraulic residence time of approximately 240 s in the bed. Dilute actual wastewaters have been treated successfully. Volumetric reaction rates in the reactors are substantially higher than those in suspended growth systems due to the high concentration of retained cells on the support particles.

Lab scale activated sludge systems with sludge recycle may exhibit volumetric phenol removal rates of 5-6 kg/cu m/day, whereas current studies have shown potential for ten fold higher rates in fixed-film fluidized bed bioreactors under favorable operating conditions. (Baker-IVI)
W85-04038

INITIAL OPERATING EXPERIENCES OF A NUTRIENT REMOVAL PROCESS (MODIFIED BARDENPHO) AT KELOWNA, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
W. K. Oldham, and G. M. Stevens.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 474-479, September, 1984. 6 Fig, 2 Tab, 1 Ref.

Descriptors: *Kelowna, *British Columbia, *Wastewater treatment, *Bardenpho system, *Nitrogen removal, *Phosphorus removal, Biological treatment, Biological wastewater treatment, Advanced wastewater treatment.

The new Kelowna Pollution Control Center was designed to operate in the 'Modified Bardenpho' or 'Phorex' mode to achieve biological removal of nitrogen and phosphorus. The 260 L/s facility (130 L/s in each of two parallel modules) required two months of operating time (single module operation) to establish the nitrification-denitrification capabilities and to build up the phosphorus release-uptake mechanism in the biomass. Subsequent to that start-up period, the process has been capable of producing an effluent containing less than 5 mg/L of nitrogen and 6 mg/L total nitrogen and less than 0.3 mg/L orthophosphate when the influent sewage has contained some 30 mg/L of nitrogen and 6 mg/L of phosphorus. The process flow pattern was subsequently changed from single-module operation to dual-module operation. (Collier-IVI)
W85-04045

COLD CLIMATE FACULTATIVE LAGOONS,
Alaska Univ., Fairbanks. Dept. of Engineering.
T. Tilsworth, and D. W. Smith.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 542-555, September, 1984. 2 Fig, 4 Tab, 72 Ref.

Descriptors: *Wastewater treatment, *Wastewater lagoons, *Sludge lagoons, *Lagoons, *Arctic zone, *Subarctic zone, Climatic zones, Ice cover, Design criteria, Rural areas.

Facultative wastewater lagoons are of great importance to small communities of Alaska and northern Canada; they have been one of the principal methods of sewage treatment in these cold climate areas. Because of permafrost, the absence of electrical power, average annual temperatures as low as -12 C (10 F), the lack of skilled manpower, and other operating restrictions, lagoons can be of strategic importance to water quality protection in these locations. These lagoons have been popular for use in rural areas because of their relatively low cost, minimal operation and maintainance requirements, and energy efficiency. They are also advantagous where large land areas are available and where seasonal odor problems are not considered a nuisance. However, the performance of these lagoons varies seasonally. Design engineers face almost formidable constraints when attempting to produce 'secondary' effluents for these communities. The use of 'southern' technology may not be applicable under arctic-subarctic conditions and even if it is applicable it must be used with considerable reservation. Ice and snow cover prevents or reduces light penetration and thus severely inhibits photosynthesis; ice depth is a function of the wastewater temperature, location, and exposure. When applicable, lagoons should be operated as long-retention cells so that they can be drained in late spring or early fall. Design of lagoon and pond systems can be modified greatly by the type of environment that will receive the effluent. For streams and rivers, the dilution factor is of major importance. Land treatment has limited value in the arctic-subarctic due to permafrost and seasonally frozen soils. The receiving environment and the retention time are the most important factors in the design process. (Collier-IVI)
W85-04048

BACTERIAL REMOVAL OF MERCURY FROM SEWAGE,
Ohio State Univ., Columbus. Coll. of Pharmacy.
C. L. Hansen, G. Zwolinski, D. Martin, and J. W. Williams.
Biotechnology and Bioengineering, Vol. 26, No. 11, p 1330-1333, November, 1984. 2 Fig, 2 Tab, 13 Ref. NIH grant ES02701.

Descriptors: *Bacteria, *Mercury, *Wastewater treatment, Aerobic conditions, Bioreactors, Biological treatment, Heavy metals.

Mercury-resistant bacteria, which are able to reduce mercuric ion ($Hg(2+)$) to metallic mercury ($Hg(0)$), were examined for their ability to remove mercury from wastewater aerobically. Growth studies in artifical medium indicated that mercury increases the lag phase, but does not effect the growth rate of these bacteria. Further studies demonstrated that growth was minimal during a phase of rapid mercury removal, after which growth resumed. Small but significant amounts of carbohydrates are required for the mercuric ion reduction. Prolonged periods of bacterial growth under nonsterile conditions was accomplished without the loss of the mercuric reducing ability of the culture. A continuous culture of the resistant organism was maintained on raw sewage for two weeks, during which time relatively high concentrations of mercury (70 mg/L) were removed from the sewage at a rate of 2.5 mg/L and at efficiencies exceeding 98%. (Author's abstract)
W85-04114

PROBLEM OF DECONTAMINATION OF WASTEWATERS OF LIVESTOCK COMPLEXES AND POSSIBLE WAYS OF SOLVING IT,
N. V. Morozov.
Water Resources, Vol. 10, No. 5, p 501-510, September-October, 1983. 44 Ref. Translated from Vodnye Resursy, No. 5, p 142-152, September-October, 1983.

Descriptors: *Wastewater treatment, *Livestock, *Farm wastes, Decontamination, Water pollution control, Bacteria, Viruses, Parasites, Manure, Biological wastewater treatment, Aquatic plants.

The problem of decontaminating wastewaters of livestock complexes is becoming especially acute in connection with the conversion of livestock farming to an industrial basis. The wastewaters of livestock complexes represent a highly concentrated mixture consisting of coarsely and finely dispersed admixtures, dissolved compounds, and water. About 50% of the microflora is made up of pathogenic species. Helminths, viruses, and protozoa are also identified in wastewaters of livestock complexes. The technological scheme of treating these wastewaters usually calls for the accumulation and settling of wastes in various liquid manure tanks and storages. At modern large complexes the livestock wastewaters after hydraulic removal via a gravity flow collector drain are fed to a grate and then are collected in the tank of the sewage pumping station where they are agitated by continuous bubbling with air until a homogeneous mass is obtained and then fed to a system of settling tanks for separation into fractions. A new method has been proposed for treating and disinfecting wastewaters of livestock complexes, which consists in holding them a little more than 2 weeks in biological ponds in contact with microalgae and higher aquatic plants. The experience of constructing and operating biological ponds with the introduction of aquatic plants shows that they can be constructed at farms and complexes wherever there are low areas, ravines, brooks, streams, etc. The body of the dam can be earth with one or two outlets, an upper siphon type and a bottom one for releasing waters in emergency situations and passage of the spring flood. (Baker-IVI)
W85-04139

OPTIMIZATION OF THE HYDROBOTANIC METHOD OF WASTEWATER TREATMENT TO REMOVE AROMATIC AMINES BY MATHEMATICAL EXPERIMENTAL DESIGN METHODS,
N. F. Kashina, S. S. Timofeeva, L. N. Ezhova, and O. M. Kozhova.
Water Resources, Vol. 10, No. 5, p 511-518, September-October, 1983. 3 Tab, 9 Ref. Translated from Vodnye Resursy, No. 5, p 153-160, September-October, 1983.

Descriptors: *Biological wastewater treatment, *Optmization, *Aromatic amines, Mathematical models, Nitella, Aquatic plants, Organic compounds, Wastewater treatment.

Investigations were carried out to determine the optimal conditions for removal of the aromatic amine benzidine from water using the stonewort (Nitella sp.). A model is presented which can be used for calculating the degree of purification of water for given values of the factors benzidine concentration, algal biomass, temperature, and time of purification, and makes it possible to predict the removal of benzidine from water in the presence of charophytes. The use of the mathematical experimental design method enables the investigators to find the optimal conditions of biodegradation of benzidine by charophytes and to construct a sufficient mathematical model, which can be used when obtaining initial data for designing hydrobotanic treatment plants with an optimal operating regime. (Baker-IVI)
W85-04140

CREATION OF CLOSED WATER MANAGEMENT SYSTEMS AT INDUSTRIAL ENTERPRISES,
Yu. P. Belichenko, and T. L. Dolgopolova.
Water Resources, Vol. 10, No. 5, p 519-524, September-October, 1983. 1 Fig, 6 Tab, Translated from Vodnye Resursy, No. 5, p 161-166, September-October, 1983.

Descriptors: *Water management, *Wastewater treatment, *Water reuse, Industrial wastewater, Water supply,.

A decrease in the discharge of various pollutants with wastewaters into surface waters can be achieved by developing and introducing closed water-management systems. The need and expediency of creating closed industrial water-supply systems are governed by three main factors: water shortage; exhaustion of the assimilating capacity of surface waters, which actually are wastewater receivers; and economic advantages over once-through water-supply systems with treatment of wastewaters to specifications governed by the requirements of the state water inspectorate. In practice the development of closed water-management systems of industrial enterprises can proceed in stages, with the gradual increase of the proportion of water being recycled. The initial stage in the creation of such systems should be the development of scientifically founded requirements imposed on the quality of water being used in all technological processes and operations. The overwhelming majority of technological operations does not require water of drinking quality. At the same time, it is necessary to determine those water indices which have a decisive effect on the quality of the product being obtained and their allowance limits. This will make it possible to create rational, scientifically founded water reuse systems. (Baker-IVI)
W85-04141

COURT-APPOINTED SPECIAL MASTERS IN COMPLEX ENVIRONMENTAL LITIGATION: CITY OF QUINCY V. METROPOLITAN DISTRICT COMMISSION,
For primary bibliographic entry see Field 6E.
W85-04182

FEASIBILITY OF RECIRCULATING BOTTOM ASH TRANSPORT WATER IN COAL-FUELED POWER GENERATING STATIONS.
Environmental Protection Service, Ottawa (Ontario).

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Available from Environmental Protection Service, Ottawa, Ontario K1A 1CB. Economic and Technical Review Report EPS 3-WP-83-1, February, 1983. 167 p, 41 Fig, 34 Tab, 51 Ref, 1 Append.

Descriptors: *Recirculated water, *Mine wastes, *Coal, Electric powerplants, Powerplants, Chemical properties, Hydraulics, Water reuse.

The technical feasibility of recirculating the water to transport bottom ash in coal-fire steam electric generating stations was examined. Information was gathered from the literature, from generating stations, and from manufacturers of ash handling systems. Successful design and operation of completely recirculating water systems for bottom ash transport must take into account both hydraulic and chemical considerations. To prevent discharge of ash sluice water for hydraulic reasons, there must be no continuing net accumulation of water in the ash system. The total water inputs from in-plant wastes, precipitation, runoff, and fresh water used around the bottom ash system must be balanced by water losses due to occlusion with the bottom ash, evaporation and re-use of excess transport water for other plant services. Hydraulically, zero discharge from recirculating bottom ash transport systems can be achieved by limiting makeup water to the 1 to 2% normal water loss from the system. The chemical characteristics of the bottom ash transport water are related to intake water quality, method of coal combustion, and the chemical properties of the bottom ash. In actual operating systems the abrasive nature of bottom ash slurry tends to erode scale which begins to accumulate on the sluice side of the recycle systems. The chemical characteristics of the wash water do not present an obstacle to complete recirculation except in special circumstances.
W85-04197

MANUAL FOR LAND APPLICATION OF TREATED MUNICIPAL WASTEWATER AND SLUDGE,
Environmental Protection Service, Ottawa (Ontario). Environmental Protection Programs Directorate.
S. A. Black, D. N. Graveland, W. Nicholaichuk, D. W. Smith, and R. S. Tobin.
Manual EPS 6-EP-84-1, March, 1984. p 216, 29 Fig, 70 Tab, 142 Ref, 4 Append.

Descriptors: *Waste disposal, *Municipal wastewater, *Land disposal, *Sludge, *Wastewater disposal, *Sludge disposal, *Wastewater irrigation, *Public health, Wastewater treatment, Wastes, Legal apects, Social aspects, Solid wastes, Reviews, Canada, Pathogens, Environmental effects, Land reclamation, Landfills, Wastewater renovation, Risks, Benefits, Site selection, Water pollution control.

This manual provides basic information for individuals and organizations interested in the application of treated municipal wastewater and sludge to land. The manual addresses the technical concerns associated with treatment, transport, spreading, agronomics and health. It also discusses legal, social and economic concerns and the need to obtain a clear indication of potential benefits and risks. Mechanical and non-mechanical wastewater and sludge treatment systems are outlined along with current disposal practices for treated municipal wastewater and sludge in Canada. When selecting the site for land disposal, soil composition, texture, structure, infiltration and permeability, water retention and movement, and chemical and biological properties should be considered. The public health risks presented by organic chemical contaminants and pathogenic organisms in municipal wastes and methods to minimize them in landfills are discussed. The benefits and risks of crop production in association with land application of treated municipal wastewater and sludge are presented. The utilization and land disposal options for municipal wastewater and sludge are outlined. Appendices on provincial agencies involved in land application, irrigation water quality criteria, representative land application sites in Canada, and case studies of land reclamation and wastewater irrigation projects are included.
W85-04213

STATE-OF-THE-ART OF THE PULP AND PAPER INDUSTRY AND ITS ENVIRONMENT PROTECTION PRACTICES,
Environmental Protection Service, Ottawa (Ontario).
N. McCubbin.
Available from Environment Canada, Environmental Protection Service, Ottawa K1A 1C8. Economic and Technical Review Report EPS 3-EP-84-2, January, 1984. 128 p, 24 Fig, 18 Tab, 104 Ref.

Descriptors: *Pulp and paper industry, *Environmental protection, Effluents, Solid wastes, Solid waste disposal, Cost analysis, Water pollution control.

The current technology for environmental protection used in the Canadian pulp and paper industry is reviewed. Recent process and equipment developments having a significant effect on the industry's effluents, atmospheric emissions and solid waste discharges from a mill operation depend on the processes used, the operating practices, the equipment and the production rate. However, typical effluents, prior to any external treatment, from bleached kraft pulp mills and newprint mills, revealed the following data: 1) older mill flow (cubic m/t)=202; 2) older mill SS (kg/t)=150; 3) older mill BOD (kg/t)=115; 4) maximum in-plant control flow (cubic m/t)=44; 5) maximum in-plant control SS (kg/t)=8; and 6) maximum in-plant control BOD (kg/t)=17.2. Drawings, flowsheets, and typical process criteria are presented. The capital costs (dollars/daily tonne product) are approximately equal to 288,000, with direct operating costs (dollars/tonne) approximately equalling 23. These costs were based on the mid 1970's proven technology, and it is probable that actual costs could be reduced in 1983 by the application of in-plant technology that has been developed in recent years. Further implications of cost, energy conservation and environmental measures are briefly discussed.
W85-04232

PROCEEDINGS OF THE 1983 ANNUAL MEETING OF THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY.
Technical Association of the Pulp and Paper Industry, Atlanta, GA.
March 2-4, 1983. 362 p.

Descriptors: *Pulp and paper industry, Environmental policy, Wastewater treatment, Acid rain, Forests, Water pollution control.

The Proceedings of the 1983 Annual Meeting of the Technical Association of the Pulp and Paper Industry included: an opening session and management perspectives, steady-state simulation, high impact pulping conference papers, local section awards papers, case histories of 3 power plant energy management systems, millwide process control, paper manufacture, pulping, process developments, high impact paper finishing and converting conference papers, dynamic simulation, paper manufacture II, fiber raw material supply, environmental issues from a management perspective (panel discussion), acid rain and the effects on the forest, and advanced distributed process control systems. The conference was held at the Georgia World Congress Center, Atlanta, Georgia.
W85-04233

DESIGN, START-UP AND OPERATION OF A LOW PRESSURE WET AIR SLUDGE OXIDATION UNIT,
Weyerhaeuser Co., Rothschild, WI.
S. M. List.
In: Proceedings of the 1983 Annual Meeting of the Technical Association of the Pulp and Paper Industry, Atlanta, GA, March, 2-4. p 71-80, 5 Fig, 6 Tab.

Descriptors: *Sludge, *Pulp and paper industry, Wastewater, Dewatering, Landfills, Cost analysis, Activated sludge, Thermal sludge conditioning, Leachates, Wastewater treatment, Water pollution control.

The first application of low pressure Wet Air Oxidation (Thermal Sludge Conditioning) in the pulp and paper industry has yielded economical and operational improvements at the Weyerhaeuser, Rothschild, Wisconsin mill. Savings in sludge conditioning dewatering and landfilling costs are being realized in comparison to the formerly employed polymer conditioning operation. The mill is a 280 TPD pulp and paper operation producing offset printing, packaging, coating base and wax grade papers. The wastewater treatment facility employs a 38,000 cu m/d (10 MGD) activated sludge treatment system and Thermal Sludge Conditioning followed by belt press dewatering. Currently, the dewatered thermally conditioned waste activated sludge is disposed of in a county operated landfill. The 11 l/s (175 GPM) thermal conditioning unit processes a 4.4 percent sludge slurry with a volatile fraction of 66.5 percent. The conditioned sludge is then thickened to roughly 16 percent solids and dewatered on belt presses to a cake of between 38 and 42 percent solids, accomplishing a 97 percent solids capture with minimal polymer addition. Total system availability is roughly 80 percent. Since start up of the system, the sludge volume to disposal has been reduced by 60 to 70 percent with the number of truck loads per day decreasing from 16 to 5. Cake solids contents have increased to 40 to 42 percent from the 20 percent level obtained with polymer conditioned sludge. Additional advantages of the new system include reduced leachate production at the landfill site and reduced ammonia requirement at the wastewater treatment facility.
W85-04234

PRELIMINARY STUDIES ON TREATMENT OF CHROMIUM TANNERY WASTE SLUDGE BY ANAEROBIC DIGESTION,
Himeji Inst. of Tech. (Japan). Dept. of Applied Chemistry.
Y. Maeda, Y. Shoji, A. Yoneda, and T. Azumi.
Journal of Fermentation Technology, Vol. 62, No. 5, p 421-427, 1984. 5 Fig, 4 Tab, 18 Ref.

Descriptors: *Anaerobic digestion, *Tannery wastes, *Chromium, *Sludge treatment, Biological wastewater treatment, Ammonia, Industrial wastewater, Sulfite, Sulfide, Ferric chloride, Hydrogen sulfide.

In order to gain information on the digestibility of tannery waste sludge containing chromium, the effects of ammonia, chromium, and sulfide on anaerobic digestion were studied using an artificial waste containing gelatin as the organic carbon source. Experiments were conducted on a batch basis in the laboratory. In the tested range of initial concentrations up to 16,000 mg/l as NH4(+), inhibition of anaerobic digestion increased progressively with increasing the ammonia concentration beyond 4,000 mg/l as NH4(+). Cr(VI) was found to be strongly inhibitory at the concentration of 50 mg/l. On the contrary, even at the concentration of 1,000 mg/l, it was not obvious that Cr(III) was inhibitory. Sulfite and sulfide were inhibitory in the range of concentrations from 300 to 5,000 mg/l as S. These inhibitory effects on anaerobic digestion could be relieved by addition of ferric chloride to the digester contents or circulation of digester gas through a hydrogen sulfide absorber. (Author's abstract)
W85-04251

SOME PROPERTIES OF MUCILAGE POLYSACCHARIDES EXTRACTED FROM SEWAGE ACTIVATED SLUDGE,
Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
K. Kakii, T. Shirakashi, and M. Kuriyama.
Journal of Fermentation Technology, Vol. 62, No. 5, p 429-435, 1984. 6 Fig, 3 Tab, 15 Ref.

Descriptors: *Activated sludge, *Mucilage, *Polysaccharides, Sludge, Hydrolysis, Glucuronic acid, Ribonucleic acid, Ribose, Glucose, Galactose, Mannose, Rhamnose, Fucose, Arabinose, Xylose.

Mucilage polysaccharides were hydrolyzed under nitrogen at 100 C for 12-72 h in 0.05 N H2SO4 in the presence of Dowex 50W (H(+) form). Maximal values of released sugars were reached after 48 h, with very little destruction with prolonged hy-

rolysis periods. The following sugars were detect-d and the molar ratio of these sugars to glucose is hown in the parentheses. Glucose (1.00), galactose 1.00), mannose (0.75), rhamnose (0.64), fucose 0.47), arabinose (0.32), xylose (0.25), and glucu-onic acid (0.49). Although ribose was detected as component, it was liberated from ribonucleic cid contained in the mucilage, but not from the olysaccharide fraction. Mucilage polysaccharides vere divided into three fractions by ion exchange hromatography using diethylaminoethyl DEAE)-cellulose. The non-adsorbed fraction oc-upied only 7% of total sugars. 74% of total sugars vas recovered by elution with a linear gradient of NaCl and with 0.1 N NaOH. The remaining 20% vas irreversibly adsorbed to the column, and not ecovered. Gel filtration on Sepharose CL-6B indi-ated that these polysaccharides might have a ma-romolecular structure. From these results, it is oncluded that the mucilage polysaccharides ex-racted from sewage activated sludge are acidic eteropolysaccharides which contain glucuronic cid. (Author's abstract)
W85-04252

BIOLOGICAL PHOSPHORUS RELEASE FROM ACTIVATED SLUDGE OF SLUDGE RECYCLING NITRIFICATION-DENITRIFICATION PROCESS,
Osaka Univ. (Japan). Dept. of Environmental Engineering.
S. Hashimoto, and K. Furukawa.
Journal of Fermentation Technology, Vol. 62, No. 5, p 437-444, 1984. 13 Fig, 2 Tab, 13 Ref.

Descriptors: *Activated sludge, *Phosphorus, *Sludge recycling, *Nitrification, *Denitrification, Anaerobic conditions, Phostrip Process, Sludge retention time, Nitrates.

In order to combine the Phostrip Process and the sludge recycling nitrogen removal process, a study was made of the characteristics of phosphorus release from activated sludge under anaerobic conditions. The phosphorus release from activated sludge occurred after complete denitrification of NO3-N and followed zero order kinetics. The activation energy and Q10 for phosphorus release were determined to be 16.4 kcal/mol and 2.4, respectively. The rate of phosphorus release was highly dependent on sludge retention time (ts). The highest rate of phosphorus release and the highest intracellular phosphorus content were obtained at about ts=5.0 days. (Author's abstract)
W85-04253

SIMULTANEOUS NITROGEN AND PHOSPHORUS REMOVAL BY ANOXIC-AEROBIC HIGH SLUDGE CONCENTRATION ACTIVITED SLUDGE PROCESS,
Osaka Univ. (Japan). Dept. of Environmental Engineering.
S. Hashimoto, and K. Furukawa.
Journal of Fermentation Technology, Vol. 62, No. 5, p 445-452, 1984. 2 Fig, 7 Tab, 13 Ref.

Descriptors: *Activated sludge process, *Phosphorus removal, *Nitrogen removal, Wastewater treatment, Alum, Anaerobic digestion, Aerobic digestion.

In this project, various combinations of the Anoxic-Aerobic High Sludge Concentration Activated Sludge Process (AAHSC-Activated Sludge Process) and phosphorus removal processes were examined. By the addition of alum salts at a molar ratio of 1:2 (Al:P) to the anoxic tank of the AAHSC-Activated Sludge Process, simultaneous removal of nitrogen and phosphorus at efficiencies greater than 80% were achieved. The phosphorus content of the activated sludge was increased slightly by applying anaerobic stress to the anoxic tank of the AAHSC-Activated Sludge Process, and could remove influent phosphorus at an efficiency of 44.3%. The AAHSC-Activated Sludge Process when supplemented by a strict anaerobic tank at the inlet port could remove nitrogen and phosphorus at efficiencies of 88.3% and 55.5%, respectively. By the combination of the AAHSC-activated Sludge Process and anaerobic dephospho-thickener, 80% of influent nitrogen and 63-76% of influent phosphorus were removed effectively over a long term. (Author's abstract)
W85-04254

TECHNIQUE FOR ESTIMATING SLUDGE COMPACTABILITY IN CENTRIFUGAL DEWATERING,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and G. Zhang.
Journal of the Water Pollution Control Federation, Vol. 56, No. 12, p 1231-1237, December, 1984. 7 Fig, 1 Tab, 6 Ref.

Descriptors: *Sludge drying, *Dewatering, *Centrifuges, *Compaction, Sludge, Sludge treatment, Centrifugal force.

The compactivity concept is introduced to describe how well a sludge compacts under centrifugal force. The ability of sludge solids, under centrifugal acceleration, to move throught a fluid can be demonstrated in a simple laboratory centrifuge. Compactivity is defined in terms of centrifugal acceleration in gravities and time in minutes. The concept can be used to characterize sludges prior to the design and purchase of centrifugal dewatering equipment, to compare the relative effectiveness of various centrifuges, and to characterize sludges so that better and more equitable performance guarantees can be written. Various sludges with different conditioners were centrifuged in a laboratory centrifuge. The increase in sludge solids concentration with centrifugal acceleration for a typical mixed digested sludge is shown. Data were also given for sludges of different origins. (Baker-IVI)
W85-04286

USE OF LIME CLARIFICATION AND REVERSE OSMOSIS IN WATER RECLAMATION,
D. R. Argo.
Journal of the Water Pollution Control Federation, Vol. 56, No. 12, p 1238-1246, December, 1984. 6 Fig, 7 Tab, 5 Ref.

Descriptors: *Reverse osmosis, *Clarification, *Lime, *Water reuse, *California, Water supply development, Water demand, Water treatment, Purification, Water quality.

Efforts being made in the Orange County Water District to improve reuse alternatives to enlarge the present water supply are reviewed. Efforts have focused on reducing the cost of producing potable quality water. The lime/reverse osmosis (RO) process is described and compared with the costs of other treatment systems. During the entire operation the lime/RO system provided excellent removals of both inorganic and organic constituents from the feedwater. Average chemical oxygen demand removal was 95%. The system is capable of long-term operation with an average flux rate of 12.7 L/sq m/hr (7.5 gpd/sq ft). Average removal of inorganic and organic constituents was more than 97%. The lime/RO process eliminates air stripping and ammonia removal, recarbonation, mixed media filtration, and activated carbon adsorption/regeneration. Although in southern California, reclaimed wastewater will not provide all the additional water necessary, the costs of development are competitive. (Baker-IVI)
W85-04287

ANAEROBIC ACTIVATED CARBON FILTER FOR THE DEGRADATION OF POLYCYCLIC N-AROMATIC COMPOUNDS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
Y.-T. Wang, M. T. Suidan, and J. T. Pfeffer.
Journal Water Pollution Control Federation, Vol. 56, No. 12, p 1247-1253, December, 1984. 7 Fig, 5 Tab, 17 Ref. DOE contracts DE-AC21-80 MC 14713 and DE-AC21-82 MC 19352.

Descriptors: *Wastewater treatment, *Anaerobic treatment, *Activated carbon, *Aromatic compounds, Nitrogen compounds, Chemical oxygen demand, Organic carbon, Indole, Quinoline, Methylquinoline, Adsorption.

A synthetically prepared polycyclic N-aromatics-bearing wastewater was treated effectively by a completely mixed, expanded-bed granular activated carbon (GAC) anaerobic filter. Steady-state removal efficiencies for COD and dissolved organic carbon (DOC) exceeded 97% and 98%, respectively. The success relied on the removal of the refractory and inhibitive methylquionline by activated carbon adsorption. After 881 days, approximately 40% feed COD was retained on the GAC anaerobic filter and about 52% feed COD was accounted for in the COD equivalent of methane gas. A biochemical methane potential (BMP) test conducted on carbon samples withdrawn from the GAC anaerobic filter confirmed that indole was biodegradable and was converted to methane and carbon dioxide under strict anaerobic conditions. A temporal correlation existed between the methane production decrease and the quinoline removal from the feed solution, and between the methane production increase and the reintroduction of quinoline into the feed solution. The data demonstrate the potential usefulness of the GAC anaerobic filter in treating wastewaters with adsorbable-refractory and inhibitory compounds. Continuous and undisturbed treatment of such wastewaters with the GAC anaerobic filter is possible if a partial GAC replacement schedule is established. Such a schedule should be designed to maintain the effluent concentration of the toxic constituents below a certain threshold. (Baker-IVI)
W85-04288

TREATMENT OF SALINE WASTEWATERS USING A ROTATING BIOLOGICAL CONTACTOR,
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
S. L. Klemetson, and M. E. Lang.
Journal of the Water Pollution Control Federation, Vol. 56, No. 12, p 1254-1259, December, 1984. 7 Fig, 5 Tab, 11 Ref.

Descriptors: *Biological wastewater treatment, *Saline wastewater, *Rotating biological contactor, *Ammonia, Nitrification, Chemical oxygen demand, Specific conductivity, Wastewater treatment.

The possibility that a rotating biological contactor (RBC) could be used to remove ammonia from a synthetic saline wastewater was investigated using a benchscale pilot reactor. The pilot system was fed a synthetic wastewater with sucrose as the limiting carbon source. The influent ammonia concentration was controlled by the amount of ammonium chloride added to the synthetic wastewater. The RBC was monitored at various ammonia loadings in both freshwater and a 10% sea water salt concentration to determine loading rate-removal efficiency relationships. The contactor successfully removed ammonia from both freshwater and 10% sea water simulated wastes. As anticipated, the ammonia removal efficiency decreased with an increase in chloride concentration. The data indicate that to obtain the same effluent ammonia concentration, the influent ammonia load must be lower for a 10% sea water wastes than that for a freshwater waste. Using the data collected in the 10% sea water segment along with a model, it is estimated that the optimal ammonia loading for a RBC system treating a 10% sea water waste with an organic concentration similar to one used in this study is 60 g/100 sq m/d. An RBC can successfully remove ammonia from wastewater with a chloride concentration equal to that of a 10% sea water solution. Additional work is needed with 10% sea water to determine the actual optimum ammonia load, and to verify that nitrification occurs in the system. (Baker-IVI)
W85-04289

COMPLEXATION OF HEAVY METALS BY EXTRACELLULAR POLYMERS IN THE ACTIVATED SLUDGE PROCESS,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
T. Rudd, R. M. Sterritt, and J. N. Lester.
Journal of the Water Pollution Control Federation, Vol. 56, No. 12, p 1260-1268, December, 1984. 6 Fig, 4 Tab, 39 Ref.

LIBRARY OF THE URBANA-CHAMPAIGN

Descriptors: *Activated sludge process, *Heavy metals, *Complexation, *Polymers, Wastewater treatment, Chemical reactions, Cadmium, Copper, Nickel, Cobalt.

Attempts were made to quantify metal binding to polymers in terms of complex strength and concentration, to evaluate the extent extracellular polymers in situ contribute to the overall metal uptake capacity of the intact activated sludge floc, and to examine the relationship between these phenomena and the biological control of the activated sludge process. Of the four metals studied, copper was most strongly bound by activated sludge flocs, followed by cadmium, cobalt, and nickel. Although conditional stability constants for metal-polymer complexes were less easily determined, the polymer showed a similar order of affinity. The complexation of Cu and Cd was controlled by two distinct types of binding site, but there probably was only one important binding site on the extracellular polymer for Co. The complexation capacities and conditional stability constants determined for both the extracted extracellular polymer and the intact activated sludge flocs were similar, an indication that extracellular polymer is a significant factor in metal uptake by activated sludge. The complexation parameters of activated sludge and extracellular polymer were not greatly influenced by sludge age, but sludge age may influence metal removal indirectly by its effects on the relative proportion of soluble polymer forms. There was a proportional relationship between the overall affinities of the sludge and the polymer and heavy metal uptake by each in the activated sludge process. (Baker-IVI)
W85-04290

SINGLE SLUDGE NITROGEN REMOVAL IN AN OXIDATION DITCH,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
Y. Argaman.
Water Research, Vol. 18, No. 12, p 1493-1500, 1984. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Oxidation ditch, *Wastewater treatment, *Single-sludge system, *Nitrogen removal, Biological wastewater treatment, Nitrification, Denitrification, Industrial wastewater, Aeration, Anaerobic conditions.

The single-sludge system for biological removal of nitrogen is based on alternating exposure of the wastewater to aerobic and anoxic environments. Activated sludge systems of the oxidation ditch configuration are uniquely suitable for the single-sludge nitrification and denitrification process. This is due to the high recycle flow generated by the aeration system. Existing systems, originally designed for carbonaceous organic removal and nitrification, can be modified to the single-sludge nitrogen removal process. This is achieved through the control of oxygen supply, creating anoxic zones in parts of the aeration basin. A full-scale industrial plant is decribed to illustrate the successful application of these principles. Calculations suggest that the system should be capable of operating in the single-sludge nitrogen removal mode. The plant was capable of complete BOD removal and nitrification as evidenced by the very low concentrations of BOD and ammonia nitrogen in the effluent. Due to denitrification in the anoxic zone over 90% nitrogen removal was achieved. The effluent nitrate nitrogen ranged from 10 to 20 mg/l. The system's anoxic capacity may be the limiting factor. This can be attributed to excess oxygen, reduced rate of denitrification due to low BOD, or a combination of both. (Moore-IVI)
W85-04296

LYSIS AS A FACTOR IN SLUDGE FLOCCULATION,
University Coll., Dublin (Ireland). Dept. of Industrial Microbiology.
J. K. Vallom, and A. J. McLoughlin.
Water Research, Vol. 18, No. 12, p 1523-1528, 1984. 3 Fig, 1 Tab, 25 Ref.

Descriptors: *Lysis, *Activated sludge process, *Flocculation, Polymers, DNA, Nucleic acids, Bacteria, Exopolymers.

A tentative relationship was established between the levels of extractable exopolymers and flocculation in activated sludge growing on a carbon limited system. Deflocculation occurred in the logarithmic growth phase and flocculation predominated in the endogenous phase. There appeared to be a relationship between lysis of sludge and flocculation, as a decrease in cell dry weight accompanied by the release of polymers, e.g. nucleic acids, resulted in an increase in flocculation. This relationship was further investigated using selected components released on lysis, i.e. DNA, which was shown to promote significant levels of flocculation when added to various microbial systems - a significant increase in the rate of flocculation in the case of addition to sludge and in increase in the rate and degree of flocculation when added to individual bacterial cultures. Thus DNA can act as a floc agent and can also survive breakdown or depolymerization. Thus polymers released on lysis of cells can enhance flocculation. (Author's abstract)
W85-04299

ECOLOGICAL STUDY OF ACTIVATED SLUDGE SETTLING PROPERTY IN THE COMPLETELY MIXED SYSTEM,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, S. L. Arnold, and K. C. Ou.
Water Research, Vol. 18, No. 12, p 1535-1543, 1984. 11 Fig, 2 Tab, 18 Ref. NSF grant ENG76-10437.

Descriptors: *Sludge bulking, *Activated sludge process, *Sludge settling, Organic loading, Wastewater treatment, Filaments, Microorganisms, Flocculation, Nitrogen.

One of the difficulties encountered in the operation of the activated sludge process is connected with the phenomenon of sludge bulking. Due to severe sludge bulking, a loss of active biomass over the effluent air of the secondary clarifier can take place. The bulking problem associated with both nitrogen-rich and nitrogen-deficient activated sludges was thoroughly investigated under a dissolved oxygen (DO) sufficient condition in the completely-mixed continuous flow system. The reactor temperature was controlled at 27 +/- 1 C and the pH was maintained at nearly equal to 7.0. Under the DO-sufficient condition, the settling properties of both nitrogen-rich and nitrogen-restricted activated sludges depended highly upon the organic loading. The poor settling property of the activated sludge primarily resulted from the overproduction of long-length filamentous microorganisms and the occurrence of dispersed growth at high organic loading condition and the production of fragile weak flocs at low organic loading condition. Balanced growth of zoogleal microorganisms and short-length attached filaments was beneficial to the interparticle bridging and bioflocculation. The settling property of nitrogen-rich activated sludge deteriorated due to the increase in cell protein content and surface charge. Heavy surface accumulation of extracellualr carbohydrate-like substances that occurred under a severe nitrogen limitation and a high organic loading could improve the settling characteristics of the activated sludge. Generally the concentration of suspended solids remaining in the system effluent was low when the settling property of the activated sludge was high. Control of sludge bulking seems possible if the effect of nutrient and operating conditions on filamentous growth is understood. (Moore-IVI)
W85-04301

MODE OF ACTION OF CHLORINE DIOXIDE ON ORGANIC COMPOUNDS IN AN AQUEOUS MEDIUM; CHLORINE DIOXIDE CONSUMPTION AND REACTIONS ON PHENOLIC COMPOUNDS (MODE D'ACTION DU BIOXYDE DE CHLORE SUR LES COMPOSES ORGANIQUES EN MILIEU AQUEUX; CONSOMMATIONS DE BIOXYDE DE CHLORE ET REACTIONS SUR LES COMPOSES PHENOLIQUES),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5F.
W85-04302

EFFECT OF SETTLING ON PERFORMANCE OF THE UPFLOW ANAEROBIC SLUDGE BED REACTORS,
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
M. F. Hamoda, and L. van den Berg.
Water Research, Vol. 18, No. 12, p 1561-1567, 1984. 6 Fig, 5 Tab, 6 Ref.

Descriptors: *Upflow anaerobic sludge bed, *Settling, *Wastewater treatment, Industrial wastewaters, Food-processing wastewater, Sludge.

The effects of settler volume on the start-up and steady-state performance of 4 liter laboratory upflow sludge bed reactors treating bean blanching waste of 10,000 mg COD/l were determined. The rate of start-up, as well as the maximum loading rate, increased with increased settler volume and performance. A loading rate of 30 kg COD/cu m/day (based on reactor volume alone) and a COD removal of 95% was obtained with a 2 liter settling flask and a 4 to 1 recirculation rate. Without a settler, the maximum loading rate was 10 kg COD/cu m/day. The sludge was flocculent rather than granular. Sludge profiles and characteristics in the reactors and settlers were determined. (Author's abstract)
W85-04303

CAUSE OF CONTINUED HYPOLIMNETIC ANOXIA IN LONG LAKE, WA, FOLLOWING ADVANCED WASTEWATER TREATMENT BY THE CITY OF SPOKANE,
Eastern Washington Univ., Cheney. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W85-04317

BIOTECHNOLOGY AND WASTE TREATMENT,
F. J. Saunders.
Effluent and Water Treatment Journal, Vol. 24, No. 11, p 421-425, November, 1984. 6 Fig, 7 Ref.

Descriptors: *Microorganisms, *Biological wastewater treatment, Effluent quality, Bacteria, Wastewater treatment, Organic matter.

Biotechnology has enabled the introduction of new components to be made to the biomass community. Freeze dried cultures of selected strains of bacteria have been utilized to improve the operational efficiency of biological wastewater treatment systems. Many plants still fail to produce the required standard of effluent in spite of the clear ability of the biomass in a wastewater treatment plant to adjust its composition under the population selection mechanism procedure. The introduction of alternative components into the biomass community has been disregarded generally because of a lack of understanding of wastewater treament microbiology. The development of adapted and mutated microbial strains, for application in the field of wastewater treatment, involves exposure of microorganisms, selected on the basis of their ability to degrade specific organic materials, to successively increasing concentrations of such materials. Addition of specific microorganisms may be necessary during certain seasons, or during periods of over loading, to make adjustments in the effluent composition. The application of microbial innoculations, to enhance the natural processes of the population selection mechanism, does have a role to play in current and future wastewater treatmen technology. (Baker-IVI)
W85-04337

CHEMICAL FLOCCULATION OF SEWAGE,
Laporte Inorganics, Cheshire (England).
A. Murray, and A. M. Simpson.
Effluent and Water Treatment Journal, Vol. 24 No. 11, p 426-429, November, 1984. 4 Fig, 4 Tab, Ref.

Descriptors: *Wastewater treatment, *Coagulants *Flocculation, Costs, Activated sludge process Phosphates.

The use of coagulants to improve processes an effluent standards in conventional sewage treat

ient is examined as it relates to overloaded existng works, higher standard discharges, reduced nergy costs for operation of activated sludge lants, and capital savings on new works. Chemial flocculation of sewage at the primary stage is a apidly installed and low capital cost method of pgrading plant performance. It can be used selecvely at times of peak load or flow. It appears conomically attractive in comparison with plant xtension for 30-50% capacity increase or to educe the capital cost of new plants. Energy avings of about 45% are achievable on activated ludge plants. Phosphate levels in the final effluent re reduced by 90%. (Baker-IVI)
W85-04338

IGNIFICANCE AND BEHAVIOUR OF IEAVY METALS IN WASTEWATER TREATMENT PROCESSES IV. WATER QUALITY TANDARDS AND CRITERIA,
mperial Coll. of Science and Technology, London England). Industrial Sociology Unit.
. W. W. Kirk, and J. N. Lester.
cience of the Total Environment, Vol. 40, p 1-44, December, 1984. 20 Tab, 99 Ref.

Descriptors: *Water quality standards, *Heavy netals, *Wastewater treatment, *Water treatment, egislation, Drinking water.

iterature on the health aspects of the presence of eavy metals in water and wastewaters is reviewed nd quality standards, criteria and legislation pronulgated by the World Health Organization, Euopean Economic Community, U.S. Environmenal Protection Agency and Government of the J.S.S.R. are assessed and compared. It is evident rom the literature that standards applied differ ccording to the projected water use and that lthough standards for potable water are generally ased on human health criteria, other factors inluding available technology and economics may e limiting. Emphasis had been placed on the proection of raw water quality as a result of the imited ability of potable water treatment processes o remove certain heavy metals. It is apparent that imitations on heavy metals in discharges from the hlor-alkali and cadmium salts and pigments indusries are more stringent in the United States than in he European Economic Community. It is conluded that the finite availabilty of unpolluted reshwater will result in greater water re-use and hat appropriate standards are required to protect otable supply, raw water and agricultural land rom contamination by heavy metals. (Author's bstract)
W85-04356

POLLUTING SEWERS BROUGHT UNDER CONTROL,
Marion County Health Dept., Indianapolis, IN. Bureau of Environmental Health.
R. S. Morse, and H. M. Eckrich.
Journal of Environmental Health, Vol. 47, No. 2, p 68-70, September/October, 1984. 3 Fig.

Descriptors: *Sewers, *Overflows, *Water pollution control, *Marion County, *Indiana, Public health, Combined sewers, Maintenance, Combined sewer overflows.

Dry weather overflows from combined sewers have had the potential of creating major public health hazards and of causing environmental damage to seven Marion County, Indiana, streams for many years. The establishment of priorities, regular inspections, and intensified communication between the Marion County Health Department and municipal officials have helped bring this situation under control. Specific steps taken to improve the situation included the setting of goals, objectives, and action plans, all of which kept this high priority problem in the forefront; a structured approach to monitoring combined sewer overflow points along with follow-up on points in violation; a systematic reporting by telephone and letter to the department of public works of flowing points with follow-up on correction; involvement of the public, both citizens and media; and education of other public officials responsible for funding and supporting the efforts of the Department of Public Works. The Department of Public Works specifically established more frequent monitoring of diversion points; purchased new sewer maintenance equipment; responded more promptly to reports of overflows with field reports sent to the Health Department; maintained sewers at night and on the weekends as needed; constructed bars across street inlets to minimize entry of debris; and repaired particularly tedious diversions with follow-up through frequent walking of these sewers to check 13 otherwise inaccessible diversion points. (Baker-IVI)
W85-04403

5E. Ultimate Disposal Of Wastes

PROTECTION OF GROUNDWATER IN RELATION TO WASTE DISPOSAL IN WESSEX WATER AUTHORITY,
Wessex Water Authority, Bristol (England).
C. J. Swinnerton.
Quarterly Journal of Engineering Geology, London, Vol. 17, No. 1, p 3-8, 1984. 7 Fig.

Descriptors: *Waste disposal, *Aquifer characteristics, *Groundwater protection, *Infiltration, *Wessex, *England, Environmental effects, Infiltration.

Wessex Water Authority, as one of the 10 water authorities in England and Wales, has the responsibility of liaising with waste disposal authorities to ensure that both groundwater and surface water resources are not polluted by waste disposal activities. Descriptions of three very different types of waste disposal sites on aquifers are presented to illustrate the wide range of sites that can result from adopting a practicable and reasonable approach to waste disposal. A much narrower range of types of sites could result if a very firm, inflexible approach was adopted. Sufficient evidence is available to encourage the adoption of a dilute and disperse approach to waste disposal on aquifers, rather than the contain and treat policy which is favored in many cases by specific water authorities. In some authorities which favor the contain and treat policy, their aquifers are predominately limestone in nature and groundwater flow is generally through discrete fissures, cracks, and faults. In this situation it is felt unwise to permit the widespread adoption of the dilute and disperse theory. The effect of migration through both the unsaturated and saturated zones of aquifers, and the effectiveness and reliability of no-site treatment need to be examined. (Baker-IVI)
W85-03766

RECIRCULATION OF LEACHATE AS A LANDFILL MANAGEMENT OPTION: BENEFITS AND OPERATIONAL PROBLEMS,
Water Research Centre, Stevenage (England).
For primary bibliographic entry see Field 5G.
W85-03768

SLUDGE APPLICATION TO LAND COMPARED WITH A PASTURE AND A HAYFIELD: REDUCTION OF BIOLOGICAL HEALTH HAZARD OVER TIME,
Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
P. M. Wallis, D. L. Lehmann, D. A. MacMillan, and J. M. Buchanan-Mappin.
Journal of Environmental Quality, Vol. 13, No. 4, p 645-650, 1984. 2 Fig, 4 Tab, 31 Ref. Alberta Environment contract 80-9108.

Descriptors: *Sludge disposal, *Land disposal, *Public health, *Coliforms, *Wastewater treatment, Parasites, Viruses, Salmonella, Staphylococcus.

The city of Calgary, Alberta, Canada, has been injecting sewage sludge into agricultural fields since 1981. The occurrence and survival of enteric viruses, pathogenic bacteria, and parasites was investigated on agricultural fields that have been injected with sludge in comparison with sludge applied to the surface of untilled grassland, an unsludged pasture occupied by cows, and a control hayfield. The sludged plots compared favorably with the control hayfield with respect to the occurrence and survival of nematode parasites, enteroviruses, and primary bacterial pathogens. Secondary bacterial pathogens persisted on all fields throughout the study, but levels declined more slowly on the sludged grass plot than the injected sludge field, the pasture, or the control hayfield. In spite of the persistence of secondary pathogens, the health hazards to humans and animals were judged to be comparable to those on a hayfield and a pasture that had not been sludged. (Baker-IVI)
W85-03863

RAPID AEROBIC BIOSTABILIZATION OF HIGH-STRENGTH INDUSTRIAL LANDFILL LEACHATE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5D.
W85-03870

DEVELOPMENT OF A COMPREHENSIVE SAMPLING PROGRAMME FOR YORKSHIRE WATER AUTHORITY,
Yorkshire Water Authority (England).
For primary bibliographic entry see Field 5F.
W85-03885

TWO-DIMENSIONAL, STEADY-STATE MODEL OF GROUND-WATER FLOW, NEVADA TEST SITE AND VICINITY, NEVADA-CALIFORNIA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03893

GEOHYDROLOGIC AND DRILL-HOLE DATA FOR TEST WELL USW H-3, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03901

QUALITY OF WATER RECOVERED FROM A MUNICIPAL EFFLUENT INJECTION WELL IN THE FLORIDAN AQUIFER SYSTEM, POMPANO BEACH, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. J. McKenzie, and G. A. Irwin.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4100, 1984. 23 p, 8 Fig, 4 Tab, 14 Ref.

Descriptors: *Disposal wells, *Effluents, *Municipal wastewater, Chloride, *Water quality standards, *Florida, Pompano Beach, Floridan aquifer system.

Approximately 69 million gallons of backflow from an injection well used for the disposal of secondary treated municipal effluent in the Floridan aquifer system near Pompano Beach, Florida, was periodically sampled for inorganic quality from March 1975 through March 1977. Analyses of the backflow effluent showed a concomitant increase in dissolved solids and a change in ionic composition as a function of cumulative volume of backflow. Both the increase in dissolved solids and the change in major ionic composition were directly related to an estimated 6 to 7 percent mixing of the moderately saline water in the Florida aquifer system with the injected system with the injected effluent. Although an estimated 3.5 billion gallons of effluent was injected into the aquifer system during the 16-year operation of the Collier Manor treatment plant, only 65 to 70 million gallons was backflowed before the chloride concentration approached 250 milligrams per liter. (USGS)
W85-03932

TREATMENT OF SURPLUS ACTIVATED SLUDGE FROM THE EMSCHER MOUTH TREATMENT PLANT, F.R.G.,

Emschergenossenschaft, Essen (Germany, F.R.).
H. J. Donges, and K. H. Kalbskopf.
Water Science and Technology, Vol. 16, No. 12, p 357-363, 1984. 4 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Sludge treatment, *Emscher Mouth Treatment Plant, *Germany (Federal Republic), Activated sludge process, Sludge drying, Fuel, Anaerobic digestion, Heat treatment.

The Emscher Mouth Treatment Plant was completed in 1977 and, since that time, effluent volumes of up to 30 cu m/sec have been treated with a high degree of efficiency using the activated sludge process. Separate treatment of the activated sludge was chosen because the raw sludge of the Emscher area could be dewatered directly in filter presses and then used as fuel. Surplus sludge quantities at the treatment plant amount during the year to about 100 t/d. After being pumped at a pressure of about 12 bar through an 18 km long 300 mm diameter pipeline, the thickened surplus sludge is treated at a central location. Heat treatment was selected to condition the activated sludge because it is always possible to attain optimum dewatering qualities without the addition of polymers, by varying the temperature. A direct heat exchanger system was selected which does not allow incrustation caused by calcium carbonate and calcium phosphate to occur. Repair costs amount essentially to the result of wear and tear of the pumps, seals, and pipelines in the pressure relief zone behind the valves of the three highest pressure stages. The dewatered sludge is burned in a fluidized bed incinerator. During heat treatment, apart from the sludge solids, 2,000 to 3,500 cu m/d of highly concentrated and unpleasantly odorous filtrate liquor are produced and anaerobically digested. (Baker-IVI)
W85-04001

INFLUENCE OF PRETREATMENT ON ANAEROBIC STABILISATION OF SEWAGE SLUDGE,
Technische Univ. Muenchen (Germany, F.R.).
F. Wechs.
Water Science and Technology, Vol. 16, No. 12, p 365-373, 1984. 7 Fig, 3 Tab, 5 Ref.

Descriptors: *Sludge conditioning, *Wastewater treatment, Anaerobic digestion, Acidification, Pasteurization, Digestion.

In principle, there are two ways of intensifying anaerobic stabilization of sewage sludge: to optimize the conditions of the digestion process itself; or to pretreat the sludge in such a way that it is transformed into a more degradable substrate. In order to intensify anaerobic stabilization of sewage sludge, several pretreatment processes have been tested, including prepasteurization, separate acidification, and short-term anaerobic digestion. Two-stage digestion seems to be a promising approach to intensify anaerobic digestion of sewage sludge. Some of the practical advantages of this technique are a reduction of investment due to smaller digestion tanks, the possibility of a combination of anaerobic pretreatment and elimination of pathogens in thermophilic pretreatment processes, avoiding the disadvantages of thermophilic one-stage digestion like odors, and cost effective extension of overloaded digesters. (Baker-IVI)
W85-04002

BENEFICIAL USE OF SEWAGE SLUDGE IN THE GOTHENBURG REGION, SWEDEN,
Goeteborg Regional Sewerage Co. (Sweden).
S. Hallquist.
Water Science and Technology, Vol. 16, No. 12, p 449-460, 1984. 12 Tab.

Descriptors: *Sludge disposal, *Land disposal, *Gothenburg, *Sweden, Wastewater treatment, Sludge stabilization, Sludge, Lime, Fertilizers, Compost.

The disposal of final wastes from wastewater treatment plants has proved difficult in the urbanized Gothenburg Region of Sweden. Efforts have thus been largely spent on finding beneficial purposes for the sludge. After unsuccessful attempts with thermal treatment, the Gothenburg Regional Sewerage Company chose to produce two different sludge products, compost and lime treated sludge. Several tests were carried out to demonstrate the usefulness of these two products. The practical sludge quantity to deal with is around 80 cu m/yr. Considering its use in land application, it is noted that continuous lime application to arable land on the Swedish west coast is necessary to avoid blighting of crops due to declining pH value from acid precipitation. The application of lime treated sludge raises the pH and increases the yield more than the corresponding generally practiced application of lime and such an application of lime treated sludge does not adversely affect the quality of the crops compared with the effect of supplying only lime. The composted sludge product has also proved to be extremely useful in parks and gardens and also in private grounds for flower and bush beds as well as grass lawns. Some of the material has also been used for landscaping purposes. (Baker-IVI)
W85-04003

GUIDELINES FOR THE UTILISATION OF SEWAGE SLUDGE ON LAND IN THE UNITED KINGDOM,
Department of the Environment, London (England).
M. G. Healey.
Water Science and Technology, Vol. 16, No. 12, p 461-471, 1984. 3 Tab, 3 Ref.

Descriptors: *Regulations, *United Kingdom, *Sludge disposal, *Land disposal, Public health, Toxicity, Guidelines, Sludge.

It is the United Kingdom view that sewage sludge should be disposed of at least cost to the community commensurate with safeguarding public health, the avoidance of environmental damage and with regard to the value of sewage sludge as a resource. General policy on sludge disposal in the United Kingdom is outlined and administrative arrangements for water services are detailed. The legislative controls through good practice are achieved through observance of non-statutory guidelines. The resource value of sewage sludge is placed in national context and an appraisal is made of the potential risk to health, the environment and crop yield, though years of experience have shown little risk so long as good practice is followed. The guidelines are designed so as to encourage the use of sewage sludge by making recommendations on suitable uses and listing precautions. General advice is available on the use of good agricultural and sewage sludge disposal methods and on the monitoring of operations employing this resource. Reference to research being undertaken for the purpose of confirming or refining the guidelines are included. (Baker-IVI)
W85-04004

POLYELECTROLYTE CONDITIONING OF SHEFFIELD SEWAGE SLUDGE,
Yorkshire Water Authority (England).
R. E. Paine, and K. C. Thompson.
Water Science and Technology, Vol. 16, No. 12, p 473-486, 1984. 4 Fig, 7 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Sludge conditioning, *Polyelectrolytes, Sludge filters, Sludge drying, Odor control, Sodium chloride, Dewatering, Blackburn Meadows, England.

Detailed pressing trials of polyelectrolyte conditioned raw sludge with three different polyelectrolytes using a Mono sludge pump are described. Full-scale trials with a Feluwa (peristaltic) sludge pump and a novel high pressure polyelectrolyte dosing system are also detailed. Polyelectrolyte conditioning of Blackburn Meadows (England) co-settled sludge had significant advantages over iron(II) sulfate/calcium hydroxide conditioning. A presscake with a mean dry solids of 30% and a mean throughput of one ton of raw sludge dry solids per press was achieved on rubber plates at Blackburn Meadows using a Mono sludge pump and polyelectrolyte conditioning. The mean ash content of the presscake has been reduced from 50 to 28% by changing to polyelectrolyte conditioning. A presscake with a mean dry solids of 28% and a mean throughput of 0.89 ton of raw sludge dry solids per press was achieved on rubber plates during the full scale trials. This compares with a mean dry solids of 29% and a throughput of 0.56 ton using iron (II) sulfate and calcium hydroxide. A novel high pressure polyelectrolyte dosing system has given satisfactory results in conjunction with the Feluwa sludge pump. Sodium chloride proved the most effective odor control chemical for addition to Blackburn Meadows raw sludge prior to polyelectrolyte conditioning and pressing. (Baker-IVI)
W85-04005

SLUDGE TREATMENT AND DISPOSAL TECHNIQUES FOR OPERATION OF THE COLESHILL SLUDGE DESTRUCTION PLANT, U.K.,
Severn-Trent Water Authority, Birmingham (England).
R. Tabberer, and J. S. Broughton.
Water Science and Technology, Vol. 16, No. 12, p 497-518, 1984. 19 Fig, 2 Ref.

Descriptors: *Sludge treatment, *Sludge disposal, Wastewater treatment, Filtration, Chemical treatment, Incineration, Monitoring, Computers.

The Coleshill Sludge Destruction Plant has to process 1100 cu m/d of wet sludge to achieve an inert ash occupying 18-20 cu m. A better understanding of the nature of the sludge destruction plant's feed sludge and its response to different chemical conditions has led to the development of a thicker sludge before pressing and the use of blended chemicals to give optimum cake quality at favorable plant costs. Monitoring techniques are becoming more complex with separate plate sampling and filtration rate studies needing computer technology to handle the mass of data. Work is in hand to link a line of 6 presses to a flow measuring device and a microprocessor that will handle filtration rate, and chemical and sludge feed data to continuously advise on plant performance. The planned increase in sludge throughput and increasing use of computer technology for plant control will minimize overall plant costs, resulting in substantial savings. (Baker-IVI)
W85-04006

TREATMENT OF SLUDGE FROM A PLANT FOR JOINT TREATMENT OF INDUSTRIAL WASTEWATER AND COMMUNAL SEWAGE,
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
H. Lauer.
Water Science and Technology, Vol. 16, No. 12, p 519-522, 1984.

Descriptors: *Sludge drying, *Sludge treatment, *Ludwigshafen, *Germany (Federal Republic), Incineration, Wastewater treatment, Industrial wastewater, Domestic wastewater, Filtration, Sludge conditioning, Polyelectrolytes, Energy.

Experience gained during the nine years of operation of the wastewater treatment plant in Ludwigshafen is reviewed. Until 1980 the concept of sludge disposal included conditioning the thickened sludge with lime, iron chloride and ash, dewatering on chamber filter presses and then incineration in a fluidized-bed furnace, without the heat produced being utilized. The first change made was to replace iron chloride with iron sulfate. The second change was from oil to coal in the incineration process and to find means of using the heat produced in the operation as a source of energy. In January of 1982 the entire dewatering procedure was converted to the CarboSed process. Even peak amounts of sludge corresponding to 400 tons of sludge dry solids/day could be reliably handled. (Baker-IVI)
W85-04007

INVESTIGATION OF THE PROCESS OF INITIAL DILUTION OF WASTEWATERS IN SHALLOW SEAS,
N. V. Zemlyanaya, and V. A. Zvereva.

Water Resources, Vol. 10, No. 5, p 459-465, September-October, 1983. 4 Fig, 12 Ref. Translated from Vodnye Resursy, No. 5, p 98-103, September-October, 1983.

Descriptors: *Wastewater outfall, *Dilution, Water pollution control, *Jets, Design criteria, Water circulation, Effluents.

The design of wastewater outlets in shallow bodies of water and the degree of treatment should be such that due to initial dilution of wastewaters the concentration of pollutants becomes less than the maximum allowable with a satisfactory general sanitary state of the water body with respect to integral assessments. A characteristic feature of a jet expanding in the presence of a sweeping flow rate insufficient for dilution is the presence of circulation zones. To determine if a water body has sufficient possibilities for dilution it is necessary to formulate the features of free, unconfined spreading. The schemes of the behavior of a jet and the presence of circulation zones were taken in this study as such features. Two schemes were investigated, the first with a jet in a nonstratified water body where the jet expands according to known relationships from the theory of jets, and the second in which the jet spurts into a dead end resulting in a confined expansion. The formation of circulation zones is characteristic for confined expansion of the jet. The greater the degree of confinement, the greater the depth to which the circulation zone extends, the smaller the distance at which addition of unpolluted water volumes to the jet will occur, and the smaller the initial dilution. These studies permit optimizing the hydraulic regime of the outlet and obtaining the maximum possible dilution. The main principle of optimization should be to provide a loss of jet velocity due to the addition of masses of clean water to it and not due to the loss of momentum. (Baker-IV)
W85-04132

MANUAL FOR LAND APPLICATION OF TREATED MUNICIPAL WASTEWATER AND SLUDGE,
Environmental Protection Service, Ottawa (Ontario). Environmental Protection Programs Directorate.
For primary bibliographic entry see Field 5D.
W85-04213

SUBSURFACE TRANSPORT WITH EMPHASIS ON HYDROLOGY: RESEARCH NEEDS,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Chemistry Section.
For primary bibliographic entry see Field 5B.
W85-04217

REVIEW OF THE POLLUTION ABATEMENT PROGRAMS RELATING TO THE PETROLEUM REFINERY INDUSTRY IN THE GREAT LAKES BASIN.
Petroleum Refinery Point Source Task Force, Windsor (Ontario).
Report to the Great Lakes Water Quality Board. International Joint Commission, Great Lakes Regional Office, Windsor, Ontario, November, 1982. 138 p, 7 Tab, 19 Ref, 12 Append.

Descriptors: *Water pollution control, *Great Lakes, *Oil industry, *Oil refineries, *Oil pollution, *Effluent limitations, Reviews, Water quality control, Wastewater management, Trace elements, Trace metals, Toxins, Hazardous materials, Canada, United States, International commissions, International law, Water quality management.

The Water Quality programs Committee of the Great Lakes Water Quality Board established a Petroleum Refinery Task Force in 1982 to review the implementation and results of the regulatory programs established for those refineries in the U.S. and Canada that discharge into the Great Lakes. This report describes the findings of the Task Force regarding effluent equality improvement, analytical procedures, trends of pollutant loading, and compliance with jurisdictional effluent limitations. It also discusses the petroleum refineries located in seven areas of concern, as defined by the Board as areas where a Great Lakes Water Quality Agreement Objective or a jurisdictional standard has been exceeded. The Task Force concludes that since 1976 there has been a significant improvement in the quality of the wastewater being discharged from petroleum refineries to the Great Lakes Basin. The Task Force recommends that additional efforts should be made to evaluate the possible long-term adverse effects of potentially toxic trace substances in refinery effluents.
W85-04228

PROCEEDINGS OF THE THIRD SYMPOSIUM ON UTILITIES DELIVERY IN COLD REGIONS.
Environmental Protection Service, Ottawa (Ontario).
Edmonton, Alberta, May 25-26, 1982. Water Pollution Control Directorate, Report EPS-3-WP-82-6, December, 1982. 419 p.

Descriptors: *Utilities, *Cold regions, Polar regions, Sanitation, Municipal water, Domestic wastes, *Canada, *Alaska.

Utilities delivery efforts in cold regions result in significant capital and operating costs. The objective of the third international Symposium on Utilites Delivery in Cold Regions was to continue to provide a forum for the exchange of information on the development and performance of utilities systems. The public health aspects of living conditions are extremely important in cold regions. Heating and electrical requirements have been major cost components of northern living. The per capita costs of solid waste management for the same quality of service is higher in small communities than in larger communities. Three case studies, two focusing on Barrow, Alaska, and one focusing on water supply at Tuktoyaktuk, N.W.T., presented information on design and construction of large scale municipal facilities. Dr. William Ryan's discussion of work he spearheaded for the World Health Organization indicated the leadership of North America in cold regions sanitation.
W85-04237

CHANGE IN MICROBIAL NUMBERS DURING THERMOPHILIC COMPOSTING OF SEWAGE SLUDGE WITH REFERENCE TO CO2 EVOLUTION RATE,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
K. Nakasaki, M. Sasaki, M. Shoda, and H. Kubota.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 37-41, January, 1985. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Composting, *Sludge digestion, *Thermophilic bacteria, *Actinomycetes, Fungi, Bacteria, Carbon dioxide, Microorganisms.

Isolation of microbial groups from a sewage sludge compost was conducted at several stages of the composting process in a laboratory-scale autothermal reactor in which a constant temperature of 60 C was maintained as long as possible by controlling the air feed rate to the reactor. During the composting, the microbial activity was monitored by measuring CO2 evolution rate, and the specific activities of isolated groups of microorganisms were assessed quantitatively. At the initial stage of the composting, mesophilic bacteria inherent to the raw sludge mainly contributed to the CO2 evolution. As temperatures rose, the leading group of microorganisms which contributed to CO2 evolution changed from mesophilic to thermophilic microorganisms. Although a large number of mesophilic bacteria were isolated from the compost materials even at the thermophilic stage of 60 C, their respiratory activity at 60 C was negligible. The first peak in the CO2 evolution rate was mostly associated with the activity of thermophilic bacteria, whereas the second one was associated with that of thermophilic actinomycetes. A large inoculation of seed gave a higher concentration of actinomycetes and the peak of CO2 evolution coincided with that of thermophilic bacteria. Actinomycetes develop far more slowly than most bacteria or fungi and are rather ineffective competitors when nutrient levels are high. Few fungi were detected during the experiments. (Moore-IVI)
W85-04259

CHARACTERISTICS OF MESOPHILIC BACTERIA ISOLATED DURING THERMOPHILIC COMPOSTING OF SEWAGE SLUDGE,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
K. Nakasaki, M. Sasaki, M. Shoda, and H. Kubota.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 42-45, January, 1985. 5 Fig, 2 Tab, 5 Ref.

Descriptors: *Sludge digestion, *Composting, *Mesophilic bacteria, *Ultraviolet radiation, Bacteria, Spores, Vegetative stage.

During experiments on the thermophilic composting of sewage sludge, a large number of mesophilic bacteria were isolated even at the thermophilic stage of 60 C. The role and existing form of the mesophilic bacteria at the thermophilic stage are of primary interest. A simple ultraviolet (UV) irradiation method was developed to estimate the spore ratio of bacteria in composting. The degree of inactivation by UV irradiation is different in vegetative cells and spores of bacteria isolated from sewage sludge composting at 60 C. By using this property, the spore ratio can be determined. This UV irradiation method was applied to the estimation of the spore ratio of sewage sludge compost samples collected at several stages of composting. At 60 C, more than 60% of the mesophilic bacteria in the samples were in a vegetative state. The vegetative mesophilic bacteria were thermotolerant at 60 C, forming colonies but showing no respiratory activity. (Moore-IVI)
W85-04260

BIOLOGICAL HEALTH RISKS ASSOCIATED WITH THE COMPOSTING OF WASTEWATER TREATMENT PLANT SLUDGE,
Cincinnati Univ. Medical Center, OH. Inst. of Environmental Health.
C. S. Clark, H. S. Bjornson, J. Schwartz-Fulton, J. W. Holland, and P. S. Gartside.
Journal of the Water Pollution Control Federation, Vol. 56, No. 12, p 1269-1276, December, 1984. 11 Tab, 21 Ref.

Descriptors: *Sludge treatment, *Public health, *Personnel, *Composting, Bacteria, Fungus, Sludge drying, Dewatering, Aspergillus, Histoplasma, Legionella.

Personnel at wastewater treatment plant sludge compost operations are exposed to a variety of gram-negative bacteria and fungi as well as microbial products such as endotoxin in their work environment. Clinical, microbiological, and immunological methods were used to evaluate the health effects related to exposure to these nonviable substances and viable microorganisms in dust that arose when dewatered sludge was composted. Throat and anterior nares cultures of workers at compost sites were frequently positive for Aspergillus fumigatus; similar cultures from workers in the intermediate-exposure and control groups were generally negative. A higher rate of abnormal skin, ear and nose conditions among the compost and intermediate-exposed workers suggests that exposure to compost could have had an adverse effect on the workers' health. There was no increased risk of Legionella pneumophila in the compost workers studied. Specific antibody directed against the H and M antigens of Histoplasma capsulatum or a pool of antigens prepared from A. fumigatus, A. flavus, A carneus, and A. niger was not detected in the sera from the study participants. This suggests that serologically-detectable infections caused by these fungi were uncommon among the workers studied, despite the exposure of compost workers to fungal spores at the compost sites. (Baker-IVI)
W85-04291

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5F. Water Treatment and Quality Alteration

SOME CONSIDERATIONS ON IRON REMOVAL,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
W. Sung, and E. J. Forbes.
Journal of Environmental Engineering, Vol. 110, No. 6, p 1048-1061, December, 1984. 6 Fig, 3 Tab, 30 Ref, 1 Append.

Descriptors: *Iron removal, *Water quality control, *Water treatment, Iron, Oxidation, Filtration, Oxygen, Groundwater.

Oxidation/filtration remains the most common method for iron removal. The common oxidants used include chlorine, oxygen and potassium permanganate. The iron problems in New Hampshire groundwaters develop over time. When the original water treatment system was designed provisions for iron removal were not always included. It is important to have a fundamental understanding of reaction mechanisms before control strategies could be rationally understood. This study reported on the influence of ionic strength and chlorocomplexation on the oxygenation kinetics of ferrous iron. With atmospheric partial pressures of oxygen and pH >6, the chemical half-life of ferrous iron is on the order of minutes to hours. The particle size distribution of some ferric oxyhydroxide precipitates are reported. The use of other oxidants such as chlorine and potassium permanganate versus oxygen is reviewed. From this information one should be able to determine aeration detention times. The next step is to study the influence of these parameters on the surface properties of such particulates. (Baker-IVI)
W85-03802

VOCS IN DRINKING WATER: COST OF REMOVAL,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. M. Clark, R. G. Eiles, and J. A. Goodrich.
Journal of Environmental Engineering, Vol. 110, No. 6, p 1146-1162, December, 1984. 10 Fig, 8 Tab, 9 Ref.

Descriptors: *Groundwater treatment, *Water treatment, *Organic compounds, Drinking water, Groundwater, Water pollution control.

Several control technology options available to treat ground water for organic chemical contamination are discussed. A cost and performance analysis is presented to guide in the selection of control technologies for seven major contaminants: trichloroethylene; tetrachloroethylene; 1,1,1-trichloroethane; carbon tetrachloride; cis-1,2-dichloroethylene, 1,2-dichloroethane; and 1,1-dichloroethylene. In all cases aeration is the cheapest alternative for treatment. If adsorption is required, home units using granular activated carbon may prove to be cheaper than central adsorption treatment. (Baker-IVI)
W85-03806

STATE-OF-THE-ART FOR ELECTRONIC GRADE ULTRAPURE WATER MANUFACTURING AND DISTRIBUTION, PART II,
Anatel Instrument Corp., Boulder, CO.
C. F. Frith.
Journal of Environmental Sciences, Vol. 27, No. 5, p 37-39, September/October, 1984. 4 Fig, 5 Ref.

Descriptors: *Ultrapure water, *Water quality control, *Water purification, Water treatment, Water distribution, Microbiological studies, Water storage, Monitoring, Quality control.

Water purification is considered an art rather than a science. However, for high technology applications, such as electronics, pharmaceutical and biomedical, ultrapure water is a science. Monitoring, design, installation, and operation have equal importance in the overall process of guaranteeing ultrapure water for the production of microelectronic devices. The distribution state for any high purity application must be of prime importance as well. Microbiological contamination is of major concern. The microbiological activity is a direct function of a stagnated or low velocity distribution network. Dead legs often occur in a distibution system when that system is modified or redesigned from its original installation. Similarly, ultrapure water cannot be stored for use in backup emergency situations. As the universal solvent, it attacks everything. The most practical advice is to provide a redundant system, in parallel, with moderate volumes of stored water either before or after primary treatment. The concept of storing water after polishing should be avoided. A critical problem for water reclamation in the electronics industry is the reliability, response time, and sensitivity of monitoring instruments. To date there are no on line real time instruments available for organic detection in the microgram per liter range. This presents a real challenge to those monitoring water for re-use as ultrapure water. Recent advances in the field of ultrafiltration are briefly discussed. (Baker-IVI)
W85-03843

SAMPLING TO MEET WATER QUALITY STANDARDS,
Thames Water Authority (England). Northern Div.
J. A. Steel.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 5, p 392-402, October, 1984. 1 Tab, 9 Ref.

Descriptors: *Monitoring, *Water quality control, *Water distribution, *England, *Water quality standards, Toxicity, Maximum allowable concentration, Bacteria, Sampling.

In the United Kingdom statutory water undertakers are required by the Water Acts of 1945 and 1973 to provide sufficient wholesome water for normal domestic purposes. To run a quality assurance program five aspects of the situation need be addressed: the purpose of the samples, what to sample and analyze for, where and how to sample, how frequently to sample and analyze, and how to judge the results. A Directive appearing in 1980 partially addressed the above concerns in noting that the essential purpose of the drinking water directive is to protect public health, that the water examined should be taken from the point where it is made available to the consumer, that the frequency of sampling should primarily be based on the size of population being served, that determinands of concern in water quality be specified, and that maximum admissible concentrations be specified for the large majority of the determinands listed. Sampling under the guidelines of the drinking water directive is to be considered with five parameters: organoleptic, physicochemical, undesirable in excessive amounts, toxicity, and microbiological. Statutory monitoring will naturally be heavily dependent upon the maximum allowable concentration of those parameters for which they exist. In the United Kingdom the Central Government has effectively defined such concentrations for many substances. There will be no consideration of the sampling program for quantifying the risks that the maximum allowable concentration is or is not being complied with. While statutory monitoring schemes are going to remain, it is felt that it would be unfortunate if they unduly distorted the disposition of resources in the quality assessment programs of authorities. It will be incumbent upon individual authorities so to lay out and explain their overall sampling programs that in the competition for scarce resources the various objectives and their related costs and benefits are apparent. The basic statutory programs will not do that. (Baker-IVI)
W85-03882

DEVELOPMENT OF A COMPREHENSIVE SAMPLING PROGRAMME FOR YORKSHIRE WATER AUTHORITY,
Yorkshire Water Authority (England).
D. A. Bailey, D. Johnson, and D. A. Woolloff.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 5, p 435-456, October, 1984. 1 Fig, 15 Tab, 12 Ref.

Descriptors: *Water quality control, *Sampling, *Yorkshire Water Authority, *England, Planning, Decision making, Water distribution, Drinking water.

The total regular and routine sampling requirements for each of a water authority's functions and for all purposes are considered in relation to the control of treatment processes, the assessment of compliance with various standards such as internal, regional water authority, US statutory and EEC directives; the collection of information used for trade effluent charging purposes; the collection of information used for planning; and the collection of information used for river management. Specific topics discussed include compliance testing for potable water, for bacteriological determinands, and for sewage treatment works consents; trade effluent for direct discharge to surface waters, and discharge to public sewers; surveillance sampling for potable water, sewage appraisal, primary treatment, secondary treatment, trade effluent, rivers, tidal rivers, sludge disposal, coastal waters, dangerous substances, process controls, charging, and discharges into the public sewers. (Baker-IVI)
W85-03885

REACTION KINETICS OF SODIUM BISULFITE AND DISSOLVED OXYGEN IN SEA WATER AND THEIR APPLICATIONS TO SEA WATER REVERSE OSMOSIS,
Toray Industries, Inc., Otsu (Japan).
For primary bibliographic entry see Field 3A.
W85-03973

UPFLOW CLARIFICATION OF NEW ENGLAND SURFACE WATER SUPPLIES,
Metcalf and Eddy, Inc., Boston, MA.
S. L. Bishop, and E. J. Cichon.
Journal of the New England Water Works Association, Vol. 98, No. 3, p 215-236, September, 1984. 11 Fig.

Descriptors: *Upflow clarification, *Water treatment, *Surface waters, Water quality control, Clarification, Flocculation, Suspended solids, Economic aspects, Water temperature, Viscosity.

Data are provided concerning an upflow solids contact process utilizing a sludge blanket as a possible means of reducing costs in water treatment plant operation. The upflow solids contact clarifier consists of a unit that usually contains mixing, flocculation and removal of suspended solids all within one tank. One of the operating characterisics of an upflow solids contact clarifier which must be evaluated thoroughly is the hydraulic flexibility. This feature determines many elements of design of a water treatment plant including the economics as well as the overload capacity which can be counted on to meet peak production requirements. Specific items discussed include mechanical flocculation and solids recirculation in solids contact clarifiers and hydraulic-pulsed solids contact clarifier. One factor that must be considered in the operation of upflow clarifiers is the temperature of the raw water. Since the viscosity of the water increases as the water temperature decreases, the number of interparticle collisions during flocculation will decrease, thereby rendering the upflow clarifier less effective. This phenomena usually manifests itself by higher levels of turbidity in the clarified water during the winter months. The upflow clarifiers in New England are usually operated with alum as the coagulant, applied at a rate of 20-30 mg/L, and 0.1 mg/L of polymer as a coagulant aid. Rapid mix tanks, for dispersal of the coagulant and polymer are not always required unless direct filtration can be implemented during certain times of the year. Pilot plant tests of a hydraulic-pulsed solids contact clarifier indicate that a surface loading rate of 4 gpm/sf is possible during the summer months. (Baker-IVI)
W85-04018

DESIGN AND OPERATION OF FLEXIBLE MEMBRANE COVERS FOR DISTRIBUTION STORAGE RESERVOIRS,
Manchester Water Works, NH.

For primary bibliographic entry see Field 8A.
W85-04020

UTILIZATION OF A MICROCOMPUTER IN THE CALCULATION OF CALCOCARBONIC EQUILIBRIUM CURVES,
Kativic Regional Administration, Kuujjuaq (Quebec).
Y. Dubuc, R. Desjardins, F. Briere, and D. L. Piron.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 610-615, September, 1984. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Calcocarbonic equilibrium, *Computer analysis, *Water treatment, *Hydrogen ion concentration, *Calcium carbonate, Model studies, Langelier equation, Drinking water.

In a water treatment plant, filtered water usually has a pH lower than 6. The recommended lower limit for drinking water is 6.5. In most cases the pH is adjusted to a value slightly higher than the equilibrium pH to stabilize the water with regard to CaCO3. The Legrand-Poirier model permits the calculations of the calcocarbonic equilibrium conditions. This model is more powerful than the Langelier equation but requires long and arduous computations. Therefore, a research group at Ecole Polytechnique de Montreal has developed a microcomputer program to compute and plot the Legrand-Poirier diagrams. This program will be put to use in the water treatment plants of the City of Laval (Quebec, Canada). (Author's abstract)
W85-04051

CLEANING AND LINING VERSUS PARALLEL MAINS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski.
Journal of Water Resources Planning and Management, Vol. 111, No. 1, p 43-53, January, 1985. 4 Fig, 1 Ref, 1 Append.

Descriptors: *Water mains, *Pipe linings, *Cleaning, *Parallel mains, *Cost analysis, Water conveyance, Carrying capacity, Head loss.

In a water distribution system, cleaning a water main with a hydraulic or mechanical pig, and lining the pipe interior can greatly restore lost carrying capacity. The alternatives to cleaning and lining are: to increase the system pressure; or to install a new pipe parallel to the existing main. Methods are presented for selecting the length of pipe to be cleaned and lined, and the diameter and length of the parallel pipe to be installed to meet a target head loss. Then, the costs of each approach are compared. If the mains must carry a high ultimate design flow, parallel pipes are most economical. If a smaller improvement in carrying capacity is required and the mains are large, cleaning and lining is more economical. Cleaning and lining is most economical when the carrying capacity of the existing mains is small. (Moore-IVI)
W85-04242

ECOLOGY OF LEGIONELLA PNEUMOPHILA WITHIN WATER DISTRIBUTION SYSTEMS,
Veterans Administration Medical Center, Pittsburgh, PA.
J. E. Stout, V. L. Yu, and M. G. Best.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 221-228, January, 1985. 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Legionella, *Water conveyance, *Sediments, *Heated water, Hospitals, Microorganisms, Potable water, Pathogenic bacteria.

The potable water distribution system is the reservoir for hospital-acquired Legionnaires disease. The influence of the natural microbial population and sediment (scale and organic particulates) found in water systems as growth-promoting factors for Legionella pneumophila were investigated. Water from a hot-water storage tank readily supported the survival of L. pneumophila. The concentration of sediment was directly related to the survival of L. pneumophila; L. pneumophila did not survive in a sediment-free suspension. The presence of environmental bacteria improved the survival of L. pneumophila via nutritional symbiosis; the combination of sediment and environmental bacteria acted synergistically to improve the survival of L. pneumophila. The role of sediments in this synergistic effect was determined to be nutritional. Sediment stimulated the growth of environmental microflora, which in turn stimulated the growth of L. pneumophila. L. pneumophila occupies an ecological niche within the potable water system, with interrelationships between microflora, sediment, and temperature. It may be a misnomer to refer to water systems as being contaminated with L. pneumophila when this organisms merely represents one of hundreds of microorganisms which occupy an ecological niche in this environment. (Moore-IVI)
W85-04264

REMOVAL OF HEAVY METALS FROM WATERS BY MEANS OF NATURAL ZEOLITES,
Ecole Nationale Superieure de Chimie de Rennes (France). Lab. de Chimie des Nuisances et Genie de l'Environnement.
G. Blanchard, M. Maunaye, and G. Martin.
Water Research, Vol. 18, No. 12, p 1501-1507, 1984. 8 Fig, 2 Tab, 8 Ref, 4 Plate.

Descriptors: *Heavy metals, *Zeolites, *Clinoptilolite, *Water treatment, Ion exchange, Ammonium, Lead, Copper, Cadmium, Zinc, Cobalt, Nickel, Mercury, Drinking water.

The natural zeolite clinoptilolite can be used as an ion exchanger for the removal of ammonium ions from drinking waters. These waters may also contain small amounts of heavy metals. The retention possibilities of these cations by the zeolite are presented. The study of the selectivity of the Na-exchanged clinoptilolite in presence of ammonium ions has been achieved by plotting the exchange isotherms relative to the various cations. This leads to the following order of decreasing efficiency of the zeolite. $Pb(2+) > NH(4+) > Cu(2+)$, $Cd(2+) > Zn(2+)$, $Co(2+) > Ni(2+) > Hg(2+)$. The exchange kinetics has been also studied and rate equations are proposed. The removal of heavy metals on clinoptilolite has been studied in flowing conditions: solutions characterized by 100-500 micro-g/l metal ion concentrations passed using a 8 m/h flow rate. A small leak (5 micro-g/l) was observed. The concentration of the filtered solutions reach the EEC norms (50 micro-g/l) when the percolated volume was 250-350 v/v (volume of solution per volume of exchanger). The regeneration conditions have been defined and optimized in order to achieve a good reproductibility of the results for several cycles. The following values for the regenerating solution were found as the best: sodium chloride concentration, 20-25 g/l; pH, 4.0-4.5 (addition of hydrochloric acid); flow rate, 10 BV/h (BV = Bed volumes); volume, 40 BV. These working conditions were applied to a pilot plant involving a 65 l clinoptilolite column and giving a 500 l/h output. The results obtained on the laboratory scale were confirmed for several metal cation containing solutions. The different release possibilities of fixed toxic ions during the exchange reaction have been studied. The examination of SEM micrographs has shown that the retention of copper occurs not only by ionic exchange but also by growing of crystal species from the zeolite surface. (Author's abstract)
W85-04297

MODE OF ACTION OF CHLORINE DIOXIDE ON ORGANIC COMPOUNDS IN AN AQUEOUS MEDIUM; CHLORINE DIOXIDE CONSUMPTION AND REACTIONS ON PHENOLIC COMPOUNDS (MODE D'ACTION DU BIOXYDE DE CHLORE SUR LES COMPOSES ORGANIQUES EN MILIEU AQUEUX; CONSOMMATIONS DE BIOXYDE DE CHLORE ET REACTIONS SUR LES COMPOSES PHENOLIQUES),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
H. B. Amor, J. De Laat, and M. Dore.
Water Research, Vol. 18, No. 12, p 1545-1560, 1984. 6 Fig, 7 Tab, 13 Ref.

Descriptors: *Chlorine dioxide, *Organic compounds, *Phenols, Chemical reactions, Disinfectants, Aromatic compounds, Sulfur compounds, Oxidation, Unsaturated acids, Decarboxylation, Oxalic acid, Malic acid, Carbon dioxide.

Chlorine dioxide demands were measured in diluted aqueous solutions of organic compounds at pH 7. Among the compounds studied, only the following types of organic compounds reacted with chlorine dioxide: aromatic compounds with OH or NR2 groups, tertiary and secondary amines, and sulfur compounds such as thioamides. Aliphatic compounds in general and a large number of aromatic compounds were relatively unreactive towards chlorine dioxide. The action of chlorine dioxide on phenols (phenol, di and triphenols) was studied by observing the change of the organic substance through global parameter controls and by identification of oxidation products by chromatographic analysis, mass spectrometry, and nuclear magnetic resonance spectrometry. Chlorine dioxide does not react in the dark with paraquinone nor within the pH range between 4 and 8. The oxidation of hydroquinone and phenol leads to the production of paraquinone as a final by-product. With the other phenolic compounds, chlorine dioxide treatment leads to the rapid disappearance of the aromaticity, accompanied by the liberation of unsaturated acids in the aqueous medium. Oxidation by chlorine dioxide can also lead to the elimination of the total organic carbon (TOC) by CO2 production. These decarboxylation reactions during phenol oxidation are relatively slow, and maximum TOC elimination is only obtained after a very long contact time. The production of CO2 as well as of oxalic and malic acids is possible even at low oxidation rates. (Moore-IVI)
W85-04302

RATIONALIZATION OF THE BURKERSDORF DRINKING-WATER-TREATMENT FACILITY (RATIONALISIERUNG DER TRINKWASSER-AUFBEREITUNGSANLAGE BURKERSDORF),
VEB Projektierung Wasserwirtschaft, Dresden (German, D.R.).
R. Meyer.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 12, p 417-419, December, 1983. 3 Fig, 8 Ref.

Descriptors: *Burkersdorf, *Germany (Democratic Republic), *Drinking water, *Water treatment, Pressure filtration, Potassium permanganate, Aluminum sulfate, Activated carbon, Caustic soda, Chlorine, Ammonium sulfate, Fluoride, Filtration, Flocculation, Hydrogen ion concentration, Disinfection, Costs.

The Burkersdorf drinking-water treatment facility (BDWTF) is part of a complex consisting of the Eibenstock dam, BDWTF, and a distribution facility on the upper Zwickauer Mulde river that serves the Karl-Marx-Stadt/Zwickau urban area in the German Democratic Republic. BDWTF is a pressure-filter facility (20 filters with a combined area of 1,200 sq m), a chemical-application facility, and two 10,000 cu m steel tanks (each 45 m in diameter and 7.5 m high) for storing treated water. BDWTF was designed so that initial capacity of 140,000 cu m/day during the filling of the reservoir could be achieved with two-stage filter operation, while the final capacity of 200,000 cu m/day for the equilibrium stage of the reservoir could be treated by single-stage filter operation. Efforts were made to lower construction costs by above- or partially above-ground building, lower construction time by using compact types of construction and prefabricated equipment, optimize investment and operating costs, and provide functional stability and good work conditions. These goals could be met by installing horizontal single-layer enclosed filters partially above ground. Chemicals used prior to filtration include potassium permanganate to remove manganese, aluminum sulfate for flocculation, and activated carbon for odor and taste control in powder form when needed; after filtration, caustic soda to balance pH, chlorine and ammonium sulfate for disinfection and fluoride are applied. Projected investment and net costs were undercut

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by 30%. The ratio of construction to equipment costs was 80%. During test operation, full capacity was achieved, and water-quality standards were met. (Gish-IVI)
W85-04324

TRIHALOMETHANES IN SOME TREATED WATERS IN SE WALES,
Welsh Water Authority, Newport (Wales).
R. J. Inverarity, and M. P. Brooker.
Effluent and Water Treatment Journal, Vol. 24, No. 11, p 417-419, November, 1984. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Trihalomethanes, *Water treament, *River Wye, *Wales, Chlorination, Pollutant identification, Disinfection, Water quality.

Two experiments were undertaken in August and September of 1981 in which samples of water from the River Wye at Monmouth were dosed with 1, 3, 5 and 10 mg/l chlorine by addition of sodium hypochlorite solution. Trihalomethane (THM) concentrations were estimated by a headspace gas-chromatographic method after incubation in the dark at 20 degrees C. Maximum total THM concentrations, principally chloroform, exceeded 400 micro-g/l in the first experiment and 150 micro-g/liter in the second. From March 1982 to June of 1983 raw, final and distibuted water samples were taken from five sites selected to represent a variety of surface-water sources and treatment processes. There were substantial differences in THM concentrations in treated waters between sites, the highest mean concentration 132 micro-g/l being recorded at Monmouth and the lowest, 23 micro-g/l, at Talybont. THM concentrations were generally lower at reservoir sources than for the two supplies abstracted directly from the River Wye. Mean THM concentrations were higher in samples collected from the distribution system than in treated water leaving the works, and this probably reflects the longer chlorine contact times. A significant positive correlation was noted of THM concentration in treated water with water temperature at both Monmouth and Broomy Hill. During most of the period of study water at Monmouth was chlorinated at the point of mixing raw water and coagulant. In June 1983 the method was changed and the point of chlorination moved to post-clarification. This brought about a significant decrease in THM formation. (Baker-IVI)
W85-04336

CONSERVING ENERGY IN WATER SYSTEMS,
Burns and McDonnell, Kansas City, MO.
For primary bibliographic entry see Field 6B.
W85-04404

APPLICATION AND EFFECTIVENESS OF SLOW SAND FILTRATION IN THE UNITED STATES,
Strand Associates, Inc., Madison, WI.
L. A. Slezak, and R. C. Sims.
Journal of the American Water Works Association, Vol. 76, No. 12, p 38-43, December, 1984. 15 Fig, 6 Tab, 1 Ref.

Descriptors: *Filtration, *Sand filters, *Water treatment, Turbidity, Design criteria, Coliforms, Bacteria, Economic aspects.

A survey was conducted of 27 slow sand filtration plants in the United States. Most of the plants served communities of fewer than 10,000 persons, were more than 50 years old, and were effective and inexpensive to operate, due to the small number of personnel required and the minimal need for chemicals to operate the system. However, there has also been a significant amount of slow sand filter construction during the past 25 years. Most slow sand filtration facilities operate at filtration rates of less than 0.25 cu m/h/sq m. The longest filter cycle durations occurred during the winter months at most facilities. Specifics are given on the slow sand filtration research facility at Logan, Utah which is comparable with other operating facilities of a similar nature. (Baker-IVI)
W85-04405

SLOW SAND AND DIRECT IN-LINE FILTRATION OF A SURFACE WATER,
Iowa State Univ., Ames. Dept. of Civil Engineering.
J. L. Cleasby, D. J. Hilmoe, and C. J. Dimitracopoulos.
Journal of the American Water Works Association, Vol. 76, No. 12, p 44-55, December, 1984. 17 Fig, 11 Tab, 19 Ref.

Descriptors: *Water treatment, *Filtration, *Sand filters, Turbidity, Bacteria, Suspended particles, Giardia, Algae, Drinking water.

Problems of the small water system faced with the need to construct treatment facilities that will be easy to operate and maintain yet will produce water that meets drinking water standards are discussed. A pilot study was performed to evaluate slow sand and direct in line filtration of a surface water. The slow sand filter outperformed the direct in-line filtration system operating with alum or cationic polymer as a primary coagulant. This conclusion was substantiated by turbidity, particle count, and total coliform data. When simple operation is important, as in small water supply systems, a slow sand filter system has advantages, but the raw water quality must be consistently high. Enumeration of algae or a surrogate measure of algal population, such as chlorophyll, is essential for judging the acceptability of a raw water for slow sand filtration. For raw waters of somewhat poorer quality, direct in-line filtration can be used, but this system requires substantially more operational skill and attention. Other alternatives, such as diatomaceous earth filtration, should also be considered. Both slow sand filtration and direct in-line filtration exhibited a period of poorer filtrate quality at the beginning of the filter runs. Thus, both systems require a filtering-to-waste period if Giardia cysts are a concern. Minimum wasting periods of two days for slow sand filtration and 1 hr for direct in-line filtration are suggested. (Baker-IVI)
W85-04406

DECLINING-RATE FILTERS: REGULATORY ASPECTS AND OPERATING RESULTS,
Florida Univ., Gainesville.
D. A. Cornwell, M. M. Bishop, and H. J. Dunn.
Journal of the American Water Works Association, Vol. 76, No. 12, p 55-61, December, 1984. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Filtration, *Water treatment, *Declining rate filters, Regulations, Turbidity, Efficiency, Operation.

Declining rate filters have been used in water treatment plants at filtration rates ranging from 1 to 3.4 mm/s (1.5 to 5 pgm/sq ft). The performance of declining-rate filters is equal to that of constant-rate filters and at times exceeds them in terms of effluent turbidity. The design of influent-controlled filters tends to make them easier to operate than effluent-controlled filters. Effluent-controlled filters conserve head loss through the filters, which is inherent to the filters' design and operation. State regulations have no specific requirements for the design and operation of declining-rate filter systems, and do not allow for the differentiation between the two types of filters. Most states indicated that maximum-filtration-rate regulations for constant-rate filters apply to clean bed filter rate of a declining-rate filter. This policy tends to discriminate against the use of declining-rate filters because the average filter loading rate for declining-rate filters is lower than that of constant-rate filters. The current trend in the design of filters leans toward constant-rate operation. Significant operating data are now available on the successful use of declining-rate filters. Declining-rate filters should be considered for new facilities or for modifications of existing plants because they can achieve a substantial cost savings through improved performance and ease of operation. (Baker-IVI)
W85-04407

PILOT-PLANT STUDIES OF SLOW-RATE FILTRATION,
Environmental Protection Agency, Cincinnati, OH. Center for Environmental Research Information.
K. R. Fox, R. J. Miltner, G. S. Logsdon, D. L. Dicks, and L. F. Drolet.
Journal of the American Water Works Association, Vol. 76, No. 12, p 62-68, December, 1984. 10 Fig, 4 Tab, 5 Ref.

Descriptors: *Water treatment, *Filtration, Coliforms, Bacteria, Drinking water, Standards.

Slow-rate filtration may be used as an alternative to conventional water filtration plants. Pilot plant studies have been conducted to evaluate slow-rate filtration for the removal of particulates, total coliforms, standard plate count bacteria, and organics. Two pilot-scale filtration systems were used: a slow sand filter, operated for 800 days, and a second slow sand filter operated in parallel with a slow-rate filter containing granular activated carbon, operated for 200 days, The study indicated that slow-rate filtration can be a relatively easily operated and effective process for small systems currently confronted with noncompliance with drinking water standards or for new small systems. (Baker-IVI)
W85-04408

5G. Water Quality Control

PROTECTION OF GROUNDWATER IN RELATION TO WASTE DISPOSAL IN WESSEX WATER AUTHORITY,
Wessex Water Authority, Bristol (England).
For primary bibliographic entry see Field 5E.
W85-03766

COMPARISON OF DIFFERENT METHODS OF ESTIMATING INFILTRATION AT A LANDFILL SITE IN SOUTH ESSEX WITH IMPLICATIONS FOR LEACHATE MANAGEMENT AND CONTROL,
Cleansway Ltd., Rayleigh (England).
R. Holmes.
Quarterly Journal of Engineering Geology, London, Vol. 17, No. 1, p 9-18, 1984. 5 Fig, 5 Tab, 9 Ref.

Descriptors: *Rainfall infiltration, *Landfills, *Essex, *England, *Leachates, Vegetation, Leachate management, Seasonal variation, Infiltration, Rainfall intensity, Water pollution control.

As a result primarily of rainfall infiltration through waste materials, all landfill sites in the United Kingdom will produce leachate. A procedure for estimating rainfall infiltration through landfill sites founded on readily and cheaply available Meteorological Office data is presented. This accounts for the distribution of rainfall throughout the year and shows that for a site in south Essex, between 14 and 34% of annual rainfall infiltrated in the past eight years. From the study of Pitsea landfill water balance, the Meteorological Office MORECS model is considered to give reasonable and seasonally variable estimates of effective rainfall input into landfills. The effective annual rainfall expressed as a percentage of the total annual rainfall for the past eight years at the Pitsea landfill ranged from 14 to 34% and averaged 24%. The impact on leachate generation of intense rainfall events does not appear to be very marked. Most effective rainfall occurred during December, January, February and March. Reasonable winter and summer operational strategies can be adopted to minimize rainfall infiltration in winter, and take up the shortfall between actual and potential evaporation and transpiration in summer. It should be common practice for landfills to be provided with refuse water level monitors and for water levels in them to be measured regularly in order that a site's hydrological development can be monitored and interpreted. Where leachate is removed from site or distributed back onto site, volume throughput should be recorded, preferably by measuring through a properly installed flowmeter. (Baker-IVI)
W85-03767

RECIRCULATION OF LEACHATE AS A LANDFILL MANAGEMENT OPTION: BENEFITS AND OPERATIONAL PROBLEMS,
Water Research Centre, Stevenage (England).
C. Barber, and P. J. Maris.
Quarterly Journal of Engineering Geology, London, Vol. 17, No. 1, p 19-29, 1984. 10 Fig, 3 Tab, 5 Ref.

Descriptors: *Leachate, *Landfills, *Leachate recirculation, *Seamer Carr, *England, Groundwater pollution, Vegetation, Water pollution control, Waste disposal, Land disposal.

In climates such as that in the UK, where rainfall exceeds potential evaporation, it is inevitable that leachates will be formed at landfill sites. Recirculation of leachate through landfilled solid wastes offers potential advantages in reducing the volume of liquid by surface evaporation, and reducing the strength of leachate by crude anaerobic treatment within that landfill. The benefits of recirculation of leachate found in smaller studies can be obtained at full scale, although longer periods of leachate recycle may be required to produce low strength leachate. Research at Seamer Carr, North Yorkshire, England, indicates that recirculation by itself cannot provide a lasting solution for leachate management, although significant reductions in the volume and strength of leachate can be achieved. Reduction in the strength of leachate can be achieved by increasing the moisture content of wastes, with greatest reduction occurring where waste are fully saturated. Careful control of recirculation is required for the best results and, in particular, it is necessary to consider the hydrology of a landfill and how this is affected by the use of cover material. (Baker-IVI)
W85-03768

CHANGES IN THE ORGANIC FRACTION OF LEACHATE FROM TWO DOMESTIC REFUSE SITES ON THE SHERWOOD SANDSTONE, NOTTINGHAMSHIRE,
Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 5B.
W85-03771

PURGING OF SALINE WEDGES FROM OCEAN OUTFALLS,
New South Wales Univ., Kensington (Australia). Water Research Lab.
For primary bibliographic entry see Field 2L.
W85-03791

MODELING FOR DESIGN OF LANDFILL BOTTOM LINERS,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Civil and Environmental Engineering.
A. C. Demetracopoulos, G. P. Korfiatis, E. L. Bourodimos, and E. G. Nawy.
Journal of Environmental Engineering, Vol. 110, No. 6, p 1084-1098, December, 1984. 14 Fig, 11 Ref.

Descriptors: *Linings, *Model studies, *Landfills, *Groundwater protection, Water pollution prevention, Leachates.

The hydraulics of a liner collection system was studied through a model capable of computing heads over a clay liner and volumes of leachate collected and leaking through the liner. The analysis was performed by a model based on Wong's formulation. The model is also applicable for variable input conditions through a quasisteady computation procedure. In addition, a time variable differential equation governing the hydraulics of the same liner system was reported. The present analysis has shown that both the geometric parameters and physical properties used for the water balance computations of the collection system influence the model output. In actual liner collection system design cases, the extent of variation of one or more of these parameters may be limited by different constraints. The two most important constraints are economic considerations and material availability. For example, reduction of the liner cell length beyond a certain limit may be uneconomical subject to drain construction costs. On the other hand, materials with low permeability may not be available in particular areas for construction of the bottom liner. The model can be used as an optimization tool to obtain the best possible design under such limiting factors. (Baker-IVI)
W85-03803

NEW CONTINUOUSLY MONITORED COLLECTION SYSTEM FOR LIQUID INDUSTRIAL WASTES,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 8A.
W85-03872

IMPACT OF DISCHARGES FROM POINT AND NONPOINT SOURCES ON WATER QUALITY OF THE UPPER REEDY RIVER NEAR GREENVILLE, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W85-03895

GROUND-WATER MODELS AS A MANAGEMENT TOOL IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03924

TRACE METALS IN SAN FRANCISCO BAY, CALIFORNIA, NEAR THE PROPOSED SAN LUIS DRAIN DISCHARGE SITE: A PRELIMINARY REPORT,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W85-03927

DRIFT MINE RECLAMATION IN BIG FOUR HOLLOW NEAR LAKE HOPE, OHIO--A PRELIMINARY DATA REPORT,
Geological Survey, Columbus, OH. Water Resources Div.
V. E. Nichols.
Available from OFSS, USGS, Box 24525, Fed. Ctr., Denver, CO 80225. USGS Open-File Report 83-217, 1983. 115 p, 9 Fig, 17 Tab, 4 Ref.

Descriptors: *Acid mine drainage, *Water pollution control, Underground structures, On-site data collections, Hydrogen ion concentration, Specific conductance, Iron oxides, Sulfates, *Ohio, Drift mines.

A subsurface clay dike and a remote hydraulic seal were constructed in an abandoned drift mine in 1979 to reduce acid-mine drainage. A monitoring program was established to evaluate sealing effects on the surface- and ground-water systems of Big Four Hollow Creek and Sandy Run. Data collected in 1970-71 just below the mine showed a pH range of 2.7 to 4.8, an estimated sulfate load of 1,000 pounds per day, and an estimated iron load of 100 pounds per day. Pre-construction data at the same site in 1979 showed daily mean pH range of 3.4 to 5.4, a daily mean specific-conductance range of 160 to 600 micromhos per centimeter (at 25 degrees Celsius), an estimated sulfate load of 1,000 pounds per day, and an estimated iron load of 50 pounds per day. Data from the first 6 mo of postconstruction showed a daily mean pH range of 4.5 to 6.8, a daily mean specific-conductance range of 175 to 405 micromhos, an estimated sulfate load of 570 pounds per day, and an estimated iron load of 8.5 pounds per day. Acidic water is still being impounded behind the dike and seals and has not been flushed out by infiltrating rain and ground water. The system has not stabilized; therefore, no interpretation or conclusive statement can be made at this time. (USGS)
W85-03950

IMPACTS, COSTS, AND TECHNIQUES FOR MITIGATION OF CONTAMINATED GROUNDWATER: A REVIEW,
Resources for the Future, Inc., Washington, DC.
M. Sharefkin, M. Shechter, and A. Kneese.
Water Resources Research, Vol. 20, No. 12, p 1771-1783, December, 1984. 1 Fig, 8 Tab, 40 Ref.

Descriptors: *Groundwater pollution, *Costs, *Water pollution control, *Cohansey aquifer, *New Jersey, Environmental effects, Public health, Mortality, Cost-benefit analysis, Hazardous wastes, Incentives, Economic aspects, Water pollution prevention.

A framework is developed for evaluating the impacts, costs, benefits, and techniques for mitigating groundwater contamination. The framework is a generalized cost-benefit analysis. Contamination of the Cohansey aquifer in New Jersey is the subject of an illustrative case study. The plume of contamination is modeled and potential health impacts are projected based on dose-response information available from the Environmental Protection Agency. The economic value of such damages is estimated using alternative mortality risk values that span those found in the recent literature. Costs for controlling the contamination from the site are estimated for alternative levels of control and techniques of control adapting information from the Environmental Protection Agency and other sources. While both the benefits and cost estimates should be mainly viewed as the result of illustrating a method and not as accurate estimates, they do suggest that in a case like the Cohansey, both potential damages (or damages averted, i.e. benefits) and the cost of containment once contamination has occurred can be quite high. Prevention in such cases appears to be the best cure. The paper closes with a discussion of the potential role of economic incentives in the generation of hazardous wastes and their 'safe' disposal. (Author's abstract)
W85-03982

EFFECTIVENESS OF FLOATING BIOFILTERS OF EMERGENT AQUATIC PLANTS IN RELATION TO THE CHARACTERISICS OF THEIR FORMATION,
A. R. Orekhovskii, and P. I. Shagovenko.
Water Resources, Vol. 10, No. 2, p 189-195, 1983. 4 Tab, 32 Ref. Translated from Vodnye Resursy, No. 2, p 132-140, 1983.

Descriptors: *Water quality control, *Biofilters, *Metals, *Organic compounds, *Aquatic plants, Phenols, Calcium, Sodium, Nitrogen, Magnesium, Phosphorus, Potassium, Silicon, Molybdenum, Copper.

An experiment was conducted over three years on the creation of microquagmires (biofilters) of reed and bulrush in canals. The greater the biomass they form during the growing season, the greater the purifying action of the biofilters. The main cause of the weak development of the experimental floating biogroups in the first set of experiments in the Dnepr-Donbas canal was the absence of a constant current, which reduced to a minimum the exchange of water masses in the root zone and hindered the supply of dissolved nutrients to the plants. Reeds and bulrushs produced a large amount of biomass in the experiments by the end of the second season when a constant circulation had been provided. The productivity of the biomass of floating bulrush cultures is considerably higher than the productivity of natural bulrush beds growing in soil. In a canal channel with constant water circulation extraction of pollutants occurs not only by direct absorption of dissolved mineral substances by root systems but also by retention (interception) of suspended clay fractions and their settlement on all plant parts submerged in water and also between the haydite and gravel particles. In addition to nitrogen, phosphorus, and potassium, reeds and bulrushs actively absorb calcium, sodium, magnesium, silicon, molybdenum, and copper from water. Bulrushs can decompose phenol and its derivates contained in water. The most important role of biofilters of emergent plants is apparently that they actively absorb nitrogen compounds. (Baker-IVI)
W85-04098

HYDROBIOLOGICAL ASPECTS OF ECOLOGICAL SUBSTANTIATION OF INTERBASIN WATER TRANSFERS,
V. D. Romanenko, O. P. Okslyuk, and V. N. Zhukinskii.
Water Resources, Vol. 10, No. 2, p 196-204, March-April 1983. 25 Ref. Translated from Vodnye Resursy, No. 2, p 141-151, March-April, 1983.

Descriptors: *Water transfers, *Interbasin transfers, Water management, Water pollution control, Environmental effects, Water quality control, Aquatic life, Hydrology, Water use.

Ecological substantiation of interbasin water transfers consists of working out recommendations on selecting the best variants of the route with consideration of the composition, morphometric, and hydrological characteristics of the water bodies incorporated into the system, recommendations on its operating regime from the viewpoint of the formation of water quality and biological productivity, and also on conducting water-protection and nature conservation measures in the zone of influence of the interbasin transfer system. The basis for creating a satisfactory ecological forecast is the accumulation of long-term representative data on the hydrological, hydrochemical, and hydrobiological regimes of existing water objects both in the zone of withdrawal of the runoff and along the entire route of diversion, and also in the zone of use of the runoff, where the main water consumers are usually located. The characteristics of water quality in reconstructed and newly created water bodies and streams of the transfer system are among the principal components of ecological substantiation. Water quality is characterized from an ecological standpoint and of its use for domestic, industrial, and agricultural water supply, irrigation, recreation or other use. The classification as developed includes hydrophysical and hydrochemical indices reflecting the composition and properties of water with respect to abiotic components and also biological indices characterizing water quality with respect to biotic components of aquatic ecosystems. Special aspects of ecological substantiation are ecotoxicological and radioecological, which assume a characterization and quantitative evaluation of the migration, transformation, and accumulation of various toxicants and radionuclides in ecosystems of water objects, both in their abiotic part and in communities of hydrobionts at all trophic levels. (Baker-IVI)
W85-04099

CONTROL OF AZOV SEA SALINITY BY REGULATING WATER EXCHANGE IN THE KERCH STRAIT,
T. A. Kochina, and D. Ya. Ratkovich.
Water Resources, Vol. 10, No. 3, p 229-241, May-June, 1983. 7 Fig, 7 Tab, 5 Ref. Translated from Vodnye Resursy, No. 3, p 43-59, May-June, 1983.

Descriptors: *Water exchange, *USSR, *Azov Sea, *Kerch Strait, *Salinity, Water quality control, Fish migration, Eutrophication, Water quality.

The Azov Sea was characterized by a high biological productivity in the past. The water balance of the Azov Sea is influenced by the river inflow and water exchange with the Black Sea through the Kerch Strait. As a result of a considerable increase in water consumption in the Azov Sea basin, in the past decade, the inflow of the more saline Black Sea water into it increased, the salinity of the sea increased, biological productivity decreased, and fish species composition deteriorated. To delay the further development of unfavorable processes in the Azov it is necessary to examine measures which would partially compensate for the decrease of inflow of river waters before the start of water transfer. An engineering scheme to regulate water exchange between the Black and Azov Seas can be constructed in the Kerch Strait which would slow the increase of salinity and in the future would somewhat reduce the volume of water contributions required. The Kerch scheme will transform the Azov Sea into a reservoir, the level of which will vary. The useful storage of this reservoir is 25 cu km, and both long-term and seasonal regulation of water exchange with the Black Sea is possible. Water exchange with the Black Sea will occur only periodically; there may be a complete absence of exchange for several years in a row. Operation of the Azov reservoir with long term regulation will lead to low salinity values, which may be accompanied by blooms and overgrowth. This regime is unfavorable for migrating fish species, including the anchovy. A change in the water exchange regime may make it possible to preserve the conditions for migratory fishes and to bring the salinity of the sea close to the desired values. For a river inflow to the sea of 25 cu km/yr and twice yearly opening of the outlets, the salinity of the Azov reservoir will vary near an average value of about 12-13. (Baker-IVI)
W85-04103

WATER PROTECTION PROBLEMS IN ESTONIA: HYGIENIC ASPECTS,
O. M. Tamm, A. E. Saava, I. A. Veldre, K. F. Birk, and I. A. Vakhula.
Water Resources, Vol. 10, No. 3, p 310-313, May-June, 1983. Translated from Vodnye Resursy, No. 3, p 154-158, May-June, 1983.

Descriptors: *Estonian SSR, *USSR, *Water quality control, Wastewater treatment, Water pollution control, Surface waters, Water use, Marine pollution, Oil pollution, Water pollution sources.

Large water-intensive industries and power facilities are generally based on surface water usage in Estonia. Surface waters are also used as the source of water supply for large cities. In recent years the use of surface sources for recreational purposes has increased considerably. At the same time, water bodies are being used as wastewater receivers. The greatest amount of wastewater entering the streams and rivers comes from industry, followed by municipal facilities. Additional wastewater comes from mine waters in the shale basin, and the Estonian and Baltic electric stations discharge considerable amounts from the cooling circuits. In many areas of Estonia there is a move toward a stabilization or even an improvement of the sanitary state of water sources, as a result of effective water-protection measures. Problems of marine water use and sanitary protection of the coastal waters of the Baltic Sea are additional areas for concern. The main sources of petroleum pollution to the bay include the port, shipyards, and ships standing on the roadstead. An oil content in the water higher than the maximum allowable is observed only in the port region with weak water exchange. (Baker-IVI)
W85-04113

ASSURANCE OF REASONABLE TOXIC RISK,
New Mexico Univ., Albuquerque.
For primary bibliographic entry see Field 6E.
W85-04190

EQO THEORY IN PRACTICE,
Anglian Water Authority, Huntingdon (England).
A. D. Barnden.
Effluent and Water Treatment Journal, Vol. 24, No. 11, p 409-416, November, 1984. 2 Fig, 6 Tab, 28 Ref.

Descriptors: *Water quality control, *Environmental quality objective, Frequency distribution, Rivers, Water management, Water quality criteria.

The principles of environmental quality objective (EQO) theory are outlined and practical application of EQO policy is discussed. Emphasis is given to the underlying assumptions about river water quality frequency distributions, derivation of water quality criteria for river uses and setting discharge consents. The water quality criteria developed in the Anglian Water Authority are presented. EQO theory provides a sound basis for environmental management. Statistical evaluation of sampling programs, data examination and compliance with standards is essential. Compatible techniques must be used at all stages from stating objectives through deriving criteria and setting consents to assessing compliance and considering capital investment. The derivation of water quality criteria is an important step in implementing EQO theory. (Baker-IVI)
W85-04335

SIGNIFICANCE AND BEHAVIOUR OF HEAVY METALS IN WASTEWATER TREATMENT PROCESSES IV. WATER QUALITY STANDARDS AND CRITERIA,
Imperial Coll. of Science and Technology, London (England). Industrial Sociology Unit.
For primary bibliographic entry see Field 5D.
W85-04356

PRESERVING NEBRASKA'S WETLANDS: NOW AND IN THE FUTURE,
M. A. Christensen.
Nebraska Law Review, Vol. 63, No. 3, p 473-513, 1984. 192 Ref.

Descriptors: *Wetlands, *Legal aspects, *Water resources development, *Nebraska, Preservation, Sandhills, Groundwater, Flood control, Water quality, Land acquisition, Cost-sharing.

In an effort to increase public awareness of the importance of Nebraska's wetlands and to evaluate the means presently available to aid in wetlands preservation, this summary of wetlands and their role in Nebraska is offered. Suggestions for further protective measures are also made. The destruction of Nebraska's wetlands is described as it relates to the rainwater basin and the sandhills. Consequences of wetlands destruction include a loss of nutrients, groundwater supplies and recycling center for water, and a lessening of the holding power of water from rainfall. Wetland protections afforded under the Clean Water Act are discussed, specifically section 404. Other means of preservation include federal land acquisition, state land acquisition, state cost sharing practices, and water bank programs. (Baker-IVI)
W85-04374

POLLUTING SEWERS BROUGHT UNDER CONTROL,
Marion County Health Dept., Indianapolis, IN. Bureau of Environmental Health.
For primary bibliographic entry see Field 5D.
W85-04403

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

GROUND-WATER MODELS AS A MANAGEMENT TOOL IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
C. B. Hutchinson.
Available from the OFSS, USGS, Box, 25425, Fed. Ctr. Denver, CO 80225. USGS Water-Resources Investigations Report 84-4016, 1984. 26 p, 5 Fig, 2 Tab, 49 Ref.

Descriptors: *Florida, *Computer models, *Groundwater movements, Hydrogeology, Water management, *Model studies, *Groundwater models.

Highly sophisticated computer models provide powerful tools for analyzing historic data and for simulating future water levels, water movement, and water chemistry under stressed conditions throughout the ground-water system in Florida. Models that simulate the movement of heat and subsidence of land in response to aquifer pumping also have potential for application to hydrologic problems in the State. Florida, with 20 groundwater modeling studies reported since 1972, has applied computer modeling techniques to a variety of water-resources problems. Models in Florida generally have been used to provide insight to problems of water supply, contamination, and impact on the environment. The model applications range from site-specific studies, such as estimating contamination by wastewater injection at

St. Petersburg, to a regional model of the entire State that may be used to assess broad-scale environmental impact of water-resources development. Recently, groundwater models have been used as management tools by the State regulatory authority to permit or deny development of water resources. As modeling precision, knowledge, and confidence increase, the use of ground-water models will shift more and more toward regulation of development and enforcement of environmental laws. (USGS)
W85-03913

OPERATION OF RESERVOIR SYSTEMS WITH SPECIAL REFERENCE TO THE UPPER WISLA,
J. Kindler, K. Salewicz, H. Slota, and T. Terlikowski.
Water Resources, Vol. 10, No. 3, p 217-229, May-June, 1983. 3 Fig, 15 Ref. Translated from Vodnye Resursy, No. 3, p 3-17, May-June, 1983.

Descriptors: *Reservoirs, *Water management, *Decision making, *Poland, *Upper Wisla, Multireservoir networks, Planning, Management, Information theory.

One of the systems of several reservoirs existing in Poland is used as an example of how it is possible to develop the operating rules for a water-management (WMS) system by means of certain theoretical methods including decision theory and information theory. Attention is devoted not only to the development of the methodological bases of operation of the WMS but also to the form of the initial information needed for constructing the operation rules and to the information structure of the rules. A description of the water-management system of the Upper Wisla is given and problems of water management in this region are defined. Two methods of determining the main parameters of the operation rules for a system of reservoirs are given and a hierarchical approach to operation of reservoirs in the described system is examined. At the given stage of investigations the proposed control scheme is still not completely adapted to a real system. (Baker-IVI)
W85-04102

6B. Evaluation Process

WATER RESOURCES OF THE THAMES BASIN: QUANTITATIVE AND QUALITATIVE ASPECTS,
Thames Water Authority (England). Northern Div.
D. G. Jamieson, and N. J. Nicolson.
Journal of the Institution of Water Engineers and Scientsts, Vol. 38, No. 5, p 379-391, October, 1984. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Thames River Basin, *England, *Water resources development, River basins, Evaluation, Planning, Decision making.

The Thames Basin is one of the most intensively used water resource systems in the world. This creates potential problems for both water quantity and quality. The paper briefly describes the planning process adopted for assessing options and outlines the proposed development strategy. At present, the water resources of the Thames basin are in a delicate state with unacceptable levels of risk in the Metropolitan area. Moreover, for the foreseeable future, demands are expected to increase at about 1% per year compound putting further strain on current resources. Since development of new resources is expensive and time consuming, the short term strategy is based on optimizing the use of existing resources. This takes a number of forms including re-deployment of temporary surpluses to areas of need, minimizing exports, seeking powers to repeal statutory constraints, and improved operational control. Before the end of the decade, new groundwater resources will have to be developed, particularly in the middle reaches of the Thames. Artificial recharge of the London chalk aquifer has already been agreeed in principle for the north metropolitan area and a staged development is expected during this period. Notwithstanding water conservation measures, additional resouces will probably be required for the 1990s and beyond. Inevitably, these will have to be based primarily on new surface water storage and/or more intensive use of effluent. With this increasing reliance on indirect effluent re-use, the need for continuing vigilance of water quality will also increase. It seems likely that the use of ozone and/or granular activated carbon will become part of conventional water treatment if quality standards are to be maintained. (Baker-IVI)
W85-03881

IMPACTS, COSTS, AND TECHNIQUES FOR MITIGATION OF CONTAMINATED GROUNDWATER: A REVIEW,
Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 5G.
W85-03982

EX POST EVALUATION OF FLOOD CONTROL INVESTMENTS: A CASE STUDY IN NORTH DAKOTA,
Tamil Nadu Agricultural Univ., Coimbatore (India). Dept. of Agricultural Economics.
K. Palanisami, and K. W. Easter.
Water Resources Research, Vol. 20, No. 12, p 1785-1790, December, 1984. 9 Tab, 12 Ref.

Descriptors: *Flood control, *Ex post evaluation, *North Dakota, Baldhill Dam, Lake Ashtabula, Water supply, Cost-benefit analysis, Ex ante evaluation, Dam effects, Comercial fishing, Recreation, Reservoir fisheries, Land acquisition, Flood forecasting.

Ex post evaluation of flood control projects is important in order to study the full range of actual project benefits which occur compared to expectations. Ex post evaluations can be used to help improve ex ante estimates. An ex post evaluation was conducted on the Baldhill Dam and Lake Ashtabula flood control project in North Dakota. Construction on the project began in 1947, with emergency operation of the dam beginning in 1950, and full operation starting in 1952. The ex post estimates were 100% higher than the ex ante estimates. The largest increases in costs were in land acquisition and construction of recreational facilities. Ninety-two percent of the ex ante benefits were suppose to come from water supply and 8% from flood control. Ex post estimates found zero water supply benefits and flood control 37 times higher than ex ante estimates. These added flood control benefits were enough to make up for all the lost water supply benefits. The ex ante estimates did not include commerical fishing and recreation benefits which accounted for 28% of the ex post benefits. The total ex post benefits were about 300% higher than the ex ante estimates. The estimated ex ante water supply and flood control benefits were based on inadequate data and analysis. The prediction of flood events was based on only three past floods and a record of 6 years of water levels. (Moore-IVI)
W85-03983

STATUS OF WATER AND SANITATION FACILITIES IN THE NORTHWEST TERRITORIES,
Government of the Northwest Territories, Yellowknife. Water and Sanitation Section.
V. Christensen.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December, 1982. p 1-17, 1 Fig, 6 Tab, 6 Ref.

Descriptors: *Utilities, *Cold regions, Polar regions, Sanitation, Northwest Territory, Public policy, Domestic water, Domestic wastes, Water resources development, Canada.

The level of service available to Northwest Territory (N.W.T) residents remains inferior to that enjoyed by residents of communities in other areas of Canada. Conditions have improved substantially in the last few years, though considerable improvements at considerable cost remains to be undertaken before acceptable levels of service are available in all N.W.T. communities. The N.W.T. is approximately 70 precent of the way toward attaining overall acceptability of water and sanitation services. At the present levels of investment by the federal, territorial and municipal goverments in improved community water and sanitation infrastructure, it will likely be another 8 to 10 years before acceptable services are realized across the N.W.T.
W85-04238

DRY SPELL CONTINUES FOR WATER PROJECTS AS FINANCING AGREEMENT ELUDES CONGRESS,
T. B. Clark.
National Journal, Vol. 16, No. 44, p 2079-2082, November, 1984. 3 Fig.

Descriptors: *Water resources development, *Government finance, Government supports, Legislation, Dams, Locks, Ports, Financing.

Prospects for a major water project authorization bill for next year in Congress do not seem favorable. The rise of the environmental movement has paralleled the decline of the government's water resources development program. Federally funded water projects have principally benefited the South and Midwest, where the Army Corps of Engineers is most active, and the West, where the Interior Department's Bureau of Reclamation has played a huge role in economic development. A bill introduced by a subcommittee calls for more than 300 projects. Among the most expensive items were seven lock and dam projects and six deep draft ports. Many features of this bill have been opposed by the Administration. Attempts have been made recently to attach water projects as riders to the huge appropriations bill that consumed congressional attention at the end of the session, an example of the extreme frustration felt by both chambers over the lack of movement in water resource development. Congressional demands for project authorizations without strict cost-sharing requirements will certainly continue next year. (Baker-IVI)
W85-04368

CASE STUDY OF THE ABUSE OF SCIENCE IN SEWAGE PLANNING,
Northwest Consultant Oceanographers, Inc., Seattle, WA.
L. C. Loehr, and E. E. Collias.
Marine Pollution Bulletin, Vol. 15, No. 12, p 439-443, 1984. 2 Fig, 31 Ref.

Descriptors: *Decision making, *Monterey Bay, *California, *Wastewater disposal, Water circulation, Legal aspects, Lead, Metals.

In 1971 a zone of prohibition was established in Monterey Bay for waste discharge. A regional sewage system is under construction bordering southern Monterey Bay, to replace small treatment plants, as a result the establishment of the zone of prohibition. The zone of prohibition was only justified by the Regional and State Water Boards several years after it had been established. In an appeal through the Regional and State Boards and the courts, it has been shown that this zone should not have been established. Over $100 million has been spent already on construction of the regional system. The zone of prohibition was upheld in November of 1982. In all cases thus far the scientific community has been excluded from the decision making process. In April of 1984, the location of a mound of metallic wastes near waters where shellfish had been taken possessing large amounts of lead prompted a reexamination of the findings. The metal could not be attributed to the sewage and it was realized that elimination of discharge in southern Monterey Bay will not produce any decrease in metals in mussels along Cannery Row. (Baker-IVI)
W85-04379

CONSERVING ENERGY IN WATER SYSTEMS,

LIBRARY OF THE URBANA-CHAMPAIGN

Burns and McDonnell, Kansas City, MO.
R. A. Daffer, Jr.
Journal of the American Water Works Association, Vol. 76, No. 12, p 34-37, December, 1984. 5 Fig, 1 Tab, 1 Ref.

Descriptors: *Conservation, *Energy, *Water treatment, *Water distribution, Gravity flow, Management, Computers, Pumps, Valves, Economic aspects.

An overview is offered of alternative sources of energy that could be practical for special water system applications and ideas are outlined for saving power from conventional sources. Sources of nonconventional energy which are briefly considered include solar, photovoltaic cells, and the use of windpower. All valves should be open, when possible. The operating pressure of the distribution system should be as low as is practical. Pipe friction can be lowered by installing new, larger lines. Pumps should not be run with throttle discharge valves. Pump curves should match the system hydraulic curve, so that pumps can be operated in their most efficient range. Energy-efficient motors should be used. Variable-speed pumps used in lieu of throttle valves to control flow can maximize energy efficiency. Computer controls can help water systems take advantage of lower nighttime power costs. Energy savings can also be found in methods of water treatment. Water can be pumped or raised with low service pumps and motors to a higher intake level so that the water can flow through the treatment process by gravity. (Baker-IVI)
W85-04404

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

SURVEY OF TRADE EFFLUENT SAMPLING FOR CHARGING IN THE SEVERN-TRENT WATER AUTHORITY,
Severn-Trent Water Authority (England).
J. Wild.
Journal of the Institution of Water Engineers and Scientsts, Vol. 38, No. 5, p 457-466, October, 1984. 2 Fig, 8 Tab, 1 Ref.

Descriptors: *Severn-Trent Water Authority, *England, *Effluents, *Pricing, Economic aspects, Decision making, Planning, Water management.

The history of trade effluent charging is surveyed considering the effect of policy changes and the rationale for determining numbers of samples required for trade effluent control and charging purposes. The foundations for an effective trade effluent control policy were laid some 70 years ago and were translated into effective legislation by the Drainage of Trade Premises Act of 1937. On those foundations a stable superstructure, with subsequent extensions, has been established, parts of which are now in need of some maintenance. As a result of the introduction of measured sewerage and sewage disposal charging it is obvious that attention must be given to flow measurements. Of the two factors, quantity and quality, required for determining trade effluent charges, quality is reasonably accurately determined provided that the samples used are representative. The same cannot be said for the determination of volumes of effluent discharged whether measured directly or determined indirectly by water balancing calculations. A rationale has been established for determining the numbers of samples required for any particular trade effluent discharge to ensure a consistent regional approach. (Baker-IVI)
W85-03886

DYNAMIC ASPECTS OF EFFLUENT TAXATION UNDER UNCERTAINTY,
J. J. Opaluch.
Journal of Environmental Economics and Management, Vol. 11, No. 1, p 1-13, March, 1984. 2 Fig, 4 Ref.

Descriptors: *Pricing, *Economic aspects, Taxation, Decision making, Planning, Water management.

Within an uncertain dynamic context, converging on an efficient effluent charge requires some sort of learning process. This paper derives the optimal adjustment scheme, which determines the fee to be charged given the current level of information. In addition, a mechanism is described to update estimates as new information becomes available. A process of this type, which accumulates information over time, is crucial for effective policy. The optimal adjustment process is shown to exhibit the dual effects of caution and probing. Because of uncertainty, society should be risk averse or cautious when setting the effluent charge. However, this tendency should be tempered by the possibility of learning through experimentation. If the uncertain parameters of the probem evolve over time, then this evolution must be explicitly accounted for in the estimation process. In general, efficient estimation of the macrorelation between the effluent charge and the aggregate level of emission requires microdata by firm. This complicates the estimation process and leads to greater informational requirements; efficient estimation requires information on activity by each firm, and not simply aggregate information on the total levels of emissions. Fortunately, unbiased but inefficient estimation is possible using aggregate data only. Hence where collecting microdata is expensive, or is not possible, estimation can proceed with data aggregated over firms. (Baker-IVI)
W85-03888

MUNICIPAL WASTEWATER TREATMENT COST,
Office of Management and Budget, Washington, DC. Office of Information and Regulatory Affairs.
A. G. Fraas, and V. G. Munley.
Journal of Environmental Economics and Management, Vol. 11, No. 1, p 28-38, March, 1984. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Municipal wastewater, *Wastewater treatment, *Economic aspects, Cost analysis, Planning, Decision making.

The cost of control for conventional pollutants at municipal wastewater treatment plants is examined. Estimates of the marginal cost for conventional control by new municipal wastewater treatment plants are designed. Ordinary least-squares regression equations relating treatment cost to publicly owned treatment works (POTW) operating characteristics are estimated using POTW data obtained from the EPA. The marginal cost to society for the removal of conventional pollutants by new POTWs can be calculated from these regression equations. The analysis presented here has direct implications for current issues in environmental policy. Congress has expressed increasing concern about the cost of municipal wastewater treatment beyond secondary treatment. These results confirm that costs rise sharply beyond secondary treatment, suggesting that further cleanup is warranted only where comparable benefits can be realized. Further, EPA has interpreted the 1977 Amendments to the Clean Water Act as estabishing the cost incurred by POTWs as a benchmark for judging the reasonableness of conventional pollutant standards for industrial dischargers. These results yield an estimate of marginal cost at secondary treatment substantially below the benchmark selected by the EPA. These findings should prove useful to policy makers in both instances. (Baker-IVI)
W85-03889

LEAK DETECTION AND UNACCOUNTED-FOR WATER ANALYSIS,
Coffin and Richardson, Inc., Boston, MA.
B. B. Babcock.
Journal of the New England Water Works Association, Vol. 98, No. 3, p 291-304, September, 1984. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Water conveyance, *Leakage, *Cost analysis, *Cambridge, *Massachusetts, Metering, Water distribution, Water loss, Computers.

A few of the problems that are faced when undertaking the assessment of a water distribution system with respect to leakage and accountability are discussed. The subject system was that serving the City of Cambridge, Massachusetts. The Department presently provides potable water and fire protection services to about 13,000 residential, 30 commercial/industrial, and institutional customers located within the City. Water treatment includes pre-aeration, coagulation/flocculation, sedimentation, filtration, post-chlorination, fluoridation and pH adjustment. All water sold to consumers is metered. An unaccounted-for water analysis was conducted after leakage losses during 1982 were deemed unacceptable. The leak detection survey showed no distinct patterns of pipeline deterioration within the system, although many individual sources of leakage were found. Leakage found during the survey was estimated at 620.5 million gallons, or 10.5% of the total system consumption. In reviewing the condition of the water meters in the city, 35% of the meters were found to have been in service over 19 years. The longer a meter is in service, the greater the chance of under-registration and the greater the percentage of inaccuracy. Efforts were undertaken to identify and eliminate all meters that had been in service over 19 years. Attempts were made to expand the computer capability of the Department to include all pertinent data for the water system and each user. (Baker-IVI)
W85-04021

PRICING AND EXPANSION OF A WATER SUPPLY SYSTEM,
Adelaide Univ. (Australia). Dept. of Civil Engineering.
G. C. Dandy, E. A. McBean, and B. G. Hutchinson.
Journal of Water Resources Planning and Management, Vol. 111, No. 1, January, 1985. 7 Fig, 5 Tab, 25 Ref, 2 Append.

Descriptors: *Kitchener-Waterloo, *Ontario, *Water conveyance, *Pricing, Optimization, Water supply, Capacity expansion, Model studies, Water use.

A model for constrained optimum water pricing and capacity expansion identifies the water price and water supply capacity, which maximizes the present value of net economic benefits over a planning horizon. Constraints on the rate of price change and financial cost recovery are included. The model is applied to the twin cities of Kitchener-Waterloo in Ontario, Canada. Kitchener-Waterloo has a combined population of 192,000 in 1981, and it is expected to undergo a population increase of approximately 2% linear growth per year with a corresponding growth in industrial employment. The existing groundwater sources are being used to their maximum capacity during periods of high summer demand. Significant economic benefits can be achieved by jointly optimizing decisions about water pricing and capacity expansion. Administrative constraints on the rate of change of price tend to reduce community benefits, but constrained optimum pricing policies are still likely to be better than average cost pricing. Optimum policies are compatible with the goal of financial cost recovery on the part of the supply authority. To maximize economic efficiency, the price of water should be varied from year to year according to the available supply capacity. For systems in which the short-run marginal cost of supply is less than the average cost, the adoption of optimum pricing policies will involve increased consumption of water, and will conflict with water conservation objectives. The benefits of optimum pricing and capacity expansion are likely to be greatest in water supply systems which exhibit economics of scale or in cities where the rate of population growth is small. (Moore-IVI)
W85-04241

6D. Water Demand

PUBLIC SUPPLY WATER USE, PALM BEACH COUNTY, FLORIDA, 1978-82,
Geological Survey, Miami, FL. Water Resources Div.
W. L. Miller, and J. A. Alvarez.
Available from the OFSS, USGS, Box. 25425, Fed. Ctr. Denver, CO 80225. USGS Open-File Report 84-240, 1984. 14 p, 2 Fig, 3 Tab, 3 Ref.

escriptors: *Water use, *Groundwater, Surface ater, *Florida, *Public supply, Surficial aquifer, lm Beach County, Municipal water.

ublic supply water-use data are listed for 32 utili-s in Palm Beach County, Florida, for 1978 rough 1982. The data are tabulated as monthly d yearly untreated water withdrawals from each blic supply utility. Utilities using ground water a source are listed separately from those using rface-water sources. In 1978, the total public pply water withdrawal in the county was ,580.64 million gallons, of which 74.0 percent 7,823.22 million gallons) was ground water. By '82, the total withdrawal had increased to ,264.16 million gallons, of which 77.5 percent 3,544.52 million gallons) was ground water. early 57 percent of the ground-water withdrawal as in southeast Palm Beach County (Zone 1) ring 1982. The greatest surface-water withdraw- during this time was from Clear Lake and Lake angonia (Zone 2) and amounted to 79.3 percent the county's total surface-water withdrawal. SGS)
'85-03916

ATER-USE COMPUTER PROGRAMS FOR LORIDA,
eological Survey, Tallahassee, FL. Water Re-urces Div.
or primary bibliographic entry see Field 7C.
'85-03934

ROBLEMS IN ESTIMATING SELF-SUP-LIED INDUSTRIAL WATER USE BY INDI-ECT METHODS--THE CALIFORNIA EXAM-LE,
eological Survey, Menlo Park, CA. Water Re-urces Div.
J. Burt.
vailable from the OFSS, USGS Box 25425, Fed. r. Denver, CO 80225. USGS Water Resources vestigations Report 83-4276, 1983. 20 p, 6 Fig, 3 ab, 21 Ref.

escriptors: *Industrial water use, *Estimating, ndirect methods, *Water demand, Consumptive e, Non-thermoelectric water use, *California.

onsumptive fresh-water use by industry in Cali-rnia is estimated at about 230 million gallons per y, or about one-half of one percent of agricultur- withdrawals in the State, and only about 1 rcent of agricultural consumptive use. There-re, a significant State-wide realignment of the tal water resources could not be made by indus-al conservation measures. Nevertheless, consid-able latitude for water conservation exists in dustry -- fresh water consumed by self-supplied dustry amounts to about 40 percent of its with-awals in California, and only about 10 to 15 rcent nationally (not including power-plant use). rthermore, where firms withdraw and consume ss water there is more for others nearby to use. he main question in attempting to estimate self-pplied industrial water use in California by indi-ct methods was whether accurate estimates of dustrial water use could be made from data on rrogates such as production and employment. he answer is apparently not. A fundamental prob-m was that different data bases produced variable efficients of water use for similar industries. uch of the potential for error appeared to lie in e water data bases rather than the production or nployment data. The apparent reasons are that ater-use data are based on responses to question-ires, which are prone to errors in reporting, and cause the data may be aggregated inappropriate- for this kind of correlation. Industries within an pparently similar category commonly use differ-nt amounts of water, both because of differences the product and because of differences in pro-uction processes even where the end-product is milar. (USGS)
'85-03957

XPERIMENTAL INVESTIGATION OF TER-ITORIAL WATER BALANCE AND ITS RANSFORMATIONS,
. P. Chernyshev.
Water Resources, Vol. 10, No. 6, p 569-577, November-December, 1983. 3 Fig, 2 Tab, 33 Ref. Translated from Vodnye Resursy, No. 6, p 97-107, November-December, 1983.

Descriptors: *Water balance, *Hydrology, *Water use, *Forecasting, Geography, Erosion, Runoff, Farming, Urban areas.

A combined geographic-hydrological method is described which is able to estimate available water resources and the changes in time and space. In the geographic method of study the territorial water balance is greatly determined by the soil which is a unique mediator between climatic factors and the water balance. At present, agriculture is having a positive effect on the water balance of the territory as it is promoting an improvement of its structure and a decrease of erosion intensity on large expanses of the southern European USSR. The effect of urbanization on the water balance of a territory and material exchange related to it is considered, including the impact on sediment load, surface runoff, dissolved organic matter in the runoff, and nitrogen and phosphorus content. By using appropriate city-planning methods it is possible to achieve various degrees of water-balance regulation and moderation of the unfavorable concentration of surface runoff and the sediment concentrations and dissolved loads associated with it. (Baker-IVI)
W85-04148

WHO OWNS THE GREAT LAKES. POSTURING FOR CONTROL OF AN INTERNATIONAL RESOURCE,
Case Western Reserve Univ., Cleveland, OH.
For primary bibliographic entry see Field 6E.
W85-04177

STANDING REQUIREMENT UNDER THE WYOMING FORFEITURE STATUTE,
For primary bibliographic entry see Field 6E.
W85-04180

WATER RESOURCE ISSUES AND THE FUTURE OF IRRIGATED AGRICULTURE,
Resources for the Future, Inc., Washington, DC. Renewable Resources Div.
K. D. Frederick.
South Dakota Law Review, Vol. 29, No. 2, p 221-231, Spring, 1984. 1 Tab, 26 Ref.

Descriptors: *Water resources development, *Irrigation, *Water demand, Farming, Water supply, Water use, Consumptive use.

A brief overview is presented of how the nation's water resource problems are likely to affect the future of irrigated agriculture. The principal focus is on the seventeen western states where there are about 50 million acres under irrigation. These lands account for about 83% of the nation's total irrigated acreage and for nearly nine of every ten gallons of water consumed in the west. Almost one fourth of the land under crops is now irrigated and these lands produce more than half of the value of western crops. Topics discussed include the past growth of western irrigation, competition for western water, freshwater consumption by western farm production region, augmenting water supplies, and eastern irrigation. (Baker-IVI)
W85-04186

NEW MEXICO'S WATER EXPORTATION STATUTE: WILL IT FLOAT,
S. Zeller.
Natural Resource Journal, Vo. 24, No. 2, p 471-486, April, 1984. 94 Ref.

Descriptors: *Water export, *New Mexico, *Legislation, Legal aspects, Water conservation, Public welfare, Interstate compacts, Constitutional law, Water use.

The constitutionality of New Mexico's exportation statute is discussed. First the Sporhase v. Nebraska decision is analyzed as well as the application of that decision in El Paso v. Reynolds. Secondly, the new exportation statute is examined, applying the Sporhase guidelines. The probable outcome of a constitutional challenge to the new exportation provision is considered. New Mexico's new statute does not reflect adequately the directives of either Sporhase or El Paso. According to those decisions, New Mexico may place conservation and public welfare restrictions on the out-of-state usage of its waters provided that the same or comparable restrictions are placed on in-state usage. The New Mexico water code, with few exceptions, does not place express conservation or public welfare restrictions on in-state water use. The constitutionality of the exportation provisions could be determined, however, by the State Engineer's application of the statute and applicable in-state standards. If he evenhandedly evaluates in-state and out-of-state applications, the constitutionality of the statute may be upheld. If the statute is applied literally or in a manner which illegitimately discriminates against interstate commerce, the exportation statute will encounter commerce clause defeat. (Baker-IVI)
W85-04189

IMPACT OF RECENT COURT DECISIONS CONCERNING WATER AND INTERSTATE COMMERCE ON WATER RESOURCES OF THE STATE OF NEW MEXICO,
For primary bibliographic entry see Field 6E.
W85-04192

CONSUMPTIVE USE ON THE NAVAJO INDIAN IRRIGATION PROJECT,
Bureau of Reclamation, Amarillo, TX. Southwest Region.
B. J. Boman.
Available from the National Technical Information Service, Springfield, VA 22161. September, 1983. 212 p, 169 Fig, 63 Tab, 17 Ref.

Descriptors: *Evapotranspiration, *Consumptive use, *Irrigation programs, *Irrigation requirements, *Crop production, *Sprinkler irrigation, Water requirements, Indian reservations, Alfalfa, Corn, Oats, Barley, Irrigation districts, Lysimeters, Water demand, Water use, Colorado River, Navajo Indian Irrigation Projects, New Mexico.

Peak period and seasonal water requirements were investigated for the major crops being grown on the Navajo Indian Irrigation Project in northwestern New Mexico. Data was collected from the actual production fields on the project using lysimeters, line source sprinklers, and farm fields. Consumptive use data was collected for alfalfa, corn, oats, spring barley, and winter barley during the years 1979 through 1982. Production functions and crop curves were developed for the various crops. The Jenson-Haise reference evapotranspiration (ET) equation was calibrated using measured ET for mature alfalfa, while the Penman reference ET equation was found to be adequate without calibration.
W85-04224

COMPATIBILITY OF MULTIPLE USES; POTABLE WATER SUPPLIES AND FISHERIES,
W. G. Layher.
Fisheries, Vol. 9, No. 6, p 2-11, November-December, 1984. 2 Tab, 86 Ref.

Descriptors: *Water resources development, *Environmental effects, *Water supply, *Fisheries, Multipurpose projects, Potable water.

Depletion of surface and groundwater supplies in many areas of the United States has caused many municipalities to consider building their own water supply reservoirs. Proponents of potable water supply development and proponents of the mutiple use concept are frequently at odds with each other. Survey results are presented which depict how state governmental agencies view this apparent conflict of interest. A review of literature relevant to the multiple use of water is presented along with conclusions on the compatibility of uses derived from an ecological viewpoint. Sixteen states have indicated that this controversy exists in many geographical areas of the country. The focal point of

the issue is primarily related to the widespread practice of leaving standing timber in the impoundment to provide useable habitat by certain game fishes. The literature review indicates that such practices contribute little to degradation of water quality. Lake morphology, drainage basin land use practices, and natural seasonal variation in climate contribute most significantly to frequently encountered water qaulity problems associated with drinking water supplies. (Baker-IVI)
W85-04391

6E. Water Law and Institutions

SAMPLING TO MEET WATER QUALITY STANDARDS,
Thames Water Authority (England). Northern Div.
For primary bibliographic entry see Field 5F.
W85-03882

GUIDELINES FOR THE UTILISATION OF SEWAGE SLUDGE ON LAND IN THE UNITED KINGDOM,
Department of the Environment, London (England).
For primary bibliographic entry see Field 5E.
W85-04004

REVIEW OF THE FEDERAL EMERGENCY MANAGEMENT AGENCY'S DAM SAFETY PROGRAMS,
Federal Emergency Management Agency, Boston, MA.
R. E. Sonnichsen.
Journal of the New England Water Works Association, Vol. 98, No. 3, p 247-258, September, 1984. 2 Tab, 6 Ref.

Descriptors: *Dams, *Safety, *Legislation, *Dam safety, Water managment, Management, Federal jurisdiction, Dam failure.

Several events occurred rapidly over the past two decades that have significantly changed the involvement of the federal government in the safety of both federally owned dams and nonfederal dams. Specific details are provided concerning the following safety measures: the National Dam Inspection Act, the workings of the Interagency Committee on Dam Safety, and the Federal Emergency Management Agency Dam Safety Program. The National Dam Inspection Act, passed in 1972, directed the US Army Corps of Engineers to develop an inventory of all dams in the US that were large enough and impounded enough water to be considered a significant safety hazard in the event of failure. The Interagency Committee on Dam Safety came into being as a direct result of the failure of the federally owned Teton Dam in Idaho in April of 1977. All federal agencies involved in dam safety were ordered to review completely their dam safety practices and to convene an ad hoc interagency committee to coordinate federal dam safety programs. (Baker-IVI)
W85-04019

WHO OWNS THE GREAT LAKES. POSTURING FOR CONTROL OF AN INTERNATIONAL RESOURCE,
Case Western Reserve Univ., Cleveland, OH.
D. S. Hoffmann.
Case Western Reserve Journal of International Law, Vol. 16, No. 1, p 71-100, 1984. 244 Ref.

Descriptors: *Legal aspects, *Water use, *Great Lakes, *Diversion, Water resources development, Legislation, Political aspects, International law, Federal jurisdiction, State jurisdiction.

From time to time proposals have been made to divert water from the Great Lakes to other points for interstate use. Few of these proposals have survived economic and political barriers. However, if large scale diversions become economically feasible, several institutional and political questions need to be answered. Regulations and use of the waters of the Great Lakes are governed by a complex array of state and federal court decisions, administrative agencies, local, state and federal statutes, and federal treaties. A brief review is offered of United States laws and regulations including state law, federal law, the commerce power, the treaty power, the compact consent power, and also Canadian regulations including provincial law, and federal law. Historical developments cited include the International Joint Commission and the Chicago Diversion. The Great Lakes Basin is an example of the struggle between regional and national interests concerning natural resources. While the region presently lacks an institution with broad representation and authority, the impending threats of a water resource crisis will require a viable solution. This solution must be based on cooperative efforts, not on declarations of federal preemption or state or provincial autonomy. A novel approach is needed for these problems. An interstate compact consisting of regional and national representation appears to be the most attractive institutional framework for the basin. (Baker-IVI)
W85-04177

DISCRIMINATION AGAINST INTERSTATE COMMERCE IN GROUND WATER FOR ECONOMIC REASONS,
A. M. Liepas.
Land and Water Law Review, Vol. 19, No. 2, p 471-483, 1984. 103 Ref.

Descriptors: *Groundwater, *Legal aspects, *Economic aspects, *New Mexico, *El Paso, *Texas, Groundwater management, Legislation, Water use, Interstate commissions, Constitutional law.

In 1980 the City of El Paso filed suit challenging New Mexico's embargo of groundwater as unconstitutional under the commerce clause of the United States Constitution. El Paso needed the water to meet the needs of its citizens. The commerce clause aspects of this controversy are considered. The Courts concluded that the embargo statute of New Mexico was an unconstitutional imposition on interstate commerce. The district court in El Paso I correctly declared the embargo statute unconstitutional but it interpreted Sporhase vs Nebraska too narrowly when it held that a state could not favor its citizens in the use of water in excess of the amount needed for health and safety. The Court in Sporhase permitted the states to show a limited preference for its citizens in the use of water for economic purposes. The Court in Sporhase also found portions of a statute similar to Senate Bill 195 valid under the commerce clause. A reciprocity requirement was the problem with the statute in Sporhase but no such requirement is present in Senate Bill 295. By combining the Pike v. Bruce Church commerce clause test with a statute similar to the one in Sporhase or Senate Bill 295 and the limited preference for economic interests, the Supreme Court has helped create a means for allocating ground water among states which is closely related in substance to the doctrine of equitable apportionment. This development is needed because there is little reason to treat ground water differently from surface water, especially when they both possess multistate characteristics. Senate Bill 295 and Sporhase provide, at best, only temporary relief for a problem which will continue to grow as the region continues to need more water. What is needed is a new Rio Grande Compact; the compact should allocate both surface and ground water and should be renegotiated periodically. The new compact should be the product of the several states in the region working together to reach a mutually beneficial solution. (Baker-IVI)
W85-04179

STANDING REQUIREMENT UNDER THE WYOMING FORFEITURE STATUTE,
J. E. Montgomery.
Land and Water Law Review, Vol. 19, No. 2, p 485-495, 1984. 93 Ref.

Descriptors: *Legal aspects, *Irrigation, *Forfeiture, *Wyoming, *Prior appropriation, Water rights, Irrigation water.

Since 1965, the Platte County Grazing Association (PCGA) held direct flow water rights of 64.06 cu ft/sec for the irrigation of 4,470.13 acres. Between 1977 and 1981 the PCGA irrigated less than half of the acreage for which they held adjudicated water rights. The water rights were appurtenant to a tract of ranchland near Rock River, Wyoming, which was purchased by the Casper Board of Public Utilities in 1981 (CBPU). On October 30, 1981, contestants Lonesome Fox Corp. and S and S Ranch Co. filed a petition for forfeiture with the Board of Control, pursuant to section 41-3-401 of the Wyoming Statutes. Soon Jankovsky Ranch Co., Double K Ranch Inc., and Noel Hal Co. joined in the forfeiture action. In Platte County, the Wyoming Supreme Court established the principle that the standing requirement of section 41-3-401 of the Wyoming Statutes may only be met by a showing that previously appropriated water rights would be adversely affected if forfeiture were denied. Thus, a contestee's non-compliance with permit provisions, coupled with a showing that the contestant's water rights would be enhanced by a forfeiture, is insufficient to establish standing. The decision in Platte County unnecessarily weakened the doctrine of prior appropriation. (Baker-IVI)
W85-04180

WETLAND REGULATION AND WILDLIFE HABITAT PROTECTION; PROPOSALS FOR FLORIDA,
G. F. Gramling, III.
Harvard Environment Law Review, Vol. 8, No. 2, p 365-394, 1984. 232 Ref.

Descriptors: *Wildlife habitats, *Wetlands, *Legal aspects, *Florida, Wildlife, Wildlife management, Wilderness areas, Habitats, Legislation.

The inadequate protection afforded wildlife habitats under Florida laws is explored and related to wetlands and wildlife. Wildlife is crucially dependent upon wetland habitat, and the alteration and destruction of wetlands has serious effects on wildlife. Wetland law is analyzed beginning with an overview of federal controls and concentrating on Florida's statutory and regulatory framework. Developments in the judicial interpretation of Florida wetland law are traced. An analysis is made of the inadequate protection afforded wildlife habitat under existing Florida law. Five specific statutory and regulatory reforms are presented: establish wildlife policy; require review of wetland development projects; revise wetland regulations; uniform definitions and descriptions of protected wildlife and habitat; and increase state acquisition of wet lands for wildlife habitat. (Baker-IVI)
W85-04181

COURT-APPOINTED SPECIAL MASTERS IN COMPLEX ENVIRONMENTAL LITIGATION: CITY OF QUINCY V. METROPOLITAN DISTRICT COMMISSION,
T. G. Little.
Harvard Environment Law Review, Vol. 8, No. 2, p 435-475, 1984. 1 Fig, 311 Ref.

Descriptors: *Boston Harbor, *Quincy, *Massachusetts, *Litigation, *Wastewater disposal, *Special masters, Harbors, Water pollution control, Legislation, Wastewater treatment.

The problem of pollution of Boston Harbor by metropolitan sewage authorities is discussed pertaining to the City of Quincy litigation as a case study in the judicial use of expert special masters in complex litigation over sewage treatment issues. The problems within the Boston metropolitan sewerage system are echoed in systems throughout the nation. The use of the court-appointed master to solve these problems is detailed. The national scope of the sewage treatment problems is reviewed along with an overview of the Boston metropolitan system including the factual background of the City of Quincy litigation. Special Master Haar's report to the court in City of Quincy is summarized and a critical evaluation is provided of the use of the special master as a tool for achieving environmental goals. (Baker-IVI)
W85-04182

'LEAN WATER, DIRTY DAMS: OXYGEN DE-LETION AND THE CLEAN WATER ACT,
W. Attey, and D. R. Liebert.
:cology Law Quarterly, Vol. 11, No. 4, p 703-729, 984. 170 Ref.

)escriptors: *Environmental effects, *Dam effects, Clean Water Act, *Dissolved oxygen, Hydroelec-ic plants, Water pollution, Oxygen, Water quality ontrol, Dams, Fish, Legal aspects, Legislation.

'he Eighth Circuit and the District of Columbia 'ourts of Appeals recently held that Congress did ot intend to regulate the destructive discharges of ams under the Clean Water Act (CWA). Informa-on is presented here from the decisions reached y these courts in Missouri v. Dept. of the Army nd National Wildlife Federation v. Gorsuch 'hich is intended to show that the decisions eached by these courts in these cases are threats to ie economic viability and biological integrity of ie nation's waterways. The relationship of dis-olved oxygen to water quality is described as well s the effect dams and hydroelectric facilities have polluting the surrounding waters. The holdings f the two circuit court opinions are discussed and ossible solutions to counter the unsatisfactory re-ults reached by the circuit courts are proposed. In olding that oxygen depletion caused by dams was ot covered under the NPDES program of the 'WA, the courts opted for a semantic argument iat ignores the purpose of the CWA and the ealities of water pollution. The inclusion of dam-duced oxygen depletion in EPA enforcement of ie CWA is considered to be the correct interpre-ition of the statute and a feasible result which will roduce both economic and environmental bene-ts. In holding otherwise, the courts may have eriously threatened the ability of our nation's wa-rways to sustain aquatic life. (Baker-IVI)
V85-04183

ITIZEN SUITS AGAINST PRIVATE INDUS-RY UNDER THE CLEAN WATER ACT,
Collier, Shannon, Rill and Scott, Washington, DC.
. E. Schwartz, and D. P. Hackett.
Natural Resource Lawyer, Vol. 27, No. 3, p 327-72, 1984. 320 Ref.

)escriptors: *Industrial wastes, *Wastewater dis-osal, *Citizen suits, *Clean Water Act, Legisla-on, Water pollution control, Public participation, Enforcement.

Citizen suits against industrial dischargers have ecome an important method for enforcement of ie Clean Water Act. Most of the recent notices of itent to sue have been submitted by environmen-l organizations which reviewed discharge moni-oring reports to identify noncomplying compa-ies. The resolution of many of the legal issues resented by Clean Water Act citizen suits will epend heavily on how the courts construe the ongressional intent underlying the Act. A brief ummary of the relevant legislative history is pro-ided. The standing to sue requirement has two omponents: constitutional requirements and statu-ory elements, each of which is detailed. Claims nd defenses are described for claims against indi-idual violators, and claims against government ntities. Defenses to citizen suits include procedur-l defenses (standing, failure to give proper notice, iligent prosecution by EPA or the state, present ompliance or mootness), and substantive defenses compliance with EPA regulations, errors in the ischarge monitoring reports, equitable defenses). Remedies suggested include injunctive relief, and ivil penalties. The possibility for multiple plain-iffs and multiple claims is considered. Attorneys ees are discussed. (Baker-IVI)
V85-04184

'ROBLEMS OF CAUSATION IN PRIVATE LEGAL REMEDIES FOR DAMAGE FROM ACID RAIN,
T. Crawford.
Natural Resources Lawyer, Vol. 7, No. 3, p 413-25, 1984. 92 Ref.

)escriptors: *Acid rain, *Water pollution effects, 'Legal aspects, *Causation, Nuisance suits, Envi-onmental effects, Tort law, Liability.

Present scientific information regaring acid rain and its effects on the environment are summarized. Private remedies center around tort law, which requires that plaintiffs establish a causal relationship between the defendants' actions and the alleged damage. In the acid rain context scientific evidence usually is necessary to prove this causation. Sufficient scientific evidence often is not available, which makes it difficult, if not impossible to prove the necessary causation for using private legal remedies for acid rain damages. Private remedies for parties claiming damages from acid rain and the problems that may arise in purchasing those private remedies are discussed. These private remedies include alternative liability, enterprise liability, market share liability, contribution-to-the-aggregate-condition test, and nuisance suits. Pending development of scientific decisionmaking tools, private remedies should be confined to situations in which the alleged damage from acid rain can be established under traditional, widely accepted objective and scientific methods. (Baker-IVI)
W85-04185

LEGAL AND INSTITUTIONAL BARRIERS TO TRANSFERS AND REALLOCATION OF WATER RESOURCES,
Clyde, Pratt, Gibbs and Cahoon, Salt Lake City, UT.
S. E. Clyde.
South Dakota Law Review, Vol. 29, No. 2, p 232-257, Spring, 1984. 123 Ref.

Descriptors: *Utah, *Institutional constraints, *Legal aspects, *Water transfer, *Water allocation, Mountains, Recreation, Resources development, Reserved rights, Water rights.

The mountains of Utah contain some of the finest winter sports recreation areas in the world. Resort developers are constructing resort facilities and converting the irrigated farmland in the headwaters of the major stream systems into high density condominiums to provide the necessary housing for approximately 60,000 transient skiers each week throughout the ski season. There are also many fuel resources located in Utah which will require vast amounts of water to develop. Legal and institutional barriers to the reallocation of water resources are reviewed and some possible solutions to these concerns are presented. Legal barriers created by state water laws include interstate embargo statutes, changes in the nature of use, uncertainties created by pending filings, and use of sewage effluent. The effect of interstate compacts on interstate sales of water resources is considered. Legal restraints created by federal laws include the role of the federal govenment in the west, federal water rights, federal reserved rights, Indian reserved rights, and the Bureau of Reclamation. (Baker-IVI)
W85-04187

MARINE POLLUTION FROM LAND-BASED SOURCES: CURRENT PROBLEMS AND PROSPECTS,
Limburg Univ., Maastricht (Netherlands). Faculty of Law.
B. Kwiatkowska.
Ocean Development and International Law, Vol. 14, No. 3, p 315-335, 1984. 29 Ref.

Descriptors: *International agreements, *Marine environment, *Water pollution control, International law, Environmental effects, Prior notification, International waters.

The cooperation of countries in preventing and combating land-based pollution is of increasing importance due to the fact that land-based sources (industrial, municipal, and agricultural) contribute on a global scale about 80% of marine pollution. The appropriate legal framework for international cooperation in this field is only now being elaborated and is still in the process of development. So far it has taken place mainly on a regional level. Solutions contained in regional conventions are surveyed, along with rules and principles which can serve as the basis for international cooperation. Special attention is given to problems which still give rise to controversies: pollution of the sea through international watercourses, control systems consisting of environmental impact assessments, and the obligation of prior notification and consultation, as well as responsibility for marine pollution damage. Taking into account the numerous deficiencies of regional cooperation in marine environment protection against land-based pollution it seems worthwhile to consider initiating work on guidelines for future conventions. The general principles of the proposed draft could be modeled after the provisions of Article 207 of the new Convention on the Law of the Sea. Detailed rules could be inferred on the basis of a comparative analysis of the existing regional conventions. (Moore-IVI)
W85-04188

NEW MEXICO'S WATER EXPORTATION STATUTE: WILL IT FLOAT,
For primary bibliographic entry see Field 6D.
W85-04189

ASSURANCE OF REASONABLE TOXIC RISK,
New Mexico Univ., Albuquerque.
J. B. Sorenson.
Natural Resources Journal, Vol. 24, No. 3, p 549-569, July, 1984. 2 Tab, 45 Ref.

Descriptors: *Regulations, *Toxicity, *Water pollution control, *New Mexico, Water quality control, Groundwater, Organic compounds.

The criteria employed to assure reasonable risk in the context of the 1980-1982 New Mexico Water Quality Control Commission (NMWQCC) regulations on the control of organic toxic contaminants in groundwaters are examined. The need for a better criteria of environmental safety and health assurance by which high and low risk choices can be made in ways more defensible than is now the case. Specific attention is devoted to water quality politics and accountability, regulatory procedures, a risk analysis of NMWQCC risk standards, recommended maximum levels in water and food and recommended industrial exposure levels for eight organic compounds, and assured reasonable toxic risk. (Baker-IVI)
W85-04190

CENTRALIZED DECISIONMAKING IN THE ADMINISTRATION OF GROUNDWATER RIGHTS: THE EXPERIENCE OF ARIZONA, CALIFORNIA AND NEW MEXICO AND SUGGESTIONS FOR THE FUTURE,
Hawaii Univ. at Hilo. Social Sciences Div.
For primary bibliographic entry see Field 4B.
W85-04191

IMPACT OF RECENT COURT DECISIONS CONCERNING WATER AND INTERSTATE COMMERCE ON WATER RESOURCES OF THE STATE OF NEW MEXICO,
C. T. Dumars, J. Campbell, R. B. Anderson, L. Davis, and C. G. Chavez.
Natural Resources Journal, Vol. 24, No. 3, p 689-744, July, 1984. 1 Fig, 12 Tab, 59 Ref.

Descriptors: *New Mexico, *Water resources development, *Legal aspects, Legislation, Reviews, Groundwater management, Aquifers, Water demand.

This report of the Water Law Study Committee reviews the impact and implications for the water resources available to the state of recent court decisions concerning water and interstate commerce for New Mexico. Topics of concern include hydrologic factors relating to the administration of water rights in non-stream-related and stream-related aquifers, and water deficits in neighboring states and their implications for New Mexico. A legal analysis of the committee recommendations concludes the article. (Baker-IVI)
W85-04192

WATER LAW - PUBLIC TRUST DOCTRINE,
E. S. Casey.
Natural Resources Journal, Vol. 24, No. 3, p 809-825, July, 1984. 130 Ref.

LIBRARY U. OF T. URBANA-CHAMP...

Descriptors: *Water law, *Public trust, *Mono Lake, *California, Environmental effects, Wildlife, Birds, Diversion, Salinity, Wildlife habitats, Water resources development.

A brief historical summary of the Public Trust Doctrine and the California Appropriative Water Rights System is provided. Mono Lake, the second largest lake in California, has been reduced to half its volume and its surface area cut by one third due to the diverting of water from the lake's feeder systems. The wildfowl population has been seriously impacted. Increased salinity threatens the brine shrimp population on which the birds feed. In the National Audubon Society v. Superior court of Alpine County, plaintiffs contended that public rights in the waters of Mono Lake are protected by a public trust administered by the state. Plaintiffs claimed that the state's power under this trust was independent of its power as administrator of the appropriate water rights system. The California Supreme Court examined the role of the Public Trust Doctrine in California's water rights system. The court affirmed the existence of a separate public trust challenge to allocative decisions. Reasonable and beneficial use will no longer be the only basis for protesting a Board granted license to divert. (Baker-IVI)
W85-04193

REPORT OF THE CLASS I AND II CULTURAL RESOURCES INVESTIGATIONS OF A PORTION OF THE CENDAK WATER PROJECT AREA, EASTERN SOUTH DAKOTA, VOLUME I. ARCHAEOLOGICAL SAMPLING SURVEY OF THE EAST HALF OF THE PROPOSED CENDAK IRRIGATION SYSTEM,
South Dakota Archaeological Research Center, Fort Meade.
J. K. Haug, R. J. Rood, and V. O. Rood.
Contract Investigations Series Number 79, 1983. 160 p, 28 Fig, 3 Tab, 52 Ref, 1 Append.

Descriptors: *Archaeology, *Irrigation, *Sampling, *Cultural resources, Cultural control, Reservation Doctrine, Surveys, Missouri Basin, *South Dakota.

The South Dakota Department of Water and Natural Resources (DWNR), in conjunction with the U.S. Bureau of Reclamation is currently in the planning stages for a large irrigation project in central South Dakota. This project is known as CENDAK. It has, over the years, grown out of the orignal plans formulated in the late 1940s and 1950s for development of the Missouri Basin using Missouri River water drawn from the large reservoirs constructed along the stream in the last few decades. It is currently planned to draw water from the Oahe Reservoir near Pierre, from which it will be pumped via canals and pipelines to areas in Hughes, Sully, Hand, Hyde, Faulk, Spink and Beadle counties. In all, about 400,000 acres will be irrigated, within an area encompassing about 3,500,000 acrea. Beginning in August 1982, the South Dakota Archaeological Research Center initiated a cultural resources investigation of the CENDAK Water Project. A Class I cultural resources inventory indicated 25 previously recorded sites in the project area. A Class II inventory followed the initial inventory, consisting of a stratified random sample of 230 quarter sections within the project area, out of an available population of about 9000 quarter sections. 94 sites were recorded by the field teams as part of the sample survey, and 9 of 19 previously recorded sites were relocated in the field. In addition, 12 sites were recorded outside the sample areas. The sample results indicated that most sites were located near permanent water sources and/or sheltered areas. It was recommended that these areas receive the most intensive examination during the later Class III inventory.
W85-04196

PRESERVING NEBRASKA'S WETLANDS: NOW AND IN THE FUTURE,
For primary bibliographic entry see Field 5G.
W85-04374

FEDERALISM AND THE WILD AND SCENIC RIVERS ACT: NOW YOU SEE IT, NOW YOU DON'T,
Navy Personnel Research and Development Center, San Diego, CA.
S. K. Fairfax, B. T. Andrews, and A. P. Buchsbaum.
Washington Law Review, Vol. 59, No. 3, p 417-470, July, 1984. 257 Ref.

Descriptors: *Wild and Scenic Rivers Act, *California, *Rivers, Water management, Environmental protection, Wild rivers, Federal jurisdiction, State jurisdiction, Litigation.

In July 1980, the governor of California nominated 4000 miles of California's North Coast rivers for inclusion in the National Wild and Scenic River System. The proposal was based on an unfamiliar provision of the Wild and Scenic Rivers Act (WSRA) that allows governors to request federal protection for state-protected rivers. The proposal would give the state a broader opportunity to administer federal lands adjacent to the rivers. By 1984, after litigation and extensive campaigning, the North Coast river designations have stalled. Developments in the legal controversy are chronicled and related to the larger issues of land and water management. The shifting legal framework and changing economic and political interests in the North Coast controversy are particularly enlightening to students of federalism. The details of the study challenge familiar notions that the federal-state conflict is the core of federalism, that cooperation between governments is preferable to confrontation; and that the role of the courts is to act as umpires in the conflict. (Baker-IVI)
W85-04375

6F. Nonstructural Alternatives

RESEARCH AGENDA FOR FLOODS TO SOLVE POLICY FAILURE,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 4A.
W85-04243

SIGNIFICANCE OF LOCATION IN COMPUTING FLOOD DAMAGE,
Hydrologic Engineering Center, Davis, CA.
W. K. Johnson.
Journal of Water Resources Planning and Management, Vol. 111, No. 1, p 65-81, January, 1985. 8 Fig, 2 Tab, 9 Ref.

Descriptors: *Flood damage, *Location, *Housing, Flood plains, Flood control, Economic feasibility, Flood plain management, Flood frequency.

Expected annual flood damage for individual residential structures may be estimated using generalized depth-damage and elevation-frequency relationships developed by the Federal Insurance Administration (FIA). Damage computation using these data for different locations of the structure in the flood plain show a significant difference between structures located within the 25 yr flood plain and structures located outside. Within the 25 yr flood plain, especially within the 15 yr flood plain, damage for one and two-story structures with and without basements are exceedingly high: up to ten times greater than those outside. Outside the 25 yr flood plain, expected annual damage decreases gradually with location. These observations have important implications for flood plain management. First, economic feasibility of flood control projects will normally require that a significant number of structures be located within the 25 yr flood plain. Second, removal of structures with high damage potential has the secondary effect of reducing economic feasibility of potential flood control projects. Third, outside the 25 yr flood plain, expected annual damage is relatively insensitive to variations in location, depth-damage function and frequency. Lastly, estimates of expected annual damage using generalized FIA data is useful in preliminary estimates of the damage reduced. (Author's abstract)
W85-04244

6G. Ecologic Impact Of Water Development

ECOTOXICOLOGICAL MODEL FOR ENERGY DEVELOPMENT AND THE SALTON SEA, CALIFORNIA,
California Univ., Los Angeles. Office of Environmental Science and Engineering.
For primary bibliographic entry see Field 4C.
W85-03823

INFLUENCE OF RESERVOIR TRANSIT ON RIVERINE ALGAL TRANSPORT AND ABUNDANCE,
Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 2H.
W85-03829

EFFECT OF IRRIGATION ON WARM SEASON PRECIPITATION IN THE SOUTHERN GREAT PLAINS,
National Weather Service, Washington, DC. Climate Analysis Center.
A. G. Barnston, and P. T. Schickedanz.
Journal of Climate and Applied Meteorology, Vol. 23, No. 6, p 865-888, June, 1984. 26 Fig, 2 Tab, 18 Ref.

Descriptors: *Irrigation, *Rainfall, *Texas, Precipitation, Atmosphere, Meteorology, Seasonal variation.

The synoptic and subsynoptic atmospheric processes that accompany statistically determined periods of irrigation-induced rainfall increases during the warm season in the Texas Panhandle are examined. Any synoptic condition providing low-level convergence and uplift was found to be fundamental in allowing irrigation-produced low-level moisture to increase cloud development and rainfall. Fronts and surface low pressure centers are such synoptic conditions, and their rainfall patterns showed the most conformity to the irrigation effect areas during the hypothesized effect periods as compared with the hypothesized noneffect periods. Stationary fronts were especially effective in bringing out the influence of irrigation, since they permit convergence and uplift for a long-time duration. In the Texas Panhandle, June is the most probable month for long-lasting stationary fronts since in this month the storm track is still within reach of northern Texas. The effect of irrigation is more evident during generally rainy periods, because if there are many rainy situations there are likely to be many surface disturbances that involve low-level convergence. On a smaller spatial scale, irrigation was shown to lower the daily maximum temperature by an average of 2 C during dry, hot conditions, and by 1 C during damp, cooler conditions. Irrigation was shown to decrease the lifted index by up to 1 C. Although this is only a slight decrease in stability, it occasionally could spell the difference between light showers and no showers in a synoptically marginal convergence situation. Several three dimensional mesoscale irrigation produced dynamic processes were discussed but a lack of mesoscale upper atmospheric data precluded empirical investigation. (Baker-IVI)
W85-03844

IMPACT OF PROPOSED GLENGOWAN DAM FLOW AUGMENTATION ON THAMES RIVER WATER QUALITY,
Gore and Storrie Ltd., Toronto (Ontario). Water Resources Div.
T. P. H. Gowda, and R. J. Dewey.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 459-473, September, 1984. 6 Fig, 6 Tab, 17 Ref.

Descriptors: *Glengowan Dam, *Thames River, *Ontario, *London, *Water quality, *Environmental impact, Municipal wastewater, Model studies.

The Thames River water management study report, prepared in 1975 by the Ontario Ministries of Natural Resources and Environment, recom-

nded the construction of the Glengowan Dam marily for flow augmentation to improve the er water quality. As part of the environmental pact assessment of the proposed dam, detailed ter quality prediction studies were carried out ng deterministic and stochastic models to evalu- the impact of the proposed flow augmentation d wastewater loading options. The river receives ated wastewater effluents from five water pollu- n control plants (WPCP) in the study area, all ated within the City of London. The processes ulated by the models include advection, decay carbonaceous and nitrogenous oxygen demand BOB and NOD), sediment oxygen demand, at- spheric reaeration, and respiration and photo- thetic activity of aquatic macrophyte communi- The options modelled include (a) projected OD and NOD loading rates from the five PCP's for the planning period 1981-2001; (b) low ws attainable with augmentation from existing nshawe reservoir and the proposed Glengowan m; and (c) zero loadings to the Thames River m WPCP's attainable with effluent bypassing to ke Erie. The results of the modelling studies are esented. (Author's abstract)
85-04044

REEDING BIRD RESPONSE TO GREEN- REE RESERVOIR MANAGEMENT,
h and Wildlife Service, Gainesville, FL. Denver ildlife Research Center.
P. Christman.
urnal of Wildlife Management, Vol. 48, No. 4, p 64-1172, October, 1984. 1 Tab, 35 Ref.

escriptors: *Greentree reservoirs, *Birds, *Eco- gical effects, *Reservoir management, *Arkan- , Species diversity, Forests.

eeding season song counts in 1980 and 1981 vealed significant differences in relative abun- nce for 12 of 28 nongame bird species between a eentree reservoir and an adjacent control area in stern Arkansas. Bird species that forage primari- in the understory were absent or occurred at wer frequencies in the greentree reservoir. Spe- s that hawk or forage primarily in the canopy re either not affected or showed slight increases frequency on the greentree reservoir transects. ere were fewer species of breeding birds and wer total birds encountered on the greentree servoir than on the control area. Greentree reser- ir management caused a reduction in understory getation that reduced foraging and nesting op- rtunities for bird species that use the ground and wer levels of the forest. (Author's abstract)
85-04082

OWNSTREAM MIGRATION OF YOUNG SHES DURING THE INITIAL PERIOD OF OW REGULATION OF THE ILI RIVER,
azakhskii Gosudarstvennyi Univ., Alma-Ata SSR).
K. Nezdoliy.
urnal of Ichthyology, Vol. 24, No. 2, p 34-46, 84. 5 Fig, 1 Tab, 22 Ref.

escriptors: *Fish migration, *Reservoirs, *Dams, li River, *Kapchagay reservoir, *Kazakhstan, SSR, Fish populations, Species composition, igration, Ecological effects.

e distribution structure of downstream migra- n of young fishes of the Ili River (Kazakhstan, SSR) were studied during the first year after nstruction of Kapchagay dam (1970). Down- eam migration in three parts of the Ili River was alyzed: above and below the Kapchagay reser- ir and within the reservoir. The trends of sea- nal and daily dynamics of migration, species and e composition of the migrants, their concentra- n and distribution by depth, width and length of e river were identified. The species composition migrants is most variable in the Ili River above e reservoir, consisting of 19 species. The range of ecies decreases sharply in the dam region to 6 ecies and is gradually restored to 11 species in e Ili River below the reservoir. These species mposition changes are mainly related to fishes in e reservoir, mortality of the migrants in the eposition zone of backwater, and passing through the turbines and the irrigation intakes. Young fishes migrating through the turbines are mainly distributed at the river surface below the dam; this is caused by the hydrostatic pressure gradient which sharply increases the buoyancy of fish and in several cases their mass scale mortality - especially in the physoclistic fishes (pike-perch, perch). (Collier-IVI)
W85-04089

MULTIPURPOSE USE AND PROTECTION OF WATER RESOURCES IN POWER COMPLEXES INCLUDING NUCLEAR POWER STATIONS,
Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
Yu. A. Landau, L. L. Levitskii, and V. I. Sevast'yanov.
Water Resources, Vol. 10, No. 2, p 123-130, March-April, 1983. 1 Fig, 2 Tab, 10 Ref. Translated from Vodnye Resursy, No. 2, p 32-42, March-April, 1983.

Descriptors: *Water resources development, *Environmental effects, *USSR, *Powerplants, Nuclear powerplants, Thermal pollution, Multipurpose projects, Environmental protection.

The investigations and comprehensive forecast of the impact of the Southern Ukraine power complex (SUPC) on the environment confirm that with consideration of the accepted environmental protection measures the creation of a power complex provides the effective multipurpose use of water resources when the standard requirements on protection of aquatic ecosystems are fulfilled. It is necessary to expand investigations of the use of the low potential heat of the discharge waters of a nuclear power station in the economy in order to make the future power biological complexes utilizing it a mandatory concomitant part of NPRS and power complexes. The Southern Ukraine power complex should be used as the reference installation for a detailed experimental check under operating conditions of its impact on the environment, and working out optimal solutions for introduction at other power complexes. (Baker-IVI)
W85-04090

ANTHROPOGENIC FACTOR IN THE DEVELOPMENT OF THE COASTAL ZONE OF THE BALTIC SEA,
N. A. Aibulatov, and O. V. Bass.
Water Resources, Vol. 10, No. 3, p 288-294, May-June, 1983. Translated from Vodnye Resursy, No. 3, p 127-134, May-June, 1983.

Descriptors: *Coastal zone management, *Shore protection, *Baltic Sea, *USSR, *Germany (Democratic Republic), Coastal engineering, Sedimentation, Sand, Recreation, Beaches.

The coastal zone of the Baltic Sea ia rather diverse in structure and occurrence of present-day morphodynamic processes. The coasts of the Soviet Baltic are mainly abrasion-aggradational with characteristic stretches of nourishment of the through-going flow and accumulation of sedimentary material. Primarily the relief, composition and balance of sediments are subject to changes in the coastal zone under the effect of man. An example of man's successful interference in the natural shore process is the construction of artificial sand and pebble beaches, for coastal protection and recreation. In East Germany in 1968, 380,000 cu m of sand was hydraulically filled on the Warnow-Peene coast, in the region of the Graal-Muritz resort, and an additional 200,000 cu m on Hiddensee Island, which prevented erosion of the beaches and considerably improved the recreational conditions of the population. Artificial free beaches are also being created in West Germany. This method of coastal protection is proving to be correct from the viewpont of preserving the natural equilibrium and from an ecological aspect. The creation of artificial sand free beachs on the northern coast of the Kalinigrad region, a region with extensive sanatorium-resort type accommodations, is particularly important. (Baker-IVI)
W85-04111

EVALUATION OF THE EFFECT OF LAKE BALKHASH LEVEL AND ILI RIVER RUNOFF ON STOCK AND CATCHES OF COMMERCIAL FISH SPECIES,
For primary bibliographic entry see Field 2H.
W85-04127

PRESENT AND PREDICTED CHANGES IN THE HYDROLOGICAL, HYDROCHEMICAL, AND HYDROBIOLOGICAL CONDITIONS OF THE ARAL SEA,
V. N. Bortnik.
Water Resources, Vol. 10, No. 5, p 417-428, September-October, 1983. 2 Fig, 4 Tab, 23 Ref. Translated from Vodnye Resursy, No. 5, p 3-16, September-October, 1983.

Descriptors: *Aral Sea, *USSR, *Saline lakes, *Environmental effects, *Nonreturnable flows, Streamflow regulation, Irrigation, Water supply development, Morphology, Runoff, Salinity, Precipitation, Evaporation, Arid lands.

The increase of nonreturnable withdrawals and streamflow regulation for economic needs is having a noticeale effect on the regime of the Azov, Caspian, and Aral seas. Preservation of the Aral Sea as a single water body under conditions of the volumes of nonreturnable streamflow withdrawals planned for the future in its basin is not possible, but it may be possible to restore and regulate the regime of several connected controlled water bodies, each of which will have its own equilibrum level, salinity, and water and biological regime. The possibility of the Aral Sea almost completely drying up could create a serious danger of wind transport of precipitated salts to the surrounding territories of the Aral region, including irrigated areas. This danger wil not be completely removed upon creation of one or several water bodies with a regulated regime, since a large part of the area of the Aral Sea will dry up. It is necessary to take into account the ecological significance of the sea, the character of its interrelation with the environment, and also the general socioeconomic consequences of drying up of the Aral Sea. Preservation of the Aral Sea and its individual regions in a transformed from is the most important link of the conservation of the natural resources of this region. (Baker-IVI)
W85-04128

CHANGES IN THE RECLAMATION CONDITIONS OF THE ILI DELTA HEAD FOLLOWING STREAMFLOW REGULATION,
V. M. Starodubtsev, T. F. Nekrasova, and Yu. M. Popov.
Water Resources, Vol. 10, No. 5, p 439-447, September-October, 1983. 5 Fig, 3 Tab, 9 Ref. Translated from Vodnye Resursy, No. 5, p 75-84, September-October, 1983.

Descriptors: *Hydroelectric powerplants, *Ili River Delta, *USSR, Water conservation, Environmental effects, Groundwater, Saline soils, Soil, River flow, Sediments, Erosion, Deltas, Suspended load.

A hydroelectric station was constructed in the Kapchagai canyon to conserve water resources of the Ili River basin in the interest of hydropower, irrigation, and other sectors of the economy. Changes in the river runoff to the delta and the evolution of soil cover, processes of soil salinization, and groundwater dynamics are considered. As a result of regulating the runoff of the Ili by the Kapchagai reservoir, the hydrologic regime of the streams of the delta primarily changed. Mineralization of the river water changed in the lower course, the mean annual mineralization at the delta head increased from 0.31 to 0.40 g/liter, the specific dissolved load increased 18-19%, and the ratio of ions changed. The inflow of the suspended load to the delta head decreased from 14 to 3.3 million tons/yr. The composition of the sediment load also changed. The sediments now contain products of erosion of the channel deposits and banks in the stretch between Kapchagai and Ushzharma and include less nutrients. The clarified waters intensify erosion processes in the channel and promote its deepening and concentration of the runoff in the

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delta in one channel. The distribution of the suspended load in the delta in the absence of large floods radically changed and development of the delta ceased. (Baker-IVI)
W85-04131

GEOGRAPHIC APPROACHES TO STUDY OF THE EFFECT OF INTERBASIN WATER TRANSFERS ON NATURAL CONDITIONS,
M. I. L'vovich, and N. I. Koronkevich.
Water Resources, Vol. 10, No. 6, p 556-563, November-December, 1983. 34 Ref. Translated from Vodnye Resursy, No. 6, p 81-89, November-December, 1983.

Descriptors: *Water transfers, *Interbasin transfers, *Geography, Environmental effects, Water balance, Water management, Irrigation.

The main principles of the approach to a study of the effect of interbasin transfer on the environment are suggested. These include a comprehensive analysis of the natural and anthropogenic relations occurring as a result of territorial redistribution of water resources, the evaluation of individual phases of interbasin transfer after evaluation of interbasin transfer in its entirety, a consideration of background changes in natural conditions due to natural and anthropogenic factors, the differentiation of the consequences of interbasin transfer according to territorial levels, special attention to the water element of the environment, and the determination of the principal changes in natural conditions. (Baker-IVI)
W85-04146

CUYAHOGA FALLS: A RIVER RETURNED TO THE PEOPLE,
Community Development, Cuyhoga Falls, OH.
J. R. Ogden, and W. R. Love.
Current Municipal Problems, Vol. 11, No. 2, p 171-179, Fall, 1984.

Descriptors: *Community development, *Cuyahoga River, *Cuyahoga Falls, *Ohio, Planning, Decision making, Urban development, Waterways.

Cuyahoga Falls, a city of more than 43,000 people located on the Cuyahoga River north of Akron, has recently undertaken a riverfront development project, reuniting the city with the river. The project was completed last fall and has been recognized as a success by the Ohio Chapter of the American Planning Association. Development in the area has also been spurred by the new river facilities. The greatest challenge to the program was the Portage Trail expressway access bridge crossing the river at the geographical center of the riverfront area. The design team utilized the bridge as the central focal point of the entire project. Efforts were made to preserve the riverfront's heritage and sensitivity to the river's natural environment was maintained. Strong community support insures a bright future for similar projects. (Baker-IVI)
W85-04178

CLEAN WATER, DIRTY DAMS: OXYGEN DEPLETION AND THE CLEAN WATER ACT,
For primary bibliographic entry see Field 6E.
W85-04183

CITIZEN SUITS AGAINST PRIVATE INDUSTRY UNDER THE CLEAN WATER ACT,
Collier, Shannon, Rill and Scott, Washington, DC.
For primary bibliographic entry see Field 6E.
W85-04184

REPORT OF THE CLASS I AND II CULTURAL RESOURCES INVESTIGATIONS OF A PORTION OF THE CENDAK WATER PROJECT AREA, EASTERN SOUTH DAKOTA, VOLUME I. ARCHAEOLOGICAL SAMPLING SURVEY OF THE EAST HALF OF THE PROPOSED CENDAK IRRIGATION SYSTEM,
South Dakota Archaeological Research Center, Fort Meade.
For primary bibliographic entry see Field 6E.
W85-04196

STATUS OF THE BLACK BASS FISHERY IN LAKE MEAD AND A PROGRAM TOWARD RESTORATION AND ENHANCEMENT,
Arizona Game and Fish Dept , Phoenix.
For primary bibliographic entry see Field 8I.
W85-04209

FEDERALISM AND THE WILD AND SCENIC RIVERS ACT: NOW YOU SEE IT, NOW YOU DON'T,
Navy Personnel Research and Development Center, San Diego, CA.
For primary bibliographic entry see Field 6E.
W85-04375

EFFECTS OF IMPOUNDMENT UPON FISH POPULATIONS IN AFFERENT STREAMS AT COW GREEN RESERVOIR,
Freshwater Biological Association, Ambleside (England).
D. T. Crisp, R. H. K. Mann, and P. R. Cubby.
Journal of Applied Ecology, Vol. 21, No. 3, p 739-756, December, 1984. 7 Fig, 9 Tab, 22 Ref.

Descriptors: *Fish populations, *Postimpoundment, *Afferent streams, *Cow Green reservoir, *England, Dam effects, Environmental effects, Trout, Bullhead, Growth, Reproduction.

The numbers, growth, production and movement of brown trout (Salmo trutta L.) and bullhead (Cottus gobio L.) are described for the streams flowing into Cow Green reservoir (upper Teesdale, northern England) after its impoundment, and comparisons are made with pre-impoundment results. There was no change in the mean length for age of trout, but there was a small, statistically significant, increase in that of bullheads. The population density of trout fry increased in most streams by 300-1100%, probably because of an increase in egg production through the immigration of large reservoir trout to spawn. There was a statistically significant ($P < 0.05$) increase in the instantaneous rate of loss of fish in most streams. In five afferent streams, trout production, from August of the first year of life onwards, increased from 0.73-3.7 g/sq m/year to 0.91-8.2 g/sq m/year following impoundment, and there was an increase in the contribution of the O group. Bullhead production in Red Sike and Near Hole Sike was estimated at 1.08 and 1.86 g/sq m/year respectively but there are no pre-impoundment results for comparison. Some reservoir trout moved into the afferent streams during the spawning run of mature fish. Recruitment to the upper reaches of most streams was largely through the upstream movement of trout from the nursery areas in the middle and lower zones. The numbers of bullheads in the lower reaches of most streams were erratic, but most adults overwintered and spawned in the reservoir, and some moved into the streams during summer. Exceptions are Red Sike and Near Hole Sike in which resident spawning populations became established. A preponderance of males was found among the sexually mature trout resident in the afferent streams, but within the reservoir there was a preponderance of female trout. (Author's abstrct)
W85-04385

7. RESOURCES DATA

7B. Data Acquisition

USE OF RESISTIVITY AND GAMMA LOGGING IN LITHOSTRATIGRAPHICAL STUDIES OF THE CHALK IN LINCOLNSHIRE AND SOUTH HUMBERSIDE,
Birmingham Univ. (England). Dept. of Geological Sciences.
R. D. Barker, J. W. Lloyd, and D. W. Peach.
Quarterly Journal of Engineering Geology, London, Vol. 17, No. 1, p 71-80, 1984. 11 Fig, 11 Ref.

Descriptors: *Chalk, *Aquifers, *Lincolnshire, *South Humberside, *England, *Resistivity, *Gamma logging, Geophysical logs, Data acquisition, Measuring instruments, Boreholes, Stratigraphy, Lithology.

The major source of water for Grimsby and surrounding areas is the Chalk aquifer of Lincolnshire and South Humberside. Electrical resistivity and natural gamma logs were obtained from 70 boreholes in Lincolnshire and South Humberside. The geophysical logs demonstrated that resistivity and gamma logs are techniques which can provide the geologist with detailed lithological information from Chalk boreholes. Important marl bands and some erosion surfaces and flint bands can be identified on the resistivity and gamma logs and traced over most of the study area. Stratigraphical positions of the logged boreholes can be determined and formation thicknesses measured. This information has enabled the construction of an accurate contour map of the elevation of the base of the Chalk and the eastward extension of the Caistor Monocline has been identified. The importance of making initial interpretations with the use of detailed lithological information obtained from direct observation rather than from the generally incomplete record provided by borehole cores is noted. (Baker-IVI)
W85-03772

V-SHAPED SHORT-CRESTED WEIR WITH SEMICIRCULAR CROSS SECTION,
Waterloopkundig Lab. te Delft, Wageningen (Netherlands). Wageningen Branch.
W. Boiten.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 4, p 315-330, December, 1984. 14 Fig, 1 Tab, 8 Ref.

Descriptors: *Weirs, *Discharge measurement, Drains, Channels, Channel flow.

The v-shaped short-crested weir with a semicircular cross section is used to measure discharges in open channels. Its truncated triangular shape provides a rather wide measuring range. Data obtained from laboratory experiments provide information on the head-discharge relations for the bottom angle, alpha = 150 degrees, under free-flow conditions. Drowned flow starts at a submergence ratio of 20-30%. The maximum discharge depends on the dimensions chosen, but may reach a rate of 15 cu m/s, making the structure suitable for small and moderate discharges. The lightweight weir is portable, and can be fixed at the front side of an existing structure or in vertical slots. If required, the weir can be constructed with a movable crest to act as a vertical gate with overflow. Results of investigations, design rules and limits of application are given. The dimensions and rating curves are presented for a typical weir designed for a capacity of 1 cu m/s. (Author's abstract)
W85-03815

METHOD FOR MEASURING STREAM FLOWS IN RIVERS,
Fisheries Research Services, Grand Chenier, LA.
E. E. Knudsen, C. E. Stephens, and W. H. Bradshaw.
North American Journal of Fisheries Management, Vol. 4, No. 4A, p 459-461, Fall, 1984. 1 Fig, 1 Ref.

Descriptors: *Measuring instruments, *Streamflow, Streams, Flow, Rivers, Fish management.

Extremely long transect distances, unwadable depths, and high velocities caused difficulties in maintaining precise and repeatable sounding positions along transects. Attachment of a boat directly to the tagline that designated the transect for depth and velocity measurements tended to bend the tagline downstream so that measurements were sometimes being taken several yards away from the actual transect. To overcome this problem a 14 ft Lavro fiberglass drift boat was equipped with a steel davit and hand winch. The davit was mounted in the bow of the boat with two cast iron, quick-release clamps for ease in disassembly. The assembly was used to suspend a 3 lb Scientific Instruments sounding weight on a rubber coated steel cable directly ahead of the bow. Accurate depth and velocity measurements were obtained relatively quickly and easily at any point along the transect. The maximum condition under which the method has been used were a discharge of 33,500

cfs, a stream width of 250 ft, and a velocity of 9.5 ft per second. The method should work well in larger rivers, depending on the configuration and gradient of the river bed. (Baker-IVI)
W85-03833

RECENT OBSERVATIONS AND NEW DEVELOPMENTS IN THE CALIBRATION OF OPEN CHANNEL WASTEWATER MONITORS,
Washington Suburban Sanitary Commission, Hyattsville, MD. Infiltration and Inflow Evaluation and Control Div.
N. T. Debevoise, and R. B. Fernandez.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1185-1191, November, 1984. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Monitors, *Measuring instruments, *Wastewater collection, Calibrations, Flow.

The development of a method for determining the combined coefficients of a roughness equation using a velocity profiling technique (VPT) is presented. The VPT was developed as a result of a year long attempt to calibrate 40 field monitors used in a sewer system evaluation survey in Prince George's County, Maryland. Single velocity calibration techniques are unsatisfactory because the equation on which they are based provides a poor fit of sewer velocity profiles. These techniques are also error prone because they depend on a single observation of a dynamic situation. The erroneously low velocities resulting from fouling of velocity probes with suspended solids are avoided by a more careful procedure arising from a velocity profile technique. (Baker-IVI)
W85-03871

USE OF LANDSAT RADIANCE PARAMETERS TO DISTINGUISH SOIL EROSION, STABILITY, AND DEPOSITION IN ARID CENTRAL AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Alice Springs (Australia). Div. of Wildlife and Rangelands Research.
G. Pickup, and D. J. Nelson.
Remote Sensing of Environment, Vol. 16, No. 3, p 195-209, December, 1984. 3 Fig, 5 Tab, 6 Ref.

Descriptors: *Australia, *Satellite technology, *Radiance, *Soil erosion, *Soil stability, Deposition, Sedimentation, Remote sensing, Arid regions.

A method of distinguishing between eroding, stable, and depositional soil environments in central Australia is described using radiance parameters in the MSS wavebands from the Landsat series of satellites data. While a number of parameters were tested, the best performance was achieved by a composite index based on a parallelogram structure in the Band 4/Band 6-Band 5/Band 6 data space. The measure does not appear to be significantly affected by solar elevation angle but it does depend on having a uniform level of greenness in the area under study. Since growth-producing rainfall is rarely uniform across a Landsat scene, this suggests that the index is best used under drier conditions or on parts of a scene where rainfall has been relatively uniform. The index has some practical application in the assessment of land conditions in rangelands. It allows rapid survey of the erosion status of large areas and provides information on a scale commensurate with the size of management units. It also provides data in grey scale format that can be presented as a photographic product. (Baker-IVI)
W85-03998

MICROWAVE REMOTE SENSING OF PLANT WATER STRESS,
Consiglio Nazionale delle Ricerche, Florence (Italy).
S. Paloscia, and P. Pampaloni.
Remote Sensing of Environment, Vol. 16, No. 3, p 249-255, 1984. 5 Fig, 20 Ref.

Descriptors: *Remote sensing, *Water stress, *Plants, *Microwaves, Vegetation, Corn, Wheat, Vapor pressure, Polarization.

The sensitivity of microwave (MW) emissions from the Ka band to physical conditions of vegetation has been experimentally determined for corn and wheat. Water stress conditions of crops can be characterized in two ways: an indirect method that uses MW emission to measure air vapor pressure at the top of vegetation and a direct one that takes advantage of an experimental relationship established between the polarization index and the crop water stress index. Relating the polarization index directly to plant stress negates the need for ancillary measurements such as surface and air temperatures. (Baker-IVI)
W85-03999

USE OF THE ELECTRONIC PARTICLE COUNTER TO INVESTIGATE PHOSPHORUS ON PARTICLES IN STREAMS,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
A. B. Viner.
Hydrobiologia, Vol. 118, No. 3, p 231-236, 1984. 3 Fig, 15 Ref.

Descriptors: *Phosphorus, *Electronic particle counter, *Particulates, Sediments, Suspended load, Nutrients, Particle size,.

A simple and rapid method is described for the measurement by electronic particle counter of the relative proportions of sediment particles, of diameters 1 to 40 micro-m, which could enter the stream suspended load. The method is useful to further investigations into nutrients borne upon such material because the amounts of phosphate per unit weight of particles varies through orders of magnitude depending on the particle size. An example is given of a sample from a New Zealand river which demonstrates the ecological significance of such an analysis by showing that much greater amounts of phosphorus are associated with clay sized particles than on larger ones. To be able to improve predictions of the nutrient effect of suspended load it is desirable to use the electronic particle counter to differentiate the relative proportions of the particle sizes. (Baker-IVI)
W85-04061

SUB-SURFACE WATER SAMPLER FOR LAKE, POND AND RIVER STUDIES,
Pennsylvania Power and Light Co., York Haven, PA. Brunner Island Aquaculture Project.
B. J. Watten.
Progressive Fish Culturist, Vol. 46, No. 3, p 213-215, July, 1984. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Water sampling, *Instrumentation, *Samplers, Water analysis, Costs.

A spring activated gate valve has been placed in the sub-surface sampler described. The instrument is light in weight, has a simplified drainage system, and is constructed of common materials. Cost of the instrument is about $176. The sampling chamber consists of a cylindrical tube with closure devices at each end. In use, the open sampler is lowered slowly on a graduated cord to a desired depth. A messenger is then sent down the cord to activate the closure mechanism and secure a water sample. While intended for use in the vertical position, it can be modified for horizontal service. (Baker-IVI)
W85-04086

USE OF ISOTOPE METHODS IN HYDROGEOLOGY,
Bierman (Sheldon L.) and Associates, Washington, DC.
For primary bibliographic entry see Field 2F.
W85-04109

SIMPLE GRAVITY CORER AND CONTINUOUS-FLOW ADAPTOR FOR USE IN SEDIMENT/WATER EXCHANGE STUDIES,
National Inst. for Water Research, Pretoria (South Africa).
A. J. Twinch, and P. J. Ashton.
Water Research, Vol. 18, No. 12, p 1529-1534, 1984. 5 Fig, 20 Ref.

Descriptors: *Gravity corers, *Continuous flow, *Sediment corers, Lake sediments, Sediment-water interface, Sampling, Phosphorus, Retention time, Steady-state, Hartbeesport Dam, South Africa.

This paper describes a gravity corer and continuous-flow adaptor for use in sediment/water exchange studies. The objectives in designing the apparatus were to provide efficient sampling of intact sediment cores from the range of sediment types that occur in Hartbeespoort Dam (South Africa), and to facilitate rapid experimental manipulation of sediment/water chemical gradients for measurement of potential exchange rates. Simple phosphate uptake/release experiments are used to demonstrate the use of the apparatus, and to establish the relationship between overlying water retention time and the time required to attain steady state conditions in the outflow. This study has demonstrated that: steady-state phosphate concentrations in the outflows from continuous-flow sediment/water systems are independent of the water volumes overlying the sediment cores; the time required to attain steady-state concentrations in the outflows is directly related to the water retention time in the reaction vessel; phosphate release rates from sediment cores decrease linearly with increasing phosphate concentration in the overlying water. (Author's abstract)
W85-04300

CONVENIENT APPARATUS FOR MICROBIOLOGICAL SAMPLING OF RIVER WATERS,
Eastern Kentucky Univ., Richmond.
J. T. Lisle, and D. M. Mardon.
Transactions of the Kentucky Academy of Science, Vol. 45, No. 3-4, p 125-127, September, 1984. 4 Fig, 7 Ref.

Descriptors: *Water sampling, *Instrumentation, *Microbiological studies, Lotic environment, Lentic environment.

A compact water sampler for the collection of microorganisms from selected depths in both lentic and lotic waters is described. The sampler demonstrated excellence performance during a six month study on a section of the Kentucky River at sampling depths between 1.0 and 9.0 m. The simple construction, rugged design and versatility should enhance its usefulness for research, industrial and educational purposes. The ability to use sampling bottles with volumes between 125 and 500 ml is an advantage. Once at a desired depth the bottle can be readily opened, filled, then closed by an operator on the surface. (Baker-IVI)
W85-04308

METHOD FOR MEASURING OXYGEN IN AQUATIC MICROZONES,
Chequamegon National Forest, Park Falls, WI.
For primary bibliographic entry see Field 2K.
W85-04312

MODELING OF FLOW VELOCITY USING WEIRS,
Poznan Technical Univ. (Poland). Inst of Environmental Engineering.
For primary bibliographic entry see Field 8B.
W85-04396

SUBMERGED WEIRS,
For primary bibliographic entry see Field 8A.
W85-04402

7C. Evaluation, Processing and Publication

CALCULATOR SMOOTHS COLOR MEASUREMENT PATH,
Auburn Univ., AL. Dept. of Civil Engineering.
S. R. Jenkins, and M. Sanders.
Water Engineering and Management, Vol. 131, No. 12, p 28-30, November, 1984. 1 Fig, 11 Ref.

Descriptors: *Water quality control, *Wastewater treatment, *Computers, Automation, Color, Calculators.

One of the parameters frequently used as a measure of the pollutant load being discharged by municipal or industrial waste treatment plants is color. When color is to be used as a reference of pollution, it is important that it be expressed as a single number. A computer program designed for a relatively inexpensive TI-59 programmable calculator has been developed. The software simplifies the confusing steps associated with the fifth order relationships previously used to convert a three digit number to a single number for color notation. The program also considerably reduces the often encountered frustration and consumption of operator time to convert spectrophotometric data obtained in the lab first to tristimulus values, Munsell values, Adams Nickerson color difference and then to ADMI color. With this new program, the user need only to input the laboratory data and the single ADMI value results. The program can be stored on twelve magnetic cards. It includes instructions about what input is needed and what output is generated. A flow diagram of the program is shown in an illustration. (Baker-IVI)
W85-03799

WETLANDS IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2H.
W85-03894

PUBLIC SUPPLY WATER USE, PALM BEACH COUNTY, FLORIDA, 1978-82,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 6D.
W85-03916

DEPTH AND THICKNESS OF SELECTED UNITS IN UPPER PERMIAN, UPPER JURASSIC, AND LOWER CRETACEOUS ROCKS IN SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03921

GROUND-WATER MODELS AS A MANAGEMENT TOOL IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03924

WATER-USE COMPUTER PROGRAMS FOR FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. H. Geiger.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Open-File Report 84-442, 1984. 91 p, 10 Fig, 53 Tab.

Descriptors: *Computer programs, *Water use, Water supply, Industrial water, *Florida, Municipal water, Rural water supply, Irrigation water supply.

Using U.S. Geological Survey computer programs L149-L153, this report shows how to process water-use data for the functional water-use categories: public supply, rural supply, industrial self-supplied, irrigation, and thermo-electric power generation. The programs are used to selectively retrieve entries and list them in a format suitable for publication. Instructions are given for coding cards to produce tables of water-use data for each of the functional use categories. These cards contain entries that identify a particular water-use data-collection site in Florida. Entries on the cards include location information such as county code, water management district code, hydrologic unit code, and, where applicable, a site name and number. Annual and monthly pumpage is included. These entries are shown with several different headings; for example, surface water or ground water, freshwater or saline pumpages, or consumptive use. All the programs use a similar approach; however, the actual programs differ with each functional water-use category and are discussed separately. Data prepared for these programs can also be processed by the National Water-Use Data System. (USGS)
W85-03934

WATER RESOURCES OF THE PALAU ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03935

WATER RESOURCES OF KOSRAE, CAROLINE ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03936

WATER RESOURCES OF PONAPE, CAROLINE ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03937

ENHANCED JOB CONTROL LANGUAGE PROCEDURES FOR THE SIMSYS2D TWO-DIMENSIONAL WATER-QUALITY SIMULATION SYSTEM,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. A. Karavitis.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Water Resources Investigations Report 84-4052, 1984. 21 p, 1 Fig, 7 Ref.

Descriptors: Computers, *Computer models, *Estuaries, *Water circulation, *Computer programs, Water quality, Simulation.

The SIMSYS2D two-dimensional water-quality simulation system is a large-scale digital modeling software system used to simulate flow and transport of solutes in freshwater and estuarine environments. Due to the size, processing requirements, and complexity of the system, there is a need to easily move the system and its associated files between computer sites when required. A series of job control language (JCL) procedures was written to allow transferability between IBM and IBM-compatible computers. (USGS)
W85-03953

MAP OF THE CARPINTERIA AREA AND VICINITY, SANTA BARBARA COUNTY, CALIFORNIA, SHOWING WATER-LEVEL CONTOURS FOR MARCH 1982,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03955

MAP OF THE CARPINTERIA AREA AND VICINITY, SANTA BARBARA COUNTY, CALIFORNIA, SHOWING WATER-LEVEL CONTOURS FOR MARCH 1983, AND NET CHANGE IN WATER LEVEL BETWEEN MARCH 1982 AND MARCH 1983,
Geological Survey, Sacramento, CA. Water Resources Div.
W. R. Moyle, Jr.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 84-4067, 1984. 2 p, 1 Fig, 2 Ref.

Descriptors: *Water level, *Wells, *Well hydrographs, Rincon Thrust fault, Contours, *California, *Maps, Carpinteria, Sandyland, Santa Barbara, Rincon Creek, Rincon.

A water-level contour map of the Carpinteria area, California, was constructed using 34 water-level measurements made by the Carpinteria County Water District in March 1983. Also shown on the map are five hydrographs that show water-level fluctuations in each well between 1978 and 1983. In addition, a water-level net-change map for March 1982 to March 1983 is shown. (USGS)
W85-03956

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1982 TO SPRING 1983.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W85-03958

AVAILABILITY OF HYDROLOGIC DATA IN SAN JUAN COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2E.
W85-03961

NOMOGRAM FOR CALCULATING WATER TEMPERATURE AND ADDITIONAL EVAPORATION LOSSES IN THERMALLY POLLUTED SURFACE WATER (EIN NOMOGRAMM ZUR BERECHNUNG DER WASSERTEMPERATUR UND DER ZUSATZLICHEN VERDUNSTUNGSVERLUSTE THERMISCH BELASTETER GEWASSER),
Meteorologischer Dienst der DDR, Berlin. Forschungsinstitut fuer Hydrometeorologie.
For primary bibliographic entry see Field 5B.
W85-04325

8. ENGINEERING WORKS

8A. Structures

NEW CONTINUOUSLY MONITORED COLLECTION SYSTEM FOR LIQUID INDUSTRIAL WASTES,
Los Alamos National Lab., NM.
L. A. Emelity, W. M. Sanders, R. Garde, and J. R. Bucholz.
Journal of the Water Pollution Control Federation, Vol. 56, No. 11, p 1192-1198, November, 1984. 8 Fig, 5 Tab, 2 Ref. DOE contract W-7405-ENG.36.

Descriptors: *Industrial wastewater, *Monitoring, *Radioactive wastes, *Sewer systems, Leakage, Corrosion, Computers, Automation, Hazardous wastes, Design criteria.

A minor incident at the Los Alamos National Laboratory - the release of some dilute radioactive industrial waste through a cleanout on a sewer line - demonstrated the need for an in depth review of waste management practices. The continuous monitoring of pipe lines for leakage adopted as a result of the study led to replacement of the existing sewer system. The potential for environmental contamination has been greatly reduced because of the no-leak design and a monitoring system which sends off an immediate alarm when a line leaks or tanks overflow. The use of a computer to pinpoint sources of increased flow signals operators to determine the cause and, in most cases, to reduce the flow to a normal rate. Planners aimed for a system that would meet pressure tests with zero leakage, resist dilute acids and alkalies, use heat welded joints at relatively large intervals, have excellent flow characteristics, and suffer minimum adverse effects from chemical, mechanical and electrolytic corrosion and erosion. (Baker-IVI)
W85-03872

LEAKAGE INVESTIGATIONS IN HOUNSLOW,
Thames Water Authority (England). Northern Div.
For primary bibliographic entry see Field 3D.
W85-03884

DESIGN AND OPERATION OF FLEXIBLE MEMBRANE COVERS FOR DISTRIBUTION STORAGE RESERVOIRS,
Manchester Water Works, NH.
D. Kittredge.
Journal of the New England Water Works Association, Vol. 98, No. 3, p 259-270, September, 1984. 3 Fig, 2 Tab, 2 Ref.

Descriptors: *Reservoir operation, *Reservoir covers, Polyethylene, Water quality control, Water management, Water storage, Storage reservoirs.

The Manchester Water Works installed new flexible membrane floating covers made of reinforced chlorosulfonated polyethylene (CSPE) on its three principal distribution storage reservoirs in 1981. The average cost of installation was $1.47/sq ft. These new covers of 45 mil reinforced CSPE have greatly out performed the original 60 ml EPDM synthetic rubber cover system which was in service for about ten years. Improved performance and lower operating costs are attributed to an improved design of the surface water collection and removal system, a new operating procedure to maintain tight control of reservoir levels during winter months, and increased strength properties of CSPE field seams. Vandalism to one of the new covers has continued to be a problem despite increased efforts to secure the reservoir area. Water quality in the system has steadily improved since the reservoirs were covered in 1970. (Baker-IVI)
W85-04020

LEAKAGE CONTROL WORKS AT THE ROUCHAIN DAM,
Coyne et Bellier, Paris (France).
M. Salembier.
International Water Power and Dam Construction, Vol. 36, No. 12, p 15-17, December, 1984. 4 Fig.

Descriptors: *Rouchain Dam, *France, *Dams, *Leakage, Water loss, Rockfill dams, Watertight overlays, Backfill.

Rouchain Dam is a conventional rockfill structure 60 m high built on the Rouchain River to supply water for domestic use to the town of Roanne, France. Excessive leakage occurred on first filling and a non-woven textile overlay was used to prevent a recurrence. The installation of this overlay is described and subsequent performance data given which suggests that this form of remedial work may become increasingly common. The plan was to place a watertight overlay over the whole concrete facing and to surround the spillway bottom with watertight backfill, which would also serve to seal the leaks at the left bank foundation. The membrane used is a non-woven polyester fabric impregnated with an acrylic monomer and a latex/bitumen emulsion, which becomes waterproof when the monomer polymerizes. The polymerization process also joins adjacent strips, so that no welding is necessary, and patching is easy. It develops enough bond with the underlying concrete to remain stable against wave action. (Baker-IVI)
W85-04028

REHABILITATION OF THE DELTA DAM,
Tippetts-Abbett-McCarthy-Stratton, New York.
K. F. Standig.
International Water Power and Dam Construction, Vol. 36, No. 12, p 21-24, December, 1984. 4 Fig, 4 Ref.

Descriptors: *Delta Dam, *New York, *Rehabilitation, Dam stability, Safety, Dam construction, Grouting, Post-tensioning anchors, Concrete dams.

When inspections under the National Dam Safety Program were implemented in 1978, Delta Dam, on the Mohawk River, 6 km north of Rome, New York, was cited as deficient. It is a cyclopean concrete structure about 305 m long, with a 91 m long centrally located, uncontrolled spillway. When the dam was completed in 1913, it was already evident that concrete deterioration had begun. Despite repairs, seepage through the dam has persisted, and over the years caused nearly complete deterioration of the gunite facing added during previous repairs. Recommendations made at the time of the inspection included improving the stability of the dam with post-tensioned anchors to withstand the increased design flood safely, rehabilitation of the downstream face, repairing the upstream face, and grouting portions of the dam. All phases of this work are underway with completion scheduled for June of 1985. (Baker-IVI)
W85-04030

TURKISH DAM IMPOUNDS WORLD'S LARGEST KARST SPRING,
9 Eylul Univ., Izmir (Turkey). Dept. of Engineering and Architecture.
U. Ozis, and H. Yanar.
International Water Power and Dam Construction, Vol. 36, No. 12, p 44-49, December, 1984. 8 Fig, 13 Ref.

Descriptors: *Arch dams, *Oymapinar Dam, *Turkey, *Karst, *Springs, Grout curtains, Leakage, Limestone.

Construction of the Oymapinar arch dam on the Manavgat river, Turkey, was completed in 1983. The Oymapinar reservoir impounds Dumanli, the world's largest karst spring issuing from a single orifice, and required unusually extensive geological investigations and treatment to prevent leakage. Preventing leakage from the left bank required a special grout curtain of 65,000 sq m, consisting of three panels and using a total of 28,000 t of grout. The diversion of the Manavgat river during construction of the dam was accomplished using a pair of cofferdams and a tunnel. The bedrock at the dam site is dolomitic limestone. The alluvium and underlying formation was excavated down to sea level, and exposed karst channels were filled with concrete. The dam is a double-curvature, variable radius, variable angle arch dam. (Moore-IVI)
W85-04033

MIDUSS - A DESIGN PROGRAM FOR STORM WATER SEWERAGE,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
A. A. Smith, and J. P. Falcone.
Canadian Journal of Civil Engineering, Vol. 11, No. 3, p 530-541, September, 1984. 6 Fig, 4 Ref, 1 Append.

Descriptors: *Computer programs, *Network design, *Storm sewers, Sewers, Design flow.

Many programs that are used for storm water management are intended primarily for analysis or simulation. The MIDUSS program facilitates the design of conveyance or detention storage elements in a tree network. The program is command driven and allows the design to proceed in a traditional manner by allowing the user to define individual subcatchments to generate the overland flow. The resulting hydrographs may be manipulated and used to design pipe and pond elements of a drainage network. The user can experiment with alternative trial designs. As the design proceeds, a file records the data input and design decisions made by the user. This file may be usd in subsequent design sessions during which the user may switch from manual (i.e., keyboard) to automatic (i.e., file) input. This allows continuation of a previous design session, testing of a prior design with a different storm, or redesign of specific elements of the system. In either mode, the user can monitor progress at each step and take corrective action in the event of bad data or incorrect design decisions. (Author's abstract)
W85-04047

EVALUATION OF SEMICIRCULAR CANALS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
W. L. Long, and T. C. Fisher.
Available from the National Technical Information Service, Springfield, VA 22161. Report, April, 1984. 48 p, 23 Fig, 7 Tab, 21 Ref.

Descriptors: *Canals, *Canal design, *Canal construction, *Canal linings, Canal seepage, Open channels, Concretes, Comparison studies, Soil mechanics, Evaporation, Design criteria, Slope stability.

A comparative study of the semicircular canal section versus the trapezoidal canal section was made to determine the potential efficiences to be gained through the use of this more hydraulically efficient open channel shape. Results of the slope stability analysis showed that at least moderately cohesive soils are required for construction of efficient semicircular sections. Strength comparisons showed that neither the semicircular nor the trapezoidal shape will take large external uplift or lateral loads when the canal is unwatered. The semicircular shape shows better structural resistance against uplift applied along the bottom of the canal lining while the trapezoidal indicates better structural resistance against lateral loads directed toward the canal. The use of precast concrete and cast-in-place concrete has been replaced by zero-slump concrete semicircular canals. The concrete, location of lining joints, excavation, lining and construction equipment are also considered. Design, maintenance and safety considerations are discussed. Semicircular canals offer reductions in material costs, right-of-way required, spans for crossing, evaporation and seepage losses, and canal invert slope. However, the semicircular shape is not suitable for larger canals because the water depths become too great.
W85-04221

MORROW POINT DAM AND POWERPLANT, TECHNICAL RECORD OF DESIGN AND CONSTRUCTION.
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
Water Resources Technical Publication, September, 1983. 417 p, 239 Fig, 11 Tab, 39 Ref, 6 Append.

Descriptors: *Dam construction, *Hydroelectric plants, Powerplants, Construction, Reservoir construction, Concrete dams, Morrow Point Dam, Colorado River, Gunnison River, Design criteria, Spillways, *Colorado.

A record of design and construction of the Morrow Point Dam and Powerplant is presented. The Colorado River Storage Project provides for the comprehensive development of the Upper Colorado River Basin. Agriculture, particularly livestock raising, and mining are the principal industries of the upper drainage basin. The Morrow Point Dam and Powerplant are located on the Gunnison River in Montrose County, near Cimarron, Colorado. Morrow Point Dam was the first double-curvature thin-arch, concrete dam constructed by the Bureau. Four orifice-type, free-fall spillways are located at the top center of the dam, each controlled by a 15- by 16.83-foot, fixed-wheel gate operated by a motor drawn, wire rope drum hoist located on the crest of the dam. Located on the centerline of the dam at elevation 6810, the outlet works consists of one 4- by 4-foot, stainless steel clad, steel-lined conduit extending through the dam and discharge into the spillway basin. Two 13.5 foot-diameter steel penstocks, installed in 18-foot diameter tunnels, are located in the left abutment rock mass to convey water to the two 83,000-horsepower hydraulic turbines in the powerplant. The underground Morrow Point Powerplant is located in the left abutment rock mass downstream from the dam and houses two 60,000-kilowatt generating units. Morrow Point Reservoir has a capacity of 117,165 acre-feet.
W85-04225

SUBMERGED WEIRS,
H. Majcherek.
Journal of Hydraulic Engineering, Vol. 111, No. 1, p 163-168, January, 1985. 2 Fig, 6 Ref.

Descriptors: *Weirs, *Design criteria, Hydraulic engineering, Head, Flow discharge.

A theoretical method for determining the shape of the upper part of a compound submerged weir with a known lower part, f1(y), and downstream heads where h < or = a, is presented. The method

requires that the relation h = h(H), between upstream, H, and downstream, h, heads be known. A relation for the shape, f2(y), of a weir with a rectangular bottom part and a linear discharge characteristic was obtained. To determine the effect of simplifying assumptions that were introduced on the accuracy of theoretical solutions, experimental studies were conducted. Based on experimental results, it is shown that the effect of simplifying assumptions on the prediction of the discharge characteristic is small, and the coefficient of discharge is a function of the upstream head. (Baker-IVI)
W85-04402

8B. Hydraulics

SCALE EFFECTS IN PUMP SUMP MODELS,
Worcester Polytechnic Inst., Holden, MA. Alden Research Labs.
For primary bibliographic entry see Field 8C.
W85-03775

LATERAL MIGRATION RATES OF RIVER BENDS,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W85-03776

SEPARATION ZONE AT OPEN-CHANNEL JUNCTIONS,
Hull Univ. (England).
J. L. Best, and I. Reid.
Journal of Hydraulic Engineering, Vol. 110, No. 11, p 1588-1594, November, 1984. 5 Fig, 14 Ref.

Descriptors: *Channels, *Separation zone, *Tributaries, River flow, Channel morphology, Model studies, Hydraulic models, Velocity, Sediment transport.

Channel junctions are of considerable importance in river engineering. The configuration of open channel junctions controls local sedimentary processes, channel scour, and sidewall erosion through its influence on the flow patterns established as confluent streams compete for limited channel capacity. The nature of the separation zone that develops downstream from the tributary entrance has not been satisfactorily studied in open channels. Experiments were conducted in a recirculating flume of rectangular cross section which was constructed to accomodate any of 4 junction angles between a main channel and its confluent tributary. Entry of a tributary into a mainstream ensures detachment of flow from the channel sidewall immediately downstream from the junction, and flume experiments show well-defined relationships between the dimensions of the separation zone and discharge from the tributary. The length and width of the flow-separation zone at open channel confluences increases with both junction angle and the contribution of the tributary to total discharge. The shape of the separation zone remains more or less constant. The zone grows at the expense of the channel width occupied by the combined streams with inevitable consequences for fluid velocity and sediment transport. (Baker-IVI)
W85-03778

UNIFIED STREAMFLOW ROUTING BY FINITE ELEMENTS,
For primary bibliographic entry see Field 2E.
W85-03779

TANGENTIAL VORTEX-INLET,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
S. C. Jain.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1693-1699, December, 1984. 3 Fig, 10 Ref, 1 Append.

Descriptors: *Hydraulics, *Tangential vortex inlet, Inlets, Design criteria, Storm sewers, Water distribution systems, Dams.

An analysis to predict the hydraulic performance of a tangential vortex-inlet which is relatively simple in shape and compact in size is presented. The depth-discharge relation agrees fairly well with the experimental data. The agreement between the predicted and observed values of the air-core area at the throat for low values of discharge is not very satisfactory. A relation to determine the dropshaft diameter for the tangential inlet vortex flow drop structure is presented. (Baker-IVI)
W85-03783

HYDRAULIC JUMP PROPERTIES OVER A ROUGH BED,
Colorado Univ. at Denver. Dept. of Civil and Urban Engineering.
W. C. Hughes, and J. E. Flack.
Journal of Hydraulic Engineering, Vol. 110, No. 12, p 1755-1771, December, 1984. 6 Fig, 8 Tab, 5 Ref. NSF grant CME-18029.

Descriptors: *Hydraulic jump, *Fluid mechanics, *Beds, Channels, Hydraulic roughness, Channel morphology.

A laboratory investigation was performed to assess the effects of a rough impervious bed on the properties of a hydraulic jump. Hydraulic jump characteristics were measured in a horizontal rectangular flume modified to accept several different artificially roughened test beds. The test beds provided a relative roughness range from 0.0-0.9, and measurements were made over a Froude number range of 3-10. The testing program involved some 200 hydraulic jump observations, which included measurements of flow rate, initial depth, tailwater depth and jump length. The laboratory observations showed conclusively that boundary roughness reduces both sequent depth and the length of a hydraulic jump. The observed reductions were found to be related to both the initial Froude number and the degree of boundary roughness. Jump length reductions were noted at all Froude numbers, while sequent depth reductions were significant at Froude numbers greater than about 3.5. A rigorous quantitative assessment of the theoretical equation derived by Leutheusser and Kartha was not possible. However, the results of this study were fully consistent qualitatively with their equation. A simplification of the equation involving more commonly available variables was proposed and found to compare favorably with the observed hydraulic jump characteristics. (Baker-IVI)
W85-03787

CHANNEL DESIGN AND FLOW OPERATION WITHOUT CHOKE,
National Univ. of Singapore. Dept. of Civil Engineering.
S.-Y. Liong.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 4, p 403-407, December, 1984. 5 Fig, 2 Ref.

Descriptors: *Design criteria, *Channels, Stream flow, Channel flow, Choke, Hydraulics, Fluid mechanics.

Choke prevention in channel transition design requires criteria on the maximum allowable changes on width and bed elevation. These limits can be determined by applying the energy and continuity equations to the cross sections immediately before and after the transition zone. Curves for one-dimensional, steady, uniform and no-choke flow in a rectangular channel with varying width and with varying width and channel-bed elevation are shown. The curves are drawn from the viewpoints of a designer, how to select the maximum allowable changes on channel structure, and an operating engineer in how to choose the upstream flow depth so that choke is prevented. Simple and convenient design curves are offered. (Baker-IVI)
W85-03822

SUBSURFACE STORAGE OF FRESHWATER IN SOUTH FLORIDA: EVALUATION OF SURFACE-WATER DISCHARGE DATA AT SELECTED SITES,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W85-03900

FINITE ELEMENT MODELLING OF SURFACE WAVES IN A CHANNEL,
Naval Research Lab., Washington, DC.
G. A. Keramidas, S. E. Ramberg, and O. M. Griffin.
Applied Mathematics and Modelling, Vol. 8, No. 5, p 298-304, October, 1984. 13 Fig, 12 Ref.

Descriptors: *Finite element method, *Model studies, *Waves, *Channels, Surface waves, Boundary conditions, Velocity, Mathematical models.

A finite element model has been developed for the solution of the depth-averaged continuity and momentum equations for free-surface wave motions. The model employs a first order space-time approximation which is shown to be stable and free of oscillations. Three examples are given to demonstrate typical outflow boundary conditions for either reflecting or non-reflection boundaries. The first problem is an open channel of uniform depth and the second an open channel of linearly varying depth. The inflow boundary conditions are prescribed in terms of the velocity which represents a wavemaker and/or a flow source, while the outflow boundary condition is specified in terms of the water action. The outflow condition is adjusted for two cases, a reflecting boundary (finite channel) and a non-reflecting boundary (open-ended channel). The latter boundary condition is examined in some detail and the results obtained show that the numerical model can produce the nonreflecting boundary that is similar to the analytical radiation condition for waves. Computational results for a third problem involving wave reflection from a submerged cylinder, are also presented and compared with both experimental data and analytical predictions. The results obtained by using the model and the proposed conditions for the outflow boundary have shown that surface waves can be modelled adequately under a variety of conditions by the simple formulation as proposed. (Baker-IVI)
W85-04014

NUMERICAL METHODS OF SOLVING ONE-DIMENSIONAL PROBLEMS OF HYDRAULICS,
A. A. Atavin, O. F. Vasil'ev, A. F. Voevodin, and S. M. Shugrin.
Water Resources, Vol. 10, No. 4, p 348-356, July-August, 1983. 6 Fig, 1 Tab, 30 Ref. Translated from Vodnye Resursy, No. 4, p 38-47, July-August, 1983.

Descriptors: *Hydraulics, *Dam failure, *Open chanels, *Pipelines, Flow, Mathematical models, Fluid mechanics.

Many important problems of fluid mechanics are described sufficiently well in the scope of the one-dimensional (hydraulic) approximation, when the main variables depend only on one space coordinant and time. The main results of investigations to solve one-dimensional problems of hydraulics are presented. The problems involved dealt with gradually varied flows in open chanels, dam failure and flows with discontinuous waves, flows in complex channel systems with rings and branches, and unsteady hydraulic processes in pipelines and their system. The mathematical formulation of the boundary value problem on a graph is discussed and examples of calculation are given. (Baker-IVI)
W85-04119

FINITE ELEMENT SOLUTIONS FOR MASS OSCILLATIONS IN SURGE TANKS,
University Coll., Cork (Ireland). Dept. of Civil Engineering.
E. McKeogh, and P. W. France.
Advances in Water Resources, Vol. 6, No. 4, p 200-204, December, 1983. 3 Fig, 4 Tab, 15 Ref, 1 Append.

Descriptors: *Surge tanks, *Mass oscillations, *Finite element method, Computers, Mathematical studies, Oscillations, Friction, Flow rate, Water surface.

The motion of the water surface in a surge tank following complete or partial valve closure has been studied by numerical methods, but was limited in application due to the high cost and restricted accessibility of large computers. A finite element technique is described which uses the method of weighted residuals for the solution of mass oscillations in surge tanks. Three weighting functions, uniform, linear and Galerkin, are applied and the results are compared with those from alternative techniques. The relatively simple case of surge analysis with flow rate change in the penstock, but neglecting tunnel friction, is first considered as a direct analytical solution is available. Friction is then included for comparison with a graphical and analogue solution. Using either a uniform or linear weighting function, it gives accurate results for the case of frictionless flow, and solutions which compare favorably with an analogue or graphical technique when friction is included. Galerkins's weighted residual approach led to artificial numerical damping of the oscillations. The recurrence formula was simple to program with the minimum amount of data preparation. Each new level in the surge tank is printed out, used twice in the recurrence relationship, and then discarded so no large arrays are needed. A fast and economic solution can be obtained as computer run time and storage are low. (Moore-IVI)
W85-04155

PUMPED-STORAGE HYDROPOWER SCHEMES: INTEGRAL PLUME MODELS FOR PUMPBACK SIMULATIONS,
Salford Univ. (England). Dept. of Mathematics.
B. Henderson-Sellers.
Advances in Water Resources, Vol. 6, No. 4, p 224-239, December, 1983. 17 Fig, 2 Tab, 47 Ref, 3 Append.

Descriptors: *Pumped storage, *Pumpback, *Plumes, Simulation, Jets, Water circulation, Density, Entrainment, Hydroelectric plants, Reservoirs, Buoyancy.

In a pumped-storage scheme, the water flowing into the upper reservoir during the pumpback phase of the cycle is unlikely to be of the same density as the ambient water at the level of the outlet. Most inflows have both buoyancy and momentum and are known as forced plume or buoyant jets. Integral plume rise formulations for submerged jets in reservoirs are analyzed for implementation in models of pumped-storage hydropower schemes. Calculations of entrainment require adequate representation of length scales, cross-sectional profiles, the entrainment coefficient and the zone of flow establishment (ZFE). The Froude number dependence of both ZFE characteristics and entrainment coefficient should be included to avoid errors in both calculated entrainment and the levels from which this entrained water is to be abstracted. In the case of a line source or a row of point diffusers, the problem of merging must be considered, but their appears as yet to be no unique method of representing this merging. The Boussinesq approximation is acceptable except in the case of highly buoyant inflows and current simulations are unlikely to be anything other than a second order problem in descriptions of the pumped back inflow. (Moore-IVI)
W85-04158

SATURATED-UNSATURATED TRANSIENT FINITE ELEMENT SEEPAGE MODEL FOR GEOTECHNICAL ENGINEERING,
Saskatchewan Univ., Saskatoon. Coll. of Engineering.
L. Lam, and D. G. Fredlund.
Advanced Water Resources, Vol. 7, No. 3, p 132-136, September, 1984. 2 Fig, 13 Ref.

Descriptors: *Finite element method, *Seepage, *Model studies, Dams, Porous media, Aeration zone, Saturation zone, Mine wastes, Groundwater mounding, Groundwater movement, Infiltration, Evaporation.

A two-dimensional transient finite element seepage analysis model is proposed and two example problems are presented to demonstrate the capabilities of the model. Example 1 is seepage through a homogeneous dam with a horizontal drain. Example 2 involves groundwater seepage under a tailings impoundment. Generally seepage under an impoundment is considered as taking place in three stages. Stage 1 is the advance of water from the impoundment through the unsaturated zone to the saturated zone which is delineated by the water table. Stage 2 is when the water contacts the water table and starts building up a groundwater mound towards the impoundment. Stage 3 occurs if the groundwater mound comes in contact with the impoundment. At this stage, the soil underneath the impoundment is saturated, and water flows from the impoundment directly into the saturated zone. The traditional saturated only approach was found to be a special case to the saturated-unsaturated model. The saturated-unsaturated model provides a more realistic representation of the actual situations, and applies to a much wider range of engineering problems. (Baker-IVI)
W85-04173

SIMPLE METHODS TO EVALUATE RELATIVE EFFECTS OF LONGITUDINAL ENCROACHMENTS,
L. A. Traille, and D. L. Chery, Jr.
Transportation Research Record, 922, p 46-53, 1984. 8 Fig, 7 Ref.

Descriptors: *Floodplains, *Channels, *Highways, *Encroachment, Stage, Simulation, Mathematical models, Flood peak.

Simplified graphical solutions were developed that provide short-cut methods for easy assessment of encroachment impacts to aid highway planners and others who must site structures and fills in natural floodplains. Changes in stage (water-surface elevation) and hydrograph peak discharge due to encroachments were determined. The simulation results indicate that the change in water-surface profile can be expressed as a function of the valley section's conveyance distribution in the main channel and floodplains, the average flow depth in the overbanks (expressed as a depth above bank-full stage), the Fronde number of the flow in the unencroached conditions, and the degree of constriction (conveyance reduction) in the overbanks due to the encroachment. Constricting the natural channel valley by encroaching laterally was found to decrease the rate of hydrograph attenuation and thus to increase the natural peak-outflow hydrograph. The characterisic shape of the inflow hydrograph, as defined by the peak-discharge rate and the time of rise of the inflow hydrograph, was found to exert considerable influence on the attenuation of a flood. (Baker-IVI)
W85-04333

SIMPLE METHODS FOR ESTIMATING BACKWATER AND CONSTRICTION SCOUR AT BRIDGES AND ABRUPT ENCROACHMENTS,
S. W. Taylor, and H. W. Shen.
Transportation Research Record 922, p 54-64, 1984. 17 Fig, 14 Ref.

Descriptors: *Encroachments, *Backwater, *Scour, *Constrictions, *Bridges, Floodplains, Regression analysis, Piers, Channels.

Expressions for backwater based on the conservation of energy in open-channel flow are presented for five commonly occurring bridge crossings. To satisfy the one-dimensional flow assumption, the theories of potential flow and empirical results were used to locate cross sections in zones of nearly one-dimensional flow. An expression for constriction scour was derived as a function of the ratio of channel width to bridge opening width and exponents describing the bed-load transport rate. A procedure referred to as the known cross-section method was developed for easily assessing the effects of constriction scour on backwater. Through numerical simulation, dimensional analysis, and regression analysis, explicit relations for bridge backwater were developed for both rigid- and movable-boundary conditions. For bridge piers, it was found that the backwater is a function of the Froude number, the kinetic-energy coefficient, and a pier energy-loss coefficient. The Froude number and the ratio of bridge opening width to channel width were found to describe the backwater in a channel abrupt encroachment. In the case of floodplain encoachments, the Froude number and the ratio of main channel conveyance to total conveyance were the primary parameters controlling backwater. These solutions are of an accuracy suitable for use in a bridge feasibility or preliminary design study; the backwater regression equations, however, are not intended for detailed analyses. Step-by-step procedures are given to demonstrate how the simple backwater and constriction scour relations may be applied to feasibility studies. (Baker-IVI)
W85-04334

MODELING OF FLOW VELOCITY USING WEIRS,
Poznan Technical Univ. (Poland). Inst of Environmental Engineering.
H. Majcherek.
Journal of Hydraulic Engineering, Vol. 111, No. 1, p 79-92, January, 1985. 4 Tab, 19 Ref.

Descriptors: *Weirs, *Mathematical models, *Velocity, Channels, Head, Flow discharge, Weir crest.

Basic equations for determining the cross-section shape of the channel, in which the average flow velocity is a specified function of the head, $v = v(h)$, are derived in this work for the case of modeling of flow velocity with proportional weirs. Studies are carried out for one- and two-part weirs with discharge characteristics described by a power function. For both types of weirs, functions that represent the channel cross-section shape are calculated from the flow continuity condition developed for the weir and in the upstream channel. The study on possibility of application of two-part weirs comprises two particular cases: when the weir crest is located at the channel bottom and when the weir crest is located above the channel bottom. The work also presents particular solutions for flow velocity described with a function in the form of power monomial. (Author's abstract)
W85-04396

LDA MEASUREMENTS IN OPEN CHANNEL,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Steffler, N. Rajaratnam, and A. W. Peterson.
Journal of Hydraulic Engineering, Vol. 111, No. 1, p 119-130, January, 1985. 8 Fig, 1 Tab, 20 Ref, 1 Append.

Descriptors: *Open channel flow, *Velocity, *Turbulence, Laser Doppler Anemometer, Law of the wall, Shear stress.

Some mean velocity and turbulence measurements in a smooth rectangular channel are presented for three aspect ratios equal to 5.08, 7.83, and 12.3 obtained with a Laser Doppler Anemometer (LDA). The longitudinal velocity measurements in the viscous sublayer were found to agree well with the linear form of the law of the wall. Near the side wall, the velocity profiles were found to drop off from the log-law line, thereby exhibiting a significant dip in the velocity profile near the water surface. Whereas the profile of the longitudinal turbulent shear stress is linear in the central region of the channel (away from the immediate vicinity of the bed), in the wall region, the shear stress profiles are rather complicated. Turbulent shear stress profiles are also measured in the central as well as wall regions. (Moore-IVI)
W85-04399

BED SHEAR FROM VELOCITY PROFILES: A NEW APPROACH,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
S. Vedula, and A. Ramakrishna Rao.
Journal of Hydraulic Engineering, Vol. 111, No. 1, p 131-143, January, 1985. 3 Fig, 1 Tab, 14 Ref, 1 Append.

Descriptors: *Bed shear, *Velocity, Shear stress, Pipes, Open channel flow, Sediments, Flow.

A new binary law of velocity distribution has been developed to describe the velocity profile for the entire flow region. The law is a combination of logarithmic law, valid in the wall (inner) region, and parabolic law, valid in the core (outer) region of the flow. The validity of the law has been established based on earlier data on flat plates, rough and smooth pipes and experimental data obtained from rigid-walled open channels with plane sand beds. A procedure of estimating bed shear stress from the proposed law of velocity distribution using the measured velocity profile has been evolved. Bed shear estimates made according to this procedure are in agreement with the values obtained from uniform flow analysis in the case of open channel flow over sediment bed. The proposed method of estimating the bed shear stress from the observed velocity profiles is found to be particularly useful in cases where it is difficult to determine precisely the true bed level, such as in the case of flow over sediment beds. (Author's abstract)
W85-04400

FLOW OVER SIDE WEIRS IN CIRCULAR CHANNELS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
A. Uyumaz, and Y. Muslu.
Journal of Hydraulic Engineering, Vol. 111, No. 1, p 144-160, January, 1985. 21 Fig, 1 Tab, 8 Ref, 1 Append.

Descriptors: *Weirs, *Side weirs, *Flow, *Circular channels, Finite difference method, Supercritical flow, Subcritical flow, Water surface profiles, Flow discharge.

Theoretical and experimental investigations of the flow over sharp-edged side weirs in circular channels are reported. A theoretical model can be obtained from energy principles, and it is solved by a finite difference method. The results are presented in diagrammatic form for practical use. The experiments cover sub- and supercritical flow regimes, and water surfaces are observed for both. The discharge coefficients are obtained for sub- and supercritical regimes. Derived expressions for the side weir discharge and water surface profiles for these regimes are compared with experimental results. (Author's abstract)
W85-04401

8C. Hydraulic Machinery

SCALE EFFECTS IN PUMP SUMP MODELS,
Worcester Polytechnic Inst., Holden, MA. Alden Research Labs.
M. Padmanabhan, and G. E. Hecker.
Journal of Hydraulic Engineering, Vol. 110, No. 11, p 1540-1556, November, 1984. 10 Fig, 2 Tab, 21 Ref.

Descriptors: *Sumps, *Scale models, *Hydraulic models, *Pump sumps, Hydraulic equipment, Vortexing, Pipe swirl, Air ingestion, Pumps.

Experiments were conducted using one full-sized and two reduced scale models of a pump sump to geometric scales of 1:2 and 1:4 to determine whether scale effects distort the predictive ability of hydraulic models of pump sumps with such large scale ratios. Possible scale effects on vortexing, pipe swirl, inlet losses, and air ingestion due to air-drawing vortices have been examined using the experimental results. No significant scale effects on free surface vortexing were evident in the tested ranges. Pipe flow swirl and inlet losses were seen to exhibit some scale effects. The air-core vortices did not produce any significant air ingestion even with screen blockage designed to enhance circulation in the sump. For the depressed sump configuration tested, subsurface vortexing was found along the shear layers formed as the flow entered the flood depression. Limited measurements of angular velocity at a selected distance from the center of air-core vortices indicated a good scaling of angular velocity by the models, and thus, of the circulation in the full-scale sump. Since the reduced scale models did not show any scale effects regarding vortexing, there is no need for tests with higher than Froude scaled velocities. (Baker-IVI)
W85-03775

8D. Soil Mechanics

EARTHQUAKE DEFORMATION OF CENTRIFUGE MODEL BANKS,
California Univ., Davis. Dept. of Civil Engineering.
B. L. Kutter.
Journal of Geotechnical Engineering, Vol. 110, No. 12, p 1697-1714, December, 1984. 11 Fig, 1 Tab, 17 Ref, 1 Append.

Descriptors: *Earthquakes, *Deformation, *Embankments, Earthworks, Centrifuge models, Sliding block analysis, Model studies, Earthquake engineering, Resonance, Shear strain.

Integrity of spillways, filters, drains, and other structures on or in embankments depend on the magnitude and mechanism of deformation in earthquakes even if collapse does not occur. A modified sliding block analysis, which allows the sliding resistance to be nonlinear visco-elastoplastic, was developed to predict deformations of embankments during earthquakes. The centrifuge models deformed along relatively wide shear bands during base shaking, contrary to the assumption of the original Newmark sliding block analysis that a distinct slip surface forms. The sliding resistance provided by a wide shear band is better characterized by visco-elastoplastic than rigid-plastic behavior. The analytical model has been used to predict the behavior of physical centrifuge models shaken during centrifuge flight using the Bumpy Road apparatus. The predicted and measured displacements are in good agreement over the full range of measured displacements. The centrifuge modeling technique is a useful tool for development, tuning, and verification of analytical models, especially in earthquake engineering where detailed field evidence is in acute shortage. The beauty of sliding block models is their simplicity. Nonlinear effects and resonance effects can be accounted for and can be mentally visualized and easily understood. (Moore-IVI)
W85-03812

CENTRIFUGE MODEL TESTS ON BEARING CAPACITY OF CLAY,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
A. Nakase, O. Kusakabe, and S.-F. Wong.
Journal of Geotechnical Engineering, Vol. 110, No. 12, p 1749-1765, December, 1984. 16 Fig, 5 Tab, 14 Ref, 1 Append.

Descriptors: *Clay, *Centrifuge models, *Bearing capacity, Soil water, Pore pressure, Shear strength, Footings, Model studies, Consolidation.

A series of centrifugal model tests to investigate the bearing capacity of a strip footing on normally consolidated Kawasaki clay was performed. The proposed prototype is a normally consolidated clay foundation having undrained shear strength increasing with depth. To ensure that the proposed modeling was performed accordingly, pore pressure and settlement behaviors with time were recorded and compared values obtained by solving the consolidation differential equation. As a further check, water content distribution of the model was obtained after loading test. All the observations gave positive evidence showing the correct modeling had been carried out successfully. The bearing capacities of the foundations were determined by plotting the load intensity settlement curve on double logarithm paper. The bearing capacities thus obtained were then compared with Davis-Booker's plasticity solution and Nakase's slip circle solution. Adjustment was also made for the 90% consolidation. The results reveal the Davis-Booker's solution (smooth) formed the lower limit of bearing capacity and that solutions for the bearing capacity of clay, having undrained shear strength increasing with depth, is relevant. (Author's abstract)
W85-03813

HYDROGEOLOGIC CONTROL AND STATISTICAL PREDICTION OF ACTIVE MASS MOVEMENT,
Florida Atlantic Univ., Boca Raton.
I. Watson.
Bulletin of the Association of Engineering Geologists, Vol. 21, No. 4, p 479-494, November, 1984. 9 Fig, 3 Tab, 18 Ref.

Descriptors: *Landslides, *Soil mechanics, *Hydrogeology, Statistical analysis, Slopes, Soil properties, Permeability, Engineering geology, Aquifers, Mass wasting, Interstitial water.

In all non-arid, or non-semiarid areas where precipitation is sufficiently high, any slope consisting of a cohesive material overlain by a layer of significantly greater competency or mass permeability is likely to be degraded by active mass movement. This type of wide-spread mass movement is quantitatively analyzed, based on an extensive research study of selected natural slopes on three continents. In non-arid areas, the overlying aquifer, in acting as a reservoir for infiltrated precipitation, furnishes a steady supply of water to the slope which initiates and reactivates mass movement through sustaining high pore water pressures in the slope-forming materials. Pore-pressure induced failure is not exclusive to the mass-movement phenomenon under study, but the accelerated rate of failure is. This is because the rate of failure is a direct function of the sustained supply of water from the overlying aquifer. Hydrogeologic variables are discussed in relation to other controls contributing to patterns and activity of mass movement. Wherever slope-forming beds consist of highly permeable materials overlying cohesive soils in a non-arid climate, the engineering geologist should anticipate some considerable level of active instability and although statistical methods may, under certain circumstances, be usefully adapted to similar problems in engineering geology, these methods should be selected with care and perspective. (Baker-IVI)
W85-04026

DISSECTING A DAM,
Soil Conservation Service, Chester, PA.
L. Kirkaldie, and L. E. Thomas.
Bulletin of the Association of Engineering Geologists, Vol. 21, No. 4, p 509-514, November, 1984. 6 Fig.

Descriptors: *Dam stability, *Earth dams, *Seepage, *Cattaraugus County, *New York, Dam safety, Flood control structures, Dam foundations, Landslides, Embankments, Dam design.

A geologic and engineering investigation was made to determine the source of seepage from a soil conservation service high hazard flood prevention dam in Cattaraugus County, New York. There was unexplained high permeability in the foundation and embankment and a possibility of voids in the trench drain system. It was felt unlikely that the dam would have suffered a catastrophic failure. The seepage in the left downstream toe was not water passing through the embankment, but resulted from water from the pool and some ground water moving through the left abutment. The centerline cutoff trench was not taken to bedrock in the left abutment in a previously unrecognized ancient landslide area. Thus permeable fractured rock, slump material and coarse alluvium remained beneath the cutoff. The foundation trench drain was installed as designed and was free of voids. The drain material has a relatively low permeability but there was no evidence the drain did not have sufficient capacity. The embankment was dense and had low permeability. The high permeabilities in the fill appear to be due to hydraulic fracturing caused by the water used in drilling or in constant head permeability testing. The density and moisture content of the embankment were near optimum. The dam was redesigned and reconstructed with higher capacity drains, and a cutoff trench in the left abutment which extended well below the slide zone. (Baker-IVI)
W85-04027

TRENDS AND DEBATABLE ASPECTS IN EMBANKMENT DAM ENGINEERING,

Sherard (J.L.), San Diego, CA.
J. L. Sherard.
International Water Power and Dam Constuction, Vol. 36, No. 12, p 26-32, December, 1984. 1 Fig, 14 Ref.

Descriptors: *Embankments, *Dam construction, Dams, Safety, Economic aspects, Rockfill dams, Earth dams.

Construction practices for embankment dams have undergone many changes over the last one or two decades. The incentive for change has come from two fronts: first to decrease costs, and second to increase safety margins. Specific areas where improvements have been made include downstream filters, cracking, differential settlement control, criteria for impervious earth core materials, seepage cutoff collars on concrete structures, downstream filters for impervious cores of coarse broadly graded soils, upstream filters for clay cores in central core rockfill dams, upstream sand zones in central core dams as crack fillers, dispersive clay, divergent and convergent foundations, and concrete face rockfill dams. (Baker-IVI)
W85-04032

USE OF DISCRIMINANT ANALYSIS WITH SATURATION EXTRACT DATE TO IDENTIFY DISPERSIVE CLAY SOILS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
D. Craft.
Report REC-ERC 83-15, December, 1983. 70 p, 1 Fig, 4 Tab, 14 Ref, 5 Append.

Descriptors: *Dispersants, *Soil dispersants, *Interstitial water, *Soil classification, Nondispersants, McGee Creek Project, Discriminant analysis, Classification, Statistical analysis, *Oklahoma, *Clays.

Soils from the McGee Creek Project, Farris, Oklahoma, may be classified as dispersive or nondispersive by substituting selected pore-water data into a discriminant function. The discriminant function was derived from a discriminant analysis (a multivariate statistical classification technique) of pore-water variables in a 28 sample data set: weight percent water in the saturated past, pH of the pore-water, log of the corrected 25 C pore-water conductivity (in microsiemens), and the log of the pore-water sodium concentration (in milliequivalents per liter). Suggestions for using the derived discriminant function as part of a sample field test and precautions regarding data interpretation are presented. Also presented is a brief description of discriminant analysis and its use with the SPSS (Statistical Package for the Social Sciences) subprogram discriminant.
W85-04219

CAUTIONS OF REINFORCED EARTH WITH RESIDUAL SOILS,
V. Elias, and P. Swanson.
Transportation Research Record 919, p 21-26, 1984. 9 Fig, 3 Tab, 4 Ref.

Descriptors: *Earthworks, *Backfill, *Reinforced earth, Construction, Fines, Moisture content, Soil texture, Soil properties, Soil water.

Construction of a reinforced earth wall began during the winter of 1978-79 in Virginia. The wall consisted of nine sections, which totaled more than 35,000 sq ft of exposed surface area. The walls varied in height; the maximum section was about 23 ft. Performance and problems encountered in this project which used fine-grained residual soils as backfill are documented. Fines content and moisture content were important factors in construction. Between 10 and 20% passing the 15 microm size, the fine-grained portion of the fill controls the desired strength properties. The use of Reinforced Earth backfill with a higher percentage of fines can result in a significant reduction of strip pull-out capacity and decrease the internal stability of the wall. The reduction in frictional strength with increasing percentage of fines is even more pronounced in saturated soils. Caution should be exercised when using residual soils as Reinforced Earth backfill. The fines content of residual soils is subject to large variations over small distances. Also, coarse-grained highly-micaceous sands common to the residual soils of the Piedmont region exhibit a marked sensitivity to moisture and significant strength reduction with increased compaction moisture content. The combination of moisture sensitivity and highly variable fines content requries strict quality control during construction to avert problems in these soil types. (Baker-IVI)
W85-04326

EFFECTS OF PREDRILLING AND LAYERED SOILS ON PILES,
Iowa State Univ., Ames. Dept. of Civil Engineering.
P.-S. Yang, A. M. Wolde-Tinsae, and L. R. Greimann.
Journal of Geotechnical Engineering, Vol. 111, No. 1, p 18-31, January, 1985. 9 Fig, 5 Tab, 14 Ref, 1 Append.

Descriptors: *Predrilling, *Layered soils, *Piles, *Soil physical properties, Computers, Bridge construction, Vertical load, Carrying capacity, Thermally induced movement, Algorithms, Soil compaction.

A state-of-the-art nonlinear finite element algorithm for pile-soil interaction has been developed and implemented in a modular computer program to study the effects of predrilled oversize holes and layered soils on the vertical load carrying capacity of piles in integral abutment bridges where thermally induced lateral movements occur. A 40-ft (12-m) H pile embedded in very stiff clay is used to study the effect of a predrilled oversize hole with or without sand fill. Numerical results showed that the vertical load carrying capacity of H piles is significantly affected by predrilling. The study of layered soils included the case where compacted soil (50 or more blow counts in standard penetration tests) is used as a fill on top of different layers of natural soil. For such cases, the numerical results indicated that the type of failure is greatly influenced by depth of the compacted soil. (Author's abstract)
W85-04383

SLOPE RELIABILITY AND RESPONSE SURFACE METHOD,
Weidlinger Associates, Menlo Park, CA.
F. S. Wong.
Journal of Geotechnical Engineering, Vol. 11, No. 1, p 32-53, January, 1985. 9 Fig, 7 Tab, 17 Ref, 3 Append.

Descriptors: *Slope reliability, *Response surface method, Simulation, Statistical reliability analysis, Soil properties, Finite element method.

A method to analyze reliability of soil slopes using the response surface method is described. The soil slope is modelled and analyzed by a finite element code as in prevalent deterministic studies. The simulation which is usually expensive, is repeated a limited number of times to give point estimates of the response corresponding to uncertainties in the model parameters. A graduating function is then fit to these point estimates so that the response given by the finite element code can be reasonably approximated by the graduating function within the region of interest. The approximating function, called the response surface, is used to replace the code in subsequent repetitive computations required in a statistical reliability analysis. The procedure is applied to a sample problem in slope stability involving uncertain soil properties. It is shown that the slope stability statistics from the response surface is within 1-9% of the statistics based on a direct Monte Carlo simulation using the finite element code. The merits of such an approach to reliability analysis are examined. (Author's abstract)
W85-04384

8E. Rock Mechanics and Geology

USING POOR QUALITY ROCK MATERIALS FOR DAM BUILDING,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow (USSR).
V. G. Melnik, and M. V. Vitenberg.
International Water Power and Dam Construction, Vol. 36, No. 12, p 17-20, December, 1984. 5 Fig, 3 Tab.

Descriptors: *Dam construction, *Rocks, *Construction materials, Stability, Earth dams, Rockfill dams, Deformation, Seepage, Compressibility.

Some poor quality, but available, materials are assessed as to their suitability for building earth and rockfill dams. The test program was designed to investigate such primary indices as dry unit weight and specific gravity, compression strength of dry unsaturated soil, characeristic water content and grain-size distribution of fines. Stability, deformations and seepage properties as well as compressibility of the poor-quality materials were studied by centrifugal modeling. Laboratory tests were checked and corrected in the field. Test results indicated that poor quality rock materials are well graded, have high stability characteristics and can be well compacted. Therefore, they are comparable with hard rock materials. One of the specific characteristics of these materials is their ability to deform badly in a loose state under insufficient compaction and especially in a saturated state. Most of the deformations take place during the construction period and the deformations in the completed structure do not exceed 1%. To decrease the amount of construction and post construction deformations as well as settlements in the saturated state, it is necessary to try for a maximum density of not less than 1.9-2 t/cu m. (Baker-IVI)
W85-04029

8F. Concrete

USE OF POLYURETHANE GROUTS AND GROUT TUBES,
Kochi Univ. (Japan).
B. Kriekemans.
International Water Power and Dam Construction, Vol. 36, No. 12, p 24-26, December, 1984. 4 Fig.

Descriptors: *Grouting, *Leaks, *Dams, Water loss, Leakage, Seals, Sealants, Polyurethane.

A number of different grouts and grouting techniques for sealing leaks have been developed over the last decade. Depending on the conditions, different materials can be used. TACSS 020 NF is a polyurethane grout that forms a rigid foam to seal water leakage in non-moving or underwater structures. Flex 44, is a polyurethane grout that forms a flexible foam (220% elongation) to seal leakage in moving cracks or expansion joints. TACSS 025 NF is a low viscosity polyurethane grout mainly used for curtain grouting or soil stabilization. These grouts are liquids that will start to react, expand and form a polyurethane foam when they come in contact with water. (Baker-IVI)
W85-04031

EVALUATION OF SEMICIRCULAR CANALS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8A.
W85-04221

8G. Materials

USING PLASTIC PIPE PROPERLY IN CONSERVATION STRUCTURES,
Soil Conservation Service, Washington, DC.
O. Perez.
Agricultural Engineering, Vol. 65, No. 3, p 6-8, March, 1984.

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Group 8G—Materials

Descriptors: *Plastics, *Pipes, *Water conservation, Irrigation, Drainage, Pipelines, Waste management, Erosion control, Physical properties.

Plastic pipe has been used extensively and successfully in many Soil Conservation Service (SCS) projects such as structures for water control, corrugated perforated tubing in agricultural land drainage, irrigation pipelines, underground outlets for terraces, erosion control structures, and special structures for strip mine reclamation. Since available plastic pipe appropriate for SCS application is much less stiff than conventional flexible pipe of the same diameter, such as corrugated metal conduit, it is much more susceptible to deformation during installation and use. Closer installation control therefore is required for plastic pipe than for conventional pipe. If the consequences of failure are significant, or installation cannot be controlled full-time, higher pipe strength should be recommended. (Baker-IVI)
W85-04342

8I. Fisheries Engineering

INTRASPECIFIC RESOURCE PARTITIONING BY YELLOW PERCH (PERCA FLAVESCENS) IN A STRATIFIED LAKE,
Iowa Cooperative Fishery Research Unit, Ames.
For primary bibliographic entry see Field 2H.
W85-03826

RELATIONSHIP OF YOUNG-OF-THE-YEAR NORTHERN PIKE TO AQUATIC VEGETATION TYPES IN BACKWATERS OF THE UPPER MISSISSIPPI RIVER,
National Fishery Research Lab., La Crosse, WI.
L. E. Holland, and M. L. Huston.
North American Journal of Fisheries Management, Vol. 4, No. 4B, p 514-522, Fall, 1984. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Fish, *Aquatic vegetation, *Mississippi River, *Fish management, Habitats, Food, Oxygen.

The association of young-of-the-year northern pike with different aquatic plant types was studied to evaluate the impacts of a potential loss of backwaters on available fish nursery habitats in the upper Mississippi River. Eight biweekly collections were made at each of six representative lentic habitats in Navigation Pool 7. In the spring, average catches of northern pike from areas with submerged vegetation were nearly three times greater than from areas with emergent vegetation, and more than 210 times greater than from an area with no vegetation. This pattern was continued until late summer, when the young became more common in the more highly oxygenated, less heavily vegetated waters. Food varied among fish in different vegetation types. However, no significant patterns of improved growth or condition were apparent. Young northern pike apparently were successful, opportunistic feeders. Although preference for habitats with submerged vegetation was seemingly not related to food, the overall production of young was clearly best in these habitats. It is suggested that methods used in the future to mitigate a rapid loss of backwaters or to revitalize backwaters must protect the integrity of submerged vegetation beds near spawning areas. Although juveniles were closely associated with submerged vegetation through much of the study, movement out of these areas later in the summer as oxygen levels dropped indicated that adequate water flows through the vegetation beds also must be maintained. If critical nursery habitat is limited, the value of available sites might be prolonged by increasing the open water vegetation edge with channels through the beds. Floating vegetation was not used widely by young-of-the-year northern pike and could be selected against in a habitat revitalization project. (Baker-IVI)
W85-03834

NON-EXPLOSIVE DEMOLITION OF ROCK TO IMPROVE FISH HABITAT,
Tongass National Forest, Ketchikan, AK.
K. C. Tappel.
North American Journal of Fisheries Management, Vol. 4, No. 4B, p 569-573, Fall, 1984. 1 Fig.

Descriptors: *Fish populations, *Demolition, *Prince of Wales Island, *Alaska, Habitats, Fish management, Rock excavation.

A bedrock waterfall on Prince of Wales Island, Alaska was altered using a non-explosive demolition agent to improve passage conditions for anadromous salmonids. A small pool halfway up the waterfall was enlarged to provide an intermediate jumping pool for fish ascending the waterfall. Non-explosive demolition agents use the enormous expansive stress generated by hydration to fracture rock and concrete. During the first excavation at this particular site, 21 holes were drilled into bedrock to an average depth of 1.5 ft with holes spaced about 2 foot apart and angled slightly toward the area to be excavated to ensure fracturing towards the rock surface. S-Mite powder was mixed with water, poured into the drilled holes, and allowed to react for several days. Although initial fracturing occurred within 12 hr, the expansive stress continued to increase for up to 2 weeks. Time of reaction depends on temperature, configuration of rock, and the angle, spacing and diameter of the drill holes. (Baker-IVI)
W85-03837

STATUS OF THE BLACK BASS FISHERY IN LAKE MEAD AND A PROGRAM TOWARD RESTORATION AND ENHANCEMENT,
Arizona Game and Fish Dept , Phoenix.
S. A. Morgensen, and C. O. Padilla.
Available from the National Technical Information Service, Springfield, VA 22161. USBR Final Report, October 1, 1977 to June 30, 1982. 114 p, 21 Fig, 32 Tab, 72 Ref, 3 Append. Contract/Grant No. 7-07-30-X0028.

Descriptors: *Fisheries, Bass, *Population dynamics, *Population density, *Lake fisheries, Lakes, Nesting, Water level fluctuations, Enrichment, Fish stocking, Cost analysis, Engineering, *Lake Mead, *Colorado River.

A five year study of the population level of black bass in Lake Mead included: (1) evaluating what factors were responsible for the decline in the fishery and whether this loss in production was related to recruitment, (2) analyzing how water levels could be manipulated to improve the fishery, and (3) determining if artificial enhancement, alone or in combination with water level manipulations, could be used to restore the fishery to 1959 levels. The contribution of black bass to the total sports harvest was evaluated and correlated with a study of the economic value of the fishery. Bass nesting success was maintained, monitored and correlated with water level fluctuations and cover. The effect of water level fluctuations on food and cover conditions for young bass was also investigated, including analysis of artificial enhancement efforts. Additionally, the feasibility of stocking fingerling, yearling or catchable bass was investigated. The major cause of decline of bass was construction of Glen Canyon Dam upstream of Lake Mead. Water-level fluctuations are the second cause. Recommendations include control of fluctuation, enhancing habitat by control of vegetation, and stocking.
W85-04209

10. SCIENTIFIC AND TECHNICAL INFORMATION

10A. Acquisition And Processing

WATER-RELATED DISEASE OUTBREAKS ANNUAL SUMMARY, 1982.
Centers for Disease Control, Atlanta, GA.
For primary bibliographic entry see Field 5C.
W85-04220

10C. Secondary Publication And Distribution

WATER-RESOURCES INVESTIGATIONS IN NORTH DAKOTA--FISCAL YEAR 1984,
Geological Survey, Bismarck, ND. Water Resources Div.
L. A. Hall, and R. L. Kuzniar.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Open-File Report 84-429, 1984. 59 p, 4 Fig.

Descriptors: *Water resources development, Hydrology, Groundwater, Surface water, Water quality, Hydrologic data collections, *North Dakota, *Water investigations.

This report is a listing of all ongoing water resources projects in North Dakota in fiscal year 1984. The report is prepared to inform interested Federal, State, and local agencies and private individuals of the activities of the Water Resources Division in the state. Information on each project includes objectives, approach, progress in 1983, plans for 1984, completed and planned reports products, and the name of the project chief. (USGS)
W85-03909

OKLAHOMA: SUMMARY OF ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, OKLAHOMA DISTRICT, 1983,
Geological Survey, Oklahoma City, OK. Water Resources Div.
R. L. Hanson, J. C. Scott, and J. K. Kurklin.
USGS Open-File Report 83-767, 1983. 104 p, 8 Fig, 3 Tab, 262 Ref.

Descriptors: Surface water, Groundwater, Water quality, *Oklahoma, *Projects.

A summary is presented of water resources activities conducted by the Water Resources Division of the U.S. Geological Survey, Oklahoma District, in 1983. It contains brief descriptions of all current and recently completed projects and the status of each project. A list of all published reports related to the water resources of Oklahoma is given. It contains a listing of all current and historic streamflow gaging stations, water-quality stations, reservoir stations, and groundwater and precipitation sites maintained by the Geological Survey. (USGS)
W85-03922

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VOLUME 18, NUMBER 9
SEPTEMBER 1985

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 18, NUMBER 9
SEPTEMBER 1985

W85-04409 -- W85-04968

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

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AUTHOR INDEX

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ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

INTERFLOW MODEL: I. MODEL DEVELOPMENT,
Alberta Univ., Edmonton. Dept. of Soil Science.
D. S. Chanasyk, and J. P. Verschuren.
Canadian Water Resources Journal, Vol. 8, No. 1, p 106-119, 1983. 4 Fig, 16 Ref.

Descriptors: *Interflow, *Hydrologic models, Forest watersheds, Soil properties, Land use, Mountainous watersheds.

Field studies in forest hydrology, conducted over the past 15 years, have shown that interflow is the major flow process on forested, mountainous watersheds. Existing hydrologic models cannot be rigorously applied to these watersheds because of the empirical treatment of interflow in these models. A hydrologic model called the SLUICES (Soils and Land Use affecting Interflow and Creating Effects on Streamflow) model, was developed to overcome these limitations. The model emphasizes the dominance of interflow, is distributed in nature and yet is simple in structure, containing only seven easily obtainable or optimized parameters. A study was conducted to evaluate the sensitivity of model parameters. (Author's abstract)
W85-04577

INTERFLOW MODEL: II. MODEL VALIDATION,
Alberta Univ., Edmonton. Dept. of Soil Science.
D. S. Chanasyk, and J. P. Verschuren.
Canadian Water Resources Journal, Vol. 8, No. 2, p 1-18, 1983. 6 Fig, 7 Ref.

Descriptors: *Interflow, *Model studies, Forest watersheds, *Jamieson Creek watershed, *British Columbia, Mountainous watersheds, Simulation, Hydrographs, Storms.

The SLUICES model was developed for the purpose of simulating interflow on forested, mountainous watersheds on a distributed basis using a grid system. The Jamieson Creek watershed located in the Seymour River Basin near Vancouver, British Columbia was selected for model validation since interflow plays a dominant role in determining discharge from that watershed. Simulated hydrographs were compared to recorded ones for seven storms, using one storm to optimize parameters. The relationship between grid size and time interval was examined and a relatively simple technique for initializing moisture conditions was derived. Simulations for the storms provided good results, as did those for extended time periods. As a result, the SLUICES model shows promise as an interflow model and its distributed nature gives it flexibility. (Author's abstract)
W85-04579

HYDROLOGY AND SEDIMENTOLOGY WATERSHED MODEL. PART I: OPERATIONAL FORMAT AND HYDROLOGIC COMPONENT,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
B. N. Wilson, B. J. Barfield, A. D. Ward, and I. D. Moore.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1370-1377, September-October, 1984. 9 Fig, 4 Tab, 22 Ref. EPA grant KY01212.

Descriptors: *Model studies, *Watersheds, *Hydrologic models, *Sedimentology, Sedimentation basins, Grass filters, Grasses, Check dams, Routing, *Rainfall-runoff relationships.

The operational format and the hydrologic component of a design oriented simulation model called SEDIMOT II is described. SEDIMOT II is capable of evaluating the hydraulic and sediment response of a watershed as well as the sedimentation effectiveness of detention ponds, grass filters, and check dams. The user of this model divides the drainage basin into subwatersheds of relatively uniform land use. A hydrograph, sedimentgraph, and particle size distribution are determined for each subwatershed, routed downstream and then combined to form a composite hydrograph, sedimentgraph and size distribution. In the hydrologic component of SEDIMOT II, the SCS's curve number method is used to determine rainfall excess, unit hydrograph theory is used to calculate a runoff hydrograph, and Muskingum procedure is used for channel routing. The accuracy of the hydrologic component was evaluated for twenty-seven storms. For all storms the SCS's curve number was known a priori. Excellent to fair agreement was obtained between predicted and observed hydrographs. A sensitivity analysis of hydrologic parameters was also conducted. (Collier-IVI)
W85-04735

HYDROLOGY AND SEDIMENTOLOGY WATERSHED MODEL. PART II: SEDIMENTOLOGY COMPONENT,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
B. N. Wilson, B. J. Barfield, I. D. Moore, and R. C. Warner.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1378-1384, September-October, 1984. 5 Fig, 2 Tab, 29 Ref. EPA grant KY01212.

Descriptors: *Model studies, *Watersheds, *Hydrologic models, *Sedimentology, *Sediment control, *Soil loss, Sedimentation basins, Grass filters, Grasses, Check dams, Particle size.

A hydrology and semdimentology simulation model called SEDIMOT II was developed which has the capability of evaluating alternatives in sediment control technology. Emphasis on predicted results is placed on the relative differences between different options rather than on absolute quantities. In SEDIMOT II, the sediment yield is calculated using either a subroutine called MUSLE (Modified Universal Soil Loss Equation) or a detachment-transport algorithm called SLOSS. Sediment yield is partitioned by assuming that the load rate is a power function of the flow rate. The particle size distribution of eroded sediment is adjusted for selective deposition by assuming that the largest particles are trapped first. The sedimentation effectiveness of three different types of sediment control structures can be evaluated in SEDIMOT II; to do so requires calculation of the sedimentgraph and particle size distributions associated with the sediment yield. In SEDIMOT II the sedimentgraph is determined by assuming that the load rate is proportional to the flow rate. The particle size distribution of eroded sediment is entered by the user and then adjusted for selective deposition. Sedimentation effectiveness of detention ponds, grass filters, and porous check dams can be evaluated. (Collier-IVI)
W85-04736

APPLICATION OF TRACER TECHNIQUES FOR DETERMINING THE WATER BALANCE IN SMALL CATCHMENT BASINS; A RESEARCH CONCEPT FOR THE EXPERIMENTAL BASINS IN THE UPPER HARZ MOUNTAINS (ANWENDUNG VON TRACERTECHNIKEN ZUR ERFASSUNG DES WASSERUMSATZES IN KLEINEN EINZUGSGEBIETEN; EIN FORSCHUNGSKONZEPT FUR DIE OBERHARZER UNTERSUCHUNGSGEBIETE),
Technische Univ., Brunswick (Germany, F.R.). Inst. fuer Geographie.
A. Herrmann, P. Maloszewski, R. Rau, W. Rosenow, and W. Stichler.
Deutsche Gewasserkundliche Mitteilungen, Vol 28, No. 3, p 65-74, July, 1984. 11 Fig, 2 Tab, 48 Ref.

Descriptors: *Tracers, *Hydrologic budget, *Harz Mountains, *Germany (Federal Republic), Isotopic tracers, Environmental tracers, Dye releases, Groundwater, Precipitation, Runoff, Snow cover, Model studies, Hydrologic models, Groundwater movement.

Tracer techniques currently in use in small catchment basins in the Upper Harz Mountains (Federal Republic of Germany) for the determination of water balance are described, based on a literature review. The Harz project employs a combination of the three most common tracer groups: fluorescent dyes; naturally present ions, compounds and electrical conductivity; and environmental isotopes. Basic long-term hydrological information on precipitation, runoff, snow cover, and groundwater is obtained through environmental isotopes and is supplemented by hydrochemical procedures and special dye-tracer experiments in groundwater. To answer process-related questions of water balance, separate models of the relevant hydrological substorage systems are constructed. Hydrological models transform given tracer input function into system-specific output functions; such a model is used to separate direct runoff components from indirect. Other models include mathematical flow models to interpret experimental environmental-isotope data for pore-water and fissure-water systems. In order to develop a model for the entire catchment basin, these models plus a comparison with results of purely hydrological studies should be used. (Moore-IVI)
W85-04804

2B. Precipitation

METHOD FOR ESTIMATING PRECIPITATION AMOUNTS AT REMOTE FIELD SITES,
Bureau of Land Management, Vale, OR.
R. R. Kindschy.
Northwest Science, Vol. 58, No. 4, November, p 256-261, 1984. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Precipitation, *Estimation, Malheur County, Oregon, Rangeland, Linear regression analysis, Crop year.

Production of vegetation on comparable sites within the semiarid rangelands of the intermountain western US is more influenced by precipitation occurring during the crop year (September through June inclusive) than by any other variable. The sparse distribution of weather stations typical of the intermountain rangeland area does not allow site specific analysis of localized precipitation. Crop year precipitation data for seven permanent recording stations in Malheur County, Oregon were analyzed for the 13 year period 1966-78. Elevation above sea level for each station was compared to precipitation received during the crop year through linear regression analysis. Analysis of precipitation amounts occurring on the arid sagebrush steppe revealed significant correlation with elevation. The method can be used to yield precipitation data for use in the determination of vegetation production. (Baker-IVI)
W85-04667

STATISTICAL INFERENCE FOR POINT PROCESS MODELS OF RAINFALL,
Interstate Commission on the Potomac River Basin, Rockville, MD.
J. A. Smith, and A. F. Karr.
Water Resources Research, Vol. 21, No. 1, p 73-79, January, 1985. 2 Fig, 4 Tab, 22 Ref.

Descriptors: *Statistical studies, *Rainfall, *Model studies, Model selection, Stochastic process, Estimation.

Development of parameter estimation and hypothesis testing procedures for stochastic rainfall models has become a critical problem of precipitation research. Maximum likelihood procedures were developed for parameter estimation and model selection that apply to a large class of point process models that have been used to model rainfall occurrences, including Cox processes, Neyman-Scott processes, and renewal processes. The model selection procedure, based on likelihood ratios, is designed to determine which of two competing classes of point processes provides a better model for a given data set. The statistical inference procedures are based on a stochastic intensity. The likelihood function of a point process has a simple expression in terms of the stochastic intensity. The main result of this paper is a recursive procedure of computing stochastic inten-

sities; the procedure is applicable to a broad class of point process models, including renewal Cox process with Markovian intensity processes and an important class of Neyman-Scott processes. A Neyman-Scott process for which the cluster size distribution is Poisson and the distribution (relative) locations of cluster members is exponential can be represented a Cox process: the directing process is a Markov process. The model selection procedure proposed, which is based on likelihood ratios, allows direct comparison of two classes of point processes to determine which provides a better model for a given data set. The estimation and model selection procedures are applied to two data sets of simulated Cox process arrivals and a data set of daily rainfall occurrences in the Potomac River basin. The interference procedures developed cannot be generalized to point processes in the plane or higher dimensions or to space-time rainfall models. Intensity-based inference procedures are intimately tied to ordering properties of the real line. (Moore-IVI)
W85-04794

ESTIMATING THE PARAMETERS OF A CUBE ROOT NORMAL DISTRIBUTION FROM REDUCED SAMPLE DATA,
Idaho Univ., Moscow. Dept. of Mathematics and Applied Statistics.
C. J. Potratz, R. K. Steinhorst, and C. L. Hanson.
Water Resources Research, Vol. 21, No. 1, p 89-90, January, 1985. 1 Tab, 5 Ref.

Descriptors: *Rainfall, *Estimating, *Distribution, Rainfall distribution, Mathematical equations, Simulation.

A procedure is presented which provides estimates for the parameters of a cube root normal distribution, using only the sample mean and variance of the untransformed data. The technique employs Newton's algorithm and yields method of moments estimates which can be applied when only aggregated data are available. When 40 year records of monthly precipitation from certain Idaho stations were studied it was found that a cube root normal distribution provided a good fit. For certain other locations, monthly figures were not available but the long term monthly average and standard deviation were known or were interpolated from maps. The goal was to simulate monthly precipitation data for all locations consistent with the long term averages and the cube root normal model. (Baker-IVI)
W85-04796

2C. Snow, Ice, and Frost

GLACIER SURGE MECHANISM: 1982-1983 SURGE OF VARIEGATED GLACIER, ALASKA,
California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.
B. Kamb, C. F. Raymond, W. D. Harrison, H. Engelhardt, and K. A. Echelmeyer.
Science, Vol. 227, No. 4686, p 469-479, February, 1985. 12 Fig, 41 Ref. NSF grants DPP-82-09824, DPP-82-00725, EAR-79-19424, EAR-79-19530.

Descriptors: *Glaciers, *Variegated Glacier, *Alaska, *Glacier surges, Glaciohydrology, Basal pressure, Basal sliding.

The recurrence period of surging of Variegated Glacier, Alaska, is about 17 to 20 years. Monitoring of the glacier beginning in 1973 revealed year to year thickening of ice in the middle and upper part of the glacier and a thinning in the lower part. In the middle glacier, the ice flow velocity approximately doubled between 1973 and 1981, and in the upper glacier it approximately quadrupled. Summertime flow velocities in 1981 were 0.4 to 1.0 m/day in the upper glacier and 0.1 to 0.2 m/day in the lower glacier; the terminal lobe was essentially stagnant. Starting in 1978, wintertime flow velocities began to show an anomalous increase, small but definite, which suggested that increased basal sliding was now occurring in winter as well as in summer. Onset of the surge began in January 1982 and was detected by a marked increase in seismic icequake activity picked up by a seismometer located on bedrock 0.5 km north of the upper glacier. The velocity in the upper glacier peaked at 10.4 m/day on 26 June and dropping to within less than half that value in a few hours. The motion thereafter was pulsatory and declining; the surging seemed to have stopped in August and September. The velocity peaked again in January 1983 at 5 to 7 m/day and in mid-June at 15 m/day. By 26 July the velocity had decreased to 0.2 m/day in the upper glacier. The hundredfold speedup in glacier motion in a surge of the kind that took place in Variegated Glacier in 1982-1983 is caused by the buildup of high water pressure in the basal passageway system, which is made possible by a fundamental and pervasive change in the geometry and water-transport characteristics of this system. Increased basal water pressure causes increased sliding by reducing friction and by increasing basal cavitation, and also by exerting a direct effect of the integral of pressure. The role of high water pressure in causing the rapid basal sliding motion in the surge of a glacier is analogous to its proposed role in the mechanics of overthrust faulting and landslides. (Collier-IVI)
W85-04472

THICKNESS OF ICE ON PERENNIALLY FROZEN LAKES,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
C. P. McKay, G. D. Clow, R. A. Wharton Jr., and S. W. Squyres.
Nature, Vol. 313, No. 6003, p 561-562, February, 1985. 2 Fig, 28 Ref.

Descriptors: *Ice cover, *Lakes, *Victoria Land, *Antarctic, Temperature effects, Freezing, Model studies, Salinity, Energy balance, Ablation.

A simple energy balance model was used to explain the observed ice thickness on perennially frozen lakes in the dry valleys of southern Victoria Land. The model uses the measured ablation rate of 30 cm/yr. The model predictions were shown to be consistent with measurements of the ice cover thickness, which in the dry valley lakes of southern Victoria Land range from 3.6 to 6.5 m. The effect of ablation in determining the thickness of the ice cover depends on the availability of liquid water beneath the ice as the source for new ice, and also on the latent heat released at the underside of the ice cover on freezing. (Baker-IVI)
W85-04883

AIRBORNE MICROWAVE MEASUREMENTS OF THE SOUTHERN GREENLAND ICE SHEET,
Massachusetts Univ., Amherst.
C. T. Swift, P. S. Hayes, J. S. Herd, W. L. Jones, and V. E. Delnore.
Journal of Geophysical Research, Vol. 90, No. B2, p 1983-1994, February, 1985. 10 Fig, 14 Ref.

Descriptors: *Remote sensing, *Microwaves, *Ice sheets, *Greenland, Ice lenses, Ice glands, Density, Glaciers, Anisotropy.

Microwave remote sensing measurements were collected over Greenland with the NASA C-130 aircraft used as a platform. The principal instruments were a C band radiometer and an X band scatterometer, which simultaneously collected both active and passive microwave remote sensing data. The data collected fully support the conclusions drawn by others that volume scattering from subsurface ice lenses and glands is the major influence on the microwave signature. Both the thermal emission and radar backscattering results are self-consistent with rather simple theories of volume scattering. The remote sensing measurements also provide a relative measure of the number density of scatterers; however, additional theoretical work is required to establish the cross section per scatterer in order to measure absolute number density. Along this avenue of thought, the data rule out Rayleigh scattering and strongly support a high frequency model. The measured anisotropy over the ice cap appears to be a new observation, and future exploitation of remote sensing techniques may provide information relating to the average shape of subsurface patterns and information relative to glacial flow. (Baker-IVI)
W85-04962

2D. Evaporation and Transpiration

WATER-TABLE CONTRIBUTION TO ALFALFA EVAPOTRANSPIRATION AND YIELDS IN SANDY SOILS,
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
L. C. Benz, E. J. Doering, and G. A. Reichman.
Transactions of the American Society of Agricultural Engineers, p 1307-1312, 1984. 2 Fig, 4 Tab, 19 Ref.

Descriptors: *Water table, *Alfalfa, *Crop yields, *Sandy soil, *Evapotranspiration, Lysimeters, Irrigation practices, Water use efficiency, Rainfall, Subsurface irrigation.

In a lysimeter experiment, four constant water-table depths and three irrigation levels were evaluated for their effects on annual alfalfa yields and growing season evapotranspiration (ET) for 2 years. Alfalfa yields were depressed and ET was excessive for the shallow (46 cm) water-table depth. The 2 years of cropping data, after an alfalfa establishment year, and excluding data from the shallowest (46 cm) water-table depth, indicated that growing-season ET values were 55.3, 64.2, and 69.3 cm with average yields of 14.0, 14.9, and 14.4 t/ha and water use efficiency (WUE) values of 4.0, 4.1, and 4.9 cm/t/ha respectively for 0.3, 0.8 and 1.3 irrigation levels (combinations of surface-applied irrigation plus rainfall that were equivalent to 0.3, 0.8, and 1.3 times calculated ET). The water table, through subirrigation, provided a sizable contribution to actual ET, which increased as level of surface irrigation decreased. Subirrigation provided 38.4% of total ET for the low (0.3) irrigation level, compared to only 0.6% of total ET for the high (1.3) irrigation level. (Author's abstract)
W85-04727

2E. Streamflow and Runoff

RESERVOIR STORAGE EQUATION EXPERIMENTALLY VERIFIED,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager, R. Sinniger, and J. M. Regamey.
International Water Power and Dam Construction, Vol. 36, No. 11, p 44-48, November, 1984. 9 Fig, 9 Ref.

Descriptors: *Reservoir storage, *Mathematical equations, *Hydrographs, Reservoirs, Flow characteristics, Flow measurement, Model studies.

The well-known storage model for a reservoir with non-prismatic shape has been experimentally verified. The results of a simplified storage model were compared with observations and this model was applied to real situations and the results of each were compared. An equation is provided which allows an accurate prediction to be made of the resulting reservoir outflow hydrograph. Maximum deviations between analysis and observations have always been less than 5% with respect to the maximum inflow discharge. The peak outflow discharge has a deviation of less than 3% of the maximum inflow discharge. Deviations must be attributed to inertial effects acting on the water. The simplified model can also be applied to real flow situations by taking account approximately of the effective inflow hydrograph. The parameters measuring the time to peak of inflow hydrograph, maximum inflow discharge, and the inflow hydrograph shape parameter allow for a fair adjustment to be made. When compared with the accuracy of the prediction of the inflow hydrograph, the simplified reservoir storage model usually yields accurate enough solutions, and therefore may be considered as an effective and simple tool for design purposes. (Baker-IVI)
W85-04416

INVESTIGATION OF THE STABILITY OF RIVER AND CANAL CHANNELS,

For primary bibliographic entry see Field 2J.
W85-04422

FUNDAMENTAL DIFFERENTIAL EQUATION OF FLOW OF A FLUID WITH A VARIABLE MASS IN THE CASE OF BILATERAL WATER DIVERSION,
N. E. Markova.
Hydrotechnical Construction, Vol. 18, No. 4, p 153-162, April, 1984. 6 Fig, 3 Ref. Translated from Gidrotecknickeskoe Stroitel'stvo, No. 4, p 17-22, April, 1984.

Descriptors: *Open channel flow, *Differential equations, *Diversion, Hydraulics, Flow discharge, Bilateral diversion, Mathematical equations, Steady flow.

The problem of division of flow is one of the urgent and most complicated problems of modern hydraulics. A fundamental differential equation of steady flow of a fluid with a variable mass is derived. This equation makes it possible to solve many theoretical and practical problems arising in the case of bilateral diversion of water in open channels. Several different variants are examined including bilateral symmetric division of flow, symmetric division of the flow, bilateral nonsymmetric division of flow, and bilateral nonsymmetric division of flow. At the site of division of flow a change in certain depths occurs related to the law of variation of discharge. The normal line and the critical depths line will be curvilinear. For bilateral symmetric diversion of water the specific energy of the basic flow before division is greater than the half-sum of the specific energies of the dividing flows. (Baker-IVI)
W85-04428

MASINGA DAM IN KENYA,
Watermeyer, Legge, Piesold and Uhlmann, Braamfontein (South Africa).
For primary bibliographic entry see Field 8A.
W85-04471

TREES SCARS TO DETERMINE THE FREQUENCY AND STAGE OF HIGH MAGNITUDE RIVER ICE DRIVES AND JAMS, RED DEER, ALBERTA,
Calgary Univ. (Alberta). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W85-04589

SIMPLEST APPROXIMATE COMPUTATION OF DAM-BREAK WAVES (DIE EINFACHSTE NAHERUNGSBERECHNUNG VON DAMMBRUCHWELLEN),
Ingenieurburo, Aarau (Switzerland).
For primary bibliographic entry see Field 8B.
W85-04630

RELATIONSHIPS BETWEEN WOODY DEBRIS AND FISH HABITAT IN A SMALL WARMWATER STREAM,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
P. L. Angermeier, and J. R. Karr.
Transactions of the American Fisheries Society, Vol. 113, No. 6, p 716-726, November, 1984. 3 Fig, 4 Tab, 54 Ref. EPA grants R806391 and CR810745.

Descriptors: *Aquatic habitats, *Fish, *Debris, Ecological effects, Species composition, Animal behavior, Invertebrates, Benthos, Litter.

Abundance of woody debris was manipulated in a small Illinois stream to determine the importance of this material to fish. When a stream reach was divided along midchannel, and debris was added to one side, but removed from the other, fish and benthic invertebrates were usually more abundant on the side with woody debris than on the cleared side. In further experiments during a low-flow year (1980), debris removal was followed by rapid decreases in water depth and occurrence of benthic organic litter, and increases in current velocity and proportion of sand bottom. These changes were less apparent in unaltered reaches during 1980, and in all reaches during 1981, which was a high-flow year. Artificial debris was colonized by many invertebrates, including chironomids, trichopterans, and ephemeropterans. Most large fish (age 2+) avoided reaches without debris, whereas some smaller fish (such as johnny darter) preferred them; preferences for reach treatments were stronger in 1980 than in 1981. The adaptive significance of associations between fish and woody debris appeared more closely related to the advantages of camouflage than those of increased food availability or protection from strong currents. Extensive removal of woody debris may disrupt structure and function in small streams, especially low-gradient ones. If the biological integrity of stream resources is to be maintained despite agricultural and urban uses, less disruptive management protocols will need to be employed. (Author's abstract)
W85-04679

RUNOFF AND SEDIMENT TRANSPORT WITHIN AND FROM SMALL AGRICULTURAL WATERSHEDS,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W85-04734

MARKOV FLOW MODELS AND THE FLOOD WARNING PROBLEM,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
S. Yakowitz.
Water Resources Research, Vol. 21, No. 1, p 81-88, January, 1985. 4 Fig, 2 Tab, 34 Ref. NSF grants Int. 78-12184, ENG 78-07358, CME 7905010 and CEE 8110778.

Descriptors: *Flood warnings, *Markov flow models, Warnings, Flood forecasting, River flow, Decision making, Model studies.

The flood warning problem is a situation where the decision maker must decide whether to release a flood warning, the decision being based on the water level, the past flow record, and the losses associated with the two types of mistakes (issuing a warning when no flood occurs, and not providing a warning for a flood). It is argued that outside the Gaussian assumption, standard time series methodology is inappropriate for the flood warning problem. A nonparametric inference procedure is described which converges to the optimal decision function for the flood warning problem as the length of the historical record increases for any stationary G sub 2-ergodic Markov process. Under additional assumptions, rates can be established and shown to be optimal in a certain sense. The new methodology is compared with autoregressive moving average predictors on simulated and river flow data. For a given data base it appears impossible to improve significantly on the asymtotic properties of the proposed methodology without invoking more stringent modeling assumptions. (Moore-IVI)
W85-04795

EXTENSION OF A STREAMFLOW TIME SERIES BY REGRESSION (VERLANGERUNG EINER ZEITREIHE DES DURCHFLUSSES MIT HILFE EINES REGRESSIONSMODELLS),
M. Domokos, and G. Kovacs.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 3, p 85-89, July, 1984. 6 Fig, 8 Ref.

Descriptors: *Streamflow, *Zala River, *Hungary, *Linear regression, Time series analysis, Flow discharge, River flow, Precipitation, Model studies, Base flow.

The runoff from 45% of the 5774 sq km large catchment of the Lake Balaton (Hungary) is drained by the Zala river to the lake. In order to protect Lake Balaton from eutrophication, a retention marsh system will be built, as a reconstrution of the earlier swampy area called Kis-Balaton, along the mouth reach of the Zala River. A long time-series of discharges at the mouth of the river is necessary for dimensioning and operational planning of this system. A flume at Fenekpuszta, near the mouth, was only constructed in 1975. Prior to this date the backwater effect from the lake prevented any measurement of the entering flow. The discharge record is continuous and reliable since 1 July 1975. Through late 1980, the discharge through the flume was measured on 788 occasions. The problem consisted thus in deriving a sound estimate of the most likely discharges which had passed the mouth of the Zala river before 1 July 1975. The five and half-year record of the Fenekpuszta gauging section, the streamflow record of the nearest gauging section (Zalaapati) on the Zala river (continuous since January 1952) and precipitation data for the sub-catchment between the two gauging sections were used to extend the record. The data generation model uses a multivariate linear regression approach to produce separately the base flow, the direct surface runoff, and the reconstructed Fenekpuszta discharge values as the sum of both. The verified model could be used to reconstruct the discharge data of the Fenekpuszta gauge over the period January 1, 1952 to June 30, 1975. (Moore-IVI)
W85-04807

CONTRAST IN STREAM-CHANNEL RESPONSE TO MAJOR STORMS IN TWO MOUNTAINOUS AREAS OF CALIFORNIA,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2J.
W85-04836

WATER QUALITY OF THE COLORADO RIVER SYSTEM: HISTORICAL TRENDS IN CONCENTRATION LOAD, AND MASS FRACTION OF INORGANIC SOLUTES,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. D. Moody, and D. K. Mueller.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-84-9, January 1984. 60 p, 14 Fig, 19 Tab, 16 Ref, 16 Append.

Descriptors: *Saline water, *Water quality, *Dissolved solids, *Reservoirs, Seasonal variation, Colorado River, Lake Mead, Lake Powell, Colorado, Utah.

A systematic change in salt loading in the lower Colorado River may manifest itself as a long-term shift in the concentration, load, or mass fraction of major solutes. In this study, shifts were identified using trend analyses and by comparing mean values before and after major reservoir development. Representative monthly solute concentration and streamflow values were computed for 15 major gage stations. For the 12 stations with sufficient data prior to major flow regulation, trends were identified using regression models. Significant decreases were found for magnesium, sodium, and sulfate at nine stations, accounting for an overall reduction of 2 mg/L/yr for the Lake Mead inflow during the months from December to March. After construction of the Colorado River Storage Project reservoirs, the seasonal variability in salinity was reduced at all downstream stations; concentrations generally decreased in May and June, and increased during the August-March season. Few trends were evident after flow regulation. In addition to reservoir construction, several activities of man were hypothesized as causes of identified trends and mean value changes. The major reservoirs, Lakes Powell and Mead, masked the effects of all other activities. No significant trends in load were found for the station below Lake Mead after 1965.
W85-04942

2F. Groundwater

POTENTIAL EFFECTS ON GROUND WATER OF A HYPOTHETICAL SURFACE COAL MINE IN INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 4C.
W85-04418

MULTISTAGE MODEL FOR THE DEVELOPMENT OF HYDROCHEMICAL ZONATION IN CHALK GROUND WATERS,
Toronto Univ. (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W85-04634

DISTRIBUTION OF CARBONATES, BICARBONATES, AND PH VALUES IN GROUND WATER OF THE NILE DELTA REGION, EGYPT,
Cairo Univ., Giza (Egypt). Dept of Chemistry.
For primary bibliographic entry see Field 2K.
W85-04638

BRACKISH WATER IN UNSATURATED CONFINING BEDS AT A TEXAS LIGNITE MINE,
Texas Univ. at Austin. Bureau of Economic Geology.
A. R. Dutton.
Ground Water, Vol. 23, No. 1, p 42-51, January-February, 1985. 8 Fig, 4 Tab, 31 Ref.

Descriptors: *Confining beds, *Brackish water, *Geohydrology, *Texas, Vadose water, Chlorides, Dissolved solids, Strip mines, Land reclamation, Groundwater, Claystone, Mudstone.

Deposits of low permeability are hydrologic barriers between reclaimed land and juxtaposed aquifers and should limit the impact of mining on ground-water quality. Claystone and mudstone in argillaceous facies of the Calvert Bluff Formation (lower Eocene, Wilcox Group) function as confining beds in the East Texas Basin. In the subsurface and at the outcrop, water in argillaceous deposits is brackish to saline. Samples of vadose water from the outcrop of confining beds at the Big Brown lignite mine in Freestone County, Texas, have a chloride concentration of up to 3,500 mg/l and total dissolved solids of up to 8,000 mg/l. Groundwater composition evolved from Eocene sea water by seven- to nine-fold dilution with rain water. Ion exchange, pyrite oxidation, and calcite dissolution further modified water composition. The amount of recharge through the vadose zone where confining layers crop out is probably negligible over an extremely long time. Meteoric flushing in reclaimed land at the surface mine is many times greater than that in unmined mudstone deposits, and the chemical composition of vadose water in reclaimed land is changed by further dilution and water-rock reactions. (Author's abstract)
W85-04639

ROLE OF SPECIFIC YIELD IN GROUNDWATER RECHARGE ESTIMATIONS: A NUMERICAL STUDY,
Kansas State Geological Survey, Lawrence.
M. Sophocleous.
Ground Water, Vol. 23, No. 1, p 52-58, January-February, 1985. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Specific yield, *Groundwater recharge, Mathematical models, Capillary fringe, Groundwater movement, Saturated flow, Unsaturated flow.

This paper numerically demonstrates and quantifies the importance of capillary-fringe and variable specific yield phenomena in ground-water recharge estimations. A one-dimensional numerical experiment consisting of a soil either with a capillary fringe or without it was set up using a finite-element code. A prescribed infiltrating flux was superimposed on top of the soil column, and the resulting unsaturated-saturated water flow was observed. By assuming a single value for specific yield, recharge is usually overestimated. For two cases considered in this study, the errors involved in ground-water recharge estimations by using such an assumption ranged from 88 to 330 times the simulated recharge, when variable specific yield is considered. This study also clearly demonstrates the effect of a constant specific yield value on the behavior of the water table rise, the total amount of which as well as the rate of such rise are underestimated under that assumption. In addition, under that assumption, the timing of the water table rise is out of phase with the timing of recharge events. (Author's abstract)
W85-04640

LGWRES - LIFE OF GROUND-WATER RESERVES,
Ministry of Planning, Riyadh (Saudi Arabia).
For primary bibliographic entry see Field 4B.
W85-04643

GALERKIN FINITE-ELEMENT PROGRAM FOR SIMULATING UNSATURATED FLOW IN POROUS MEDIA,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
R. Khaleel, and T.-C. Yeh.
Ground Water, Vol. 23, No. 1, p 90-96, January-February, 1985. 1 Fig, 8 Ref. 1 Append.

Descriptors: *Unsaturated flow, *Computer programs, *Porous media, Simulation, Mathematical studies, Groundwater movement.

Unsaturated flow typically involves nonuniform, time-dependent moisture contents and flow fields. The partial differential equation governing unsaturated flow in porous media is nonlinear, and not readily amendable to accurate analytical solutions. In the Galerkin approach, the dependent variable (the pressure head) is approximated by a series of basis (or shape) functions and associated time-dependent coefficients. A Galerkin finite-element solution of the one-dimensional unsaturated flow equation is developed using a linear basis or shape functions. A fully documented listing of the FORTRAN program is provided. Material balance error summaries are presented to demonstrate the accuracy of the numerical scheme. Excellent agreement of simulated results with other existing numerical solutions using the Galerkin scheme was found. (Moore-IVI)
W85-04645

ARSENIC SPECIATION IN SOIL-PORE WATERS FROM MINERALIZED AND UNMINERALIZED AREAS OF SOUTH-WEST ENGLAND,
Thames Polytechnic, London (England).
For primary bibliographic entry see Field 2K.
W85-04662

GROUNDWATER SEEPAGE AND THE WATER BALANCE OF A CLOSED, FRESHWATER, COASTAL DUNE LAKE: LAKE WINDERMERE, JERVIS BAY,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
G. Jacobson, and A. W. Schuett.
Australian Journal of Marine and Freshwater Research, Vol. 35, No. 6, p 645-654, 1984. 7 Fig, 3 Tab, 7 Ref.

Descriptors: *Groundwater recharge, *Water level fluctuations, *Lake Windermere, *Australia, *Jervis Bay, Dune lakes, Lakes, Groundwater level.

Lake Windermere is a closed, freshwater dune lake in the Commonwealth Territory of Jervis Bay, Australia. It is subject to cyclical water-level fluctuations of up to 12 m in response to climatic variations with a period of several years. In the Jervis Bay Territory, groundwater occurs both in unconsolidated sand and in jointed sandstone. Groundwater flows westwards from the lake through a highly permeable Pleistocene sand aquifer. An approximate water balance indicates that groundwater seepage is the most significant component (84%) of the outflow from the lake, whereas surface streams are the most significant component (89%) of the inflow to the lake. There is clearly a large amount of groundwater in storage in the Pleistocene sand aquifer and thus there is considerable scope for water supply development by pumping from bores, should the volume of lake water again fall to a critically low level. (Collier-IVI)
W85-04698

MACROINVERTEBRATES IN A SEWAGE-POLLUTED AQUIFER,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
For primary bibliographic entry see Field 5C.
W85-04720

STREAM WATER LEVELS AFFECT FIELD WATER TABLES AND CORN YIELDS,
Agricultural Research Service, Florence, SC.
C. W. Doty, J. E. Parsons, A. Nassehzadeh-Tabrizi, R. W. Skaggs, and A. W. Badr.
Transactions of the American Society of Agricultural Engineers, p 1300-1306, 1984. 9 Fig, 1 Tab, 20 Ref.

Descriptors: *Water table, *Crop yield, *Corn, *Drawdown, *Mitchell Creek, *North Carolina, *Edgecombe County, *Pitt County, Flow control, Dams, Streamflow, Channels.

A section of land about 1800 m wide and 4000 m along Mitchell Creek in Edgecombe and Pitt Counties, North Carolina, was studied for three years, 1980, 1981, and 1982. During 1980 and 1981 the deep channel in these sandy soils caused a water table drawdown of about 3 m near the stream. The water table was affected 884 m away. Corn yields near the creek were one-half those at 800 m from the creek. Stress-day indices varied inversely with yield. In 1982 a fabric dam, filled with water that automatically controls water levels in the creek and allows floods to pass, was installed in the creek. Stream water level control caused a significant rise in water table levels in the fields, and corn yields were 23% more than yields without water table control within 488 m of Mitchell Creek. This increased value of yield in 1982 will pay for the high costing prototype dam in about 15 years if these results continue. (Author's abstract)
W85-04726

FIELD METHOD TO DETERMINE UNSATURATED HYDRAULIC CONDUCTIVITY USING FLOW NETS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W85-04791

STOCHASTIC MODELING OF GROUNDWATER FLOW BY UNCONDITIONAL AND CONDITIONAL PROBABILITIES: THE INVERSE PROBLEM,
Tel-Aviv Univ. (Israel). Faculty of Engineering.
G. Dagan.
Water Resources Research, Vol. 21, No. 1, p 65-72, January, 1985. 3 Fig, 13 Ref, 1 Append.

Descriptors: *Groundwater movement, *Stochastic process, *Model studies, Transmissivity, Hydraulic head, Mathematical equations, Groundwater recharge, Aquifers.

The inverse problem is defined here as follows: determine the transmissivity at various points, given the shape and boundary of the aquifer and recharge intensity and given a set of measured log-transmissivity Y and head H values at a few points. The log-transmissivity distribution is regarded as a realization of a random function of normal and stationary unconditional probability density function (pdf). The solution of the inverse problem is the conditional normal pdf of Y, conditioned on measured H and Y, which is expressed in terms of the unconditional joint pdf of Y and H. The problem is reduced to determining the unconditioned head-log-transmissivity covariance and head variogram for a selected Y covariance which depends on a few unknown parameters. This is achieved by solving a first-order approximation of the flow equations. The method is illustrated for an exponential Y covariance, and the effect of head and transmissivity measurements upon the reduction of uncertainty of Y is investigated systematically. It is shown that measurement of H has a lesser impact than those of Y, but a judicious combination may lead to significant reduction of the predicted variance of Y. Possible applications to real aquifers are outlined. (Author's abstract)
W85-04793

2G. Water In Soils

EVALUATION TECHNIQUE FOR GROUND WATER QUALITY BENEATH URBAN RUNOFF RETENTION AND PERCOLATION BASINS,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
H. I. Nightingale, D. Harrison, and J. E. Salo.
Ground Water Monitoring Review, Vol. 5, No. 1, p 43-50, 1985. 6 Fig, 4 Tab, 17 Ref.

Descriptors: *Groundwater, *Soil water, *Water quality, *Sampling devices, *Urban runoff, *Percolation basins, *Fresno, *California, Water sampling, Observation wells, Shallow wells, Catchment basins.

The Fresno Metropolitan Flood Control District (FMFCD) in California is using small (<4 ha) retention/recharge basins for the management and conservation of urban runoff because of a lack of natural water courses. In addition to storm runoff, some basins are selected to receive imported surface water for groundwater recharge. A sampling program was conducted of water percolating through the soil profile during the recharge events and the upper zone of the unconfined aquifer directly beneath the basin floor; soil and water samples were taken at five FMFCD basins. Obtaining a suitable size sample of the soil solution for chemical analysis from the unsaturated (vadose) zone requires some type of porous material to separate the solid soil phase from the liquid phase. A vadose zone water extractor was constructed with Teflon and a porous ceramic suction cup. The extractor can usually be retrieved if the access well and well head as described are used; the ceramic cup can then be replaced if necessary and the extractor reused at another site. The water extractor is not suitable for obtaining samples for analysis of highly volatile pollutants. Up to four of these water extractors were used to monitor the quality of percolating urban runoff water and top of the ground water table (20 to 30 m) beneath the retention/recharge basins. Presence of water in the basins requires constructing a sealed borehole annular space, a watertight well head, and seal around the Teflon access tubes to the extractor at a control box containing the valves in the access tubes. Sampling percolating soil water in the unsaturated zone was dependent on having a recharge event of sufficient magnitude. Sampling the water in the saturated zone was easy unless the regional water table fell below the ceramic cup during the summer months of high pumping. (Collier-IVI)
W85-04417

COMPARISON OF FIELD- AND LABORATORY-MEASURED AND PREDICTED HYDRAULIC PROPERTIES OF A SOIL WITH MACROPORES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
J. A. Field, J. C. Parker, and N. L. Powell.
Soil Science, Vol. 138, No. 6, p 385-396, December, 1984. 6 Fig, 2 Tab, 21 Ref.

Descriptors: *Macropores, *Soil hydraulic properties, Matric tension, Soil water, Soil saturation, Conductivity, Soil porosity, Root channels, Hydraulic properties.

Soil hydraulic properties were determined in situ by the instantaneous profile method on three 3-m square plots of Dothan soil (plinthic paleudult, fine-loamy siliceous, thermic). Simultaneous measurements of matric tension and moisture content with depth during drainage were made with tensiometers and a field-calibrated neutron probe. Unsaturated conductivity values calculated from the in situ data range within an order of magnitude for corresponding horizons in the three plots. Variability between plots was greatest at moisture contents near saturation. The large data scatter is attributed to soil heterogeneity and to nonuniform drainage resulting form interaggregate porosity and root channels in the soil profile. Unsaturated conductivities calculated from the instantaneous profile test were compared with values predicted by two cut-and-random-rejoin-type pore structure models using laboratory- and field-measured moisture retention data. Laboratory measurements of moisture retention characteristics were made by pressure desorption of 54-mm diameter 'undisturbed' cores. The models of Jackson (1972. Soil Sci. Soc. Am. Proc., 36:380-383) and van Genuchten (1980. Soil Sci. Soc. Am. J., 44:892-898) were both successful in predicting unsaturated conductivities within the scatter of in situ values when field-measured moisture retention data were used and the mean in situ saturated conductivity was employed as a matching point. Correspondence between predicted and in situ conductivities was poorer when using laboratory retention data, reflecting difficulties in obtaining representative undisturbed core samples. (Author's abstract)
W85-04617

SOIL MOISTURE REGIMES OF THREE CONSERVATION TILLAGE SYSTEMS,
Wisconsin Univ.-Madison. Dept. of Soil Science.
M. D. Johnson, B. Lowery, and T. C. Daniel.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1385-1390 and 1395, September-October, 1984. 10 Fig, 3 Tab, 16 Ref.

Descriptors: *Soil water, *Conservation tillage, *Soil conservation, *Tillage, *Cultivation, Chisel plowing, No-till, Moldboard plowing, Recharge.

Comparison of three conservation tillage systems, chisel plowing (CH), till-plant (TP) and no-till (NT), to conventional moldboard plowing (CN) indicates soil moisture advantages with conservation tillage vary. Volumetric water content (3-year average, 0-76 mm depth) at planting was 0.324, 0.279, 0.267 and 0.246 cu m/cu m for NT, CH, TP, and CN, respectively. Average 3-year water content in the 0-0.25 m zone for weekly measurements during the growing season was 0.320, 0.309, 0.300, and 0.297 cu m/cu m for NT, CH, CN and TP, respectively. Soil moisture was higher in the NT treatment during most of the growing period. However, during a heavy rain period (93 mm), profile recharge in the CN, TP and NT treatments was 34, 34 and 44% less than for the CH treatment, respectively. Less water was removed from the 0.50-1.0 m zone of NT during extensive water depletion. For this soil with a 6-% slope, the NT treatment displayed the least water fluctuation during drying periods. (Author's abstract)
W85-04737

CORN SILAGE RESPONSE TO SUBSURFACE DRAINAGE ON ALLUVIAL SOIL,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
R. L. Bengtson, C. E. Carter, V. McDaniel, and B. E. Halverson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1391-1395, September-October, 1984. 6 Fig, 5 Tab, 11 Ref.

Descriptors: *Drainage, *Subsurface drainage, *Louisiana, *Precipitation, *Water table, Crop yield, Corn, Soil water.

Severe problems with high water tables exist in Southern Louisiana due to precipitation and low lying, nearly level, topography. Although surface drainage systems are used throughout the region, practically no use has been made of subsurface drainage. A subsurface drainage experiment on clay loam soil near Baton Rouge, Louisiana, was conducted from 1980-1983. The experiment consisted of four plots, of which two were both surface and subsurface drained; subsurface drainage was accomplished with 10 cm diameter, corrugated, perforated, polyethylene drain tubes installed one m below the soil surface on a grade of 0.10%. The other two plots contained surface drainage only. Corn silage was grown each year; average yields from the subsurface drained plots were 84% higher than the yields from plots with surface drainage only. The growing season high water table stress as quantified by SEW sub 30 had a highly significant effect on corn silage yields. SEW sub 30 values for the surface-only drained plots were 323.7, 200.6, and 462.7 cm-days for 1981, 1982, and 1983, respectively; the SEW sub 30 values for the subsurface drained plots were 0, 0, and 13.0 for the same years. Subsurface drainage effectively lowers the water table in flat topography, clay loam alluvial soil in areas with high growing season rainfall, thus controlling excess water in the root zone. Subsurface drainage thereby very significantly increases corn yields in areas with clay loam alluvial soil where a high water table above the 30 cm depth occurs during the growing season. (Collier-IVI)
W85-04738

HYDRAULIC CONDUCTIVITY MEASURED ELECTRONICALLY IN AN AUGER HOLE,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
C. E. Carter, F. T. Wratten, V. McDaniel, and B. Halverson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1400-1404, 1984. 6 Fig, 1 Tab, 8 Ref.

Descriptors: *Permeability coefficient, *Measurement instrumentation, *Augur holes, Subsurface drainage, Soil properties, Computers.

An electronic system for measuring hydraulic conductivity in a single auger hole was developed, laboratory and field tested, and put into use. The system consisted of a capacigage probe and transmitter, a digital voltmeter, a desktop computer with a real time clock, and a plotter. The capacigage probe's transmitter was modified so that the water level surrounding the probe inside a metal pipe was indicated by DC volts. The computer was programmed to read the voltage, convert to water levels and calculate the hydraulic conductivity of the soil based on the rate at which the water level increased with time. The data were recorded on cassette and paper tape, and plotted on a graph as the data were taken in the field. The system provides an improved method for measuring water levels in an auger hole which in turn improves the quality of hydraulic conductivity measurements. (Baker-IVI)
W85-04740

MULTIPHASE APPROACH TO THE MODELING OF POROUS MEDIA CONTAMINATION BY ORGANIC COMPOUNDS; I. EQUATION DEVELOPMENT,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-04787

MULTIPHASE APPROACH TO THE MODELING OF POROUS MEDIA CONTAMINATION BY ORGANIC COMPOUNDS; 2. NUMERICAL SIMULATION,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-04788

INFILTRATION IN SWELLING SOILS,
Instituto Nacional de Investigaciones Agrarias, Cordova (Spain). Dept. de Plantas Oleaginosas.
J. V. Giraldez, and G. Sposito.
Water Resources Research, Vol. 21, No. 1, p 33-44, January, 1985. 14 Fig, 6 Tab, 67 Ref.

Descriptors: *Swelling soils, *Infiltration, Mathematical equations, Ponding, Permeability coefficient, Model studies, Soil physical properties.

Infiltration phenomena in swelling soils were investigated theoretically. The approach taken consisted of applying both approximate analytical techniques and conventional finite difference numerical methods to study the generalized Richards equation for one-dimensional infiltration in a swelling soil. Equations were derived for the ponding time and the postponding infiltration rate that are generalizations of the Parlange-Smith model expressions for rigid soils. Ponding times for swelling soils were shorter than those for nonswelling analogs, and postponding infiltration rates in swelling

soils approach zero instead of becoming equal to the hydraulic conductivity, as in rigid soils. These results were confirmed, both qualitatively and quantitatively, with the numerical model, which also provided instantaneous moisture profiles and surface swelling predictions in agreement with field observations. The generalized three-parameter infiltration equation developed appears to be satisfactory for describing both laboratory and field data on swelling soils. The equation should prove to be a useful tool for hydrologists dealing with swelling soils who need to obtain parameters for use in runoff forecasting and vadose zone hydrology. (Moore-IVI)
W85-04790

FIELD METHOD TO DETERMINE UNSATURATED HYDRAULIC CONDUCTIVITY USING FLOW NETS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens.
Water Resources Research, Vol. 21, No. 1, p 45-50, January, 1985. 9 Fig, 24 Ref. Bureau of Mines project G11511321, OWRT project B-073-NMEX.

Descriptors: *Permeability coefficient, *Flow nets, Hydraulic head, Aeration, Reservoirs, Hydraulic gradient, Soil water, Stream tube.

A practical new field method is proposed to evaluate hydraulic conductivity in partially saturated media near a water impoundment. The new method is an inverse procedure which utilizes a flow net constructed from the steady state total hydraulic head distribution around the water source. In the vicinity of constant head sources and downstream along any stream tube, wetness and conductivity generally decrease. Knowing the stream tube geometry and hydraulic gradient from the flow net, Darcy's law is used to determine unsaturated hydraulic conductivities within the stream tube relative to some segment of the stream tube where conductivity is known. This approach was used successfully to predict the unsaturated hydraulic conductivity which was input to two variably saturated numerical models, utilizing total hydraulic head fields generated by the models. This prodecure is also applied to pressure head and water content data collected in the field surrounding a constant head borehole infiltration test originally designed to determine only saturated hydraulic conductivity above the water table. For practical purposes the new procedure compares very favorably with (1) results of a field experiment to obtain unsaturated hydraulic conductivity in situ using the instantaneous profile method and (2) values of unsaturated conductivity calculated from field and laboratory measurements of water content and pressure head. (Author's abstract)
W85-04791

COARSE FRACTION OF SOILS: THE ROLE IT PLAYS IN PLANT NUTRITION, LIMING AND IRRIGATION,
F. Du P. Joubert.
Deciduous Fruit Growth (Cape Town), Vol. 32, No. 7, p 277,279, 281-285, 1982. 9 Tab, 4 Ref. (in Afrikaans and English).

Descriptors: *Plant nutrition, *Soil texture, *Particle size, Crops, Nutrients, Soil properties, Trace element, Lime, Irrigation.

The role of the coarse fraction of the soil in plant nutrition is considered. Specific attention is devoted to a discussion of soil analysis results which refer only to the soil fraction and not to the coarse fraction. Frequently the calcium and magnesium portions of the coarse fraction are overlooked in their contribution to fertilization or plant nutrition as the principal reason for liming is to raise a low pH to the optimum level for a specific crop. The role of the coarse fraction in irrigated soils is to help guard against the establishment of waterlogged conditions. (Baker-IVI)
W85-04823

PEDOLOGIC PROPERTIES OF NEW JERSEY TIDAL MARSHES,
Fruit and Food Technology Research Inst., Stellenbosch (South Africa).
For primary bibliographic entry see Field 2L.
W85-04955

RELATIONSHIPS AMONG OXYGEN FLUX, SOIL WATER TENSION, AND AERATION POROSITY IN A DRYING SOIL PROFILE,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
G. V. Wilson, B. R. Thiesse, and H. D. Scott.
Soil Science, Vol. 139, No. 1, p 30-36, January, 1985. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Soil water tension, *Oxygen flux, *Aeration porosity, Soil aeration, Soil porosity, Drainage, Evaporation, Mathematical equations, Soil physical properties.

Managing the water status of soil for crop production and waste disposal requires knowledge of the oxygen availability in the profile. In this study a Captina silt loam (Typic Fragiudult) was nearly saturated and allowed to dry by drainage and evaporation. Oxygen flux and soil water tension were measured simultaneously on two bare plots during three drying cycles. At the end of the study, undisturbed cores were taken at three depth intervals in two plots and determined aeration porosity characteristics. The functional relationships between oxygen flux and aeration porosity determined from tensiometer data in the field and between tension and aeration porosity determined from the undisturbed cores were used to derive the mathematical relation between oxygen flux and soil water tension for the Captina profile. For the Captina soil, aeration porosity increased linearly with the natural logarithm of soil water tension. Similarly, the natural logarithm of oxygen flux was linearly related to aeration porosity. The combined equation describing oxygen flux as a function of soil water tension in the Captina soil constituted a power function. The description of the field data by the derived equations was excellent at all depths, and close agreement was found between the derived and the regression parameters of the power function relating oxygen flux and soil tension. (Author's abstract)
W85-04956

MOVEMENT OF WATER IN A PLINTHIC PALEUDULT USING A BROMIDE TRACER,
Georgia Univ., Athens. Dept. of Agronomy.
W. L. Carlen, H. F. Perkins, and R. A. Leonard.
Soil Science, Vol. 139, No. 1, p 62-66, January, 1985. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Soil water, *Plinthite, *Storm seepage, Bromides, Tracers, Soil saturation, Irrigation effects, Perched water table, Laterites.

Plinthite is a form of laterite that generally occurs in subsurface horizons as mottles or continuous phases of firm or hard iron-rich, red soil bodies. Mottles are considered plinthite after significant Fe segregation has occurred and they are capable of becoming irreversibly hardened upon repeated cycles of wetting and drying. Plinthite perches water during periods of excess soil moisture. Water movement in a plinthic soil in the Southern Coastal Plain was monitored over an 8-week period using a bromide tracer. Field investigations conducted on a Tifton loamy sand (Plinthic Paleudult) with a 4% slope indicate that much subsurface flow under saturated conditions occurs above and within plinthite. This partially accounts for seepage areas downslope in plinthic soils during periods of excess moisture as a result of rainfall or irrigation. Although plinthite may create a perched water table, it is not impervious to water movement. Water moves (albeit at a slow rate) through plinthic layers in interconnecting low-chroma soil bodies that have a lower bulk density and a higher percentage of pore space than surrounding plinthite and other high-chroma soil bodies. (Moore-IVI)
W85-04957

2H. Lakes

PHYTOPLANKTON IN A POLLUTED SUBARCTIC LAKE BEFORE AND AFTER NUTRIENT REDUCTION,
Laensstyrelsen, Ostersund (Sweden).
For primary bibliographic entry see Field 5C.
W85-04490

CONCEPTUAL MODEL OF LAKE ACIDIFICATION,
Norges Landbrukshoegskole, Aas. Dept. of Agricultural Hydrotechnics.
For primary bibliographic entry see Field 5C.
W85-04531

CHANGES IN BASE CATION CONCENTRATIONS DUE TO FRESHWATER ACIDIFICATION,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5C.
W85-04532

EXPERIMENTAL LAKE FERTILIZATION: TURNOVER OF NITROGEN AND PHOSPHORUS IN STRATIFIED AND NON-STATIFIED SUBARCTIC LAKES IN NORTHERN SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
M. Jansson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 708-711, October, 1984. 2 Tab, 5 Ref.

Descriptors: *Lakes, *Fertilization, *Nitrogen, *Phosphorus, *Sweden, Subarctic lakes, Stratification, Lake sediments, Nutrients, Plankton, Thermoclines, Sorption, Denitrification.

Important features of the whole lake metabolism of N and P are summarized as they became evident from experiments with artificial nutrient addition to subarctic lakes in the Kuokkel area, northern Sweden. The field studies began in 1971 and were terminated in 1980 during which interval N and P were supplied as single nutrients or in combination to two shallow polymictic lakes, Lake Hymenjaure and Lake Magnusjaure, and one deeper thermally stratified lake, Lake Gunillajaure. The differences in the effect and utilization of increased nutrient input to stratified and nonstratified lakes can be satisfactorily explained by the existence or absence of a thermocline and the manner in which the stratification affects the whole lake metabolism of N and P. Furthermore, they emphasize the highly important role of the sediments as active metabolic sites in the turnover of nutrients, particularly in shallow lakes. The fact that the utilization of nutrients in Lake Gunillajaure was nearly twice as high as in the holomictic lakes means that more of the supplied nutrients were available to plankton. This in turn is a consequence of the thermocline which constitutes a very efficient barrier preventing nutrients from having contact with large areas of the sediment-containing sites for P sorption and denitrification. In shallow lakes the organisms in lake water become nutrient-limited because of the efficient P sorption and denitrification in the sediment. With this background the fate of added nutrients in the different types of lakes in the Kuokkel area can be described as follows. When N + P is supplied to shallow fully circulating lakes the sediments more or less continuously sorb parts of the added P. N is not actively locked in the bottoms but instead metabolized in denitrification processes which reduce the amount of N available for production in the water column. In the stratified lake the thermocline prevents the contact between the sediment and the epilimnion and consequently more N and P are metabolized in planktonic production. Excess of N available for denitrification does not occur until mineralization and nitrification have supplied a surplus of NO3, which in the Kuokkel experiments happened after one winter. (Baker-IVI)
W85-04534

VARIATION OF WATER QUALITY PARAMETERS IN MESO- TO HYPEREUTROPHIC LAKES,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
C. Forsberg, and U. Heyman.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 730-733, October, 1984. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Lakes, *Sweden, *Mesoeutrophic lakes, *Hypereutrophic lakes, *Water quality, Conductivity, Nutrients, Nitrates, Phosphates, Ammonium, Nitrogen, Phosphorus, Chlorophyll a, Nitrites, Seasonal variation.

Taking into consideration that the ecological functions of the separate water quality parameters are similar in most lakes, it is likely that their concentrations are subject to similar principle types of variation. Surface water samples were taken 3-7 times per week, mainly during June to September, from 25 meso- to hypereutrophic Swedish lakes for a total of 950 samples. Samples were mixed to obtain composite weekly samples and analyzed for 13 water quality parameters. The relative range for conductivity was very narrow about 0.3 x mean. Total-P, total-N, transparency and absorbance (suspended solids) had ranges of about 1.3 x mean. The widest range was noted for NO3-N, 6.5 x mean. The relationships between the relative ranges were: conductivity:tot-P:MRP:chlorophyll a:NH4-N:NO3-N = 1:4:6:7:14:19. Variances within lakes varied in the same order as ranges. Comparatively high variance was noted for phosphorus, especially for MRP. The variances between lakes dominated for all variables with exception of NH4-N and NO3-N; between- and within-lake variances were of similar size for the former while the latter showed very pronounced variance within the lakes. Phosphorus showed low within-lake variance in surface water during summer, indicating steady-state. The highest between-lake variances were obtained for phosphorus and NO2-N, probably due to varying loading conditions. Phosphorus can be looked upon as a regional variable while nitrogen can be characterized as a time variable. The degree of bio-activity, including also bacterial processes, will regulate the concentration ranges for certain parameters greatly; because nutrients like NH4-N and NO3-N have low concentration levels but are highly involved in physiological processes, these nutrients are often exhausted during summer. The variances of chlorophyll a were low in relation to those of P and N. This indicates light limited algal growth in these productive waters. (Collier-IVI)
W85-04536

SMALL-SCALE TEMPORAL CHANGES IN THE BIOLOGICAL AND CHEMICAL COMPOSITION OF SURFACE MICROLAYERS IN A EUTROPHIC LAKE,
Lund Univ. (Sweden). Lab. of Ecological Chemistry.
A. Sodergren.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 765-771, October, 1984. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Surface layers, *Lakes, *Eutrophic lakes, *Micro layers, *Chemical composition, *Lake Havagardsjon, Plankton, Phytoplankton, Zooplankton, Algae, Cyanophyta, Dynophyceae, Organic carbon, Lipids, Chlorophyll.

To study the influence of vertical organism migration on the chemical composition of surface microlayers (SM) of a eutrophic lake, the distribution in SM of organic carbon, lipids, pigments, phytoplankton, and bacteria was examined every fourth hour during one day and compared to the subsurface water (SS). SM was sampled with a rotating drum mounted on a 1.5 m catamaran; the drum was coated with a layer of hydrophilic teflon and water adsorbed onto the teflon was scraped off with a hydrophobic teflon blade and collected into a bottle. One l of microlayer water was normally collected within 1 h. Samples were collected in September 1981 on natural slicks present on Lake Havgardsjon which were characterized by the absence of capillary waves and defined by surface tension measurements. The thickness of the layer sampled was 10-40 micro m. Compared to the subsurface water an enrichment in the microlayer was evident for dissolved lipids, particulate organic carbon, dissolved organic carbon, chlorophyll a, phytoplankton and bacteria. A distinct diel pattern was also noted and a vertical phototactic migration was found for Cyanophyta and Dinophyceae. The phytoplankton community of the surface microlayer showed a species-abundance distribution which was significantly different from that of the subsurface community. The differential distribution is probably a function of resource partioning between SM and SS, transport mechanisms, and the microlayers' physical and chemical properties to keep the organisms attached to the air/water interface. (Collier-IVI)
W85-04538

DISSOLVED ORGANIC CARBON IN DANISH LAKES: CONCENTRATION, COMPOSITION, AND LABILITY,
Aarhus Univ. (Denmark). Botanical Inst.
For primary bibliographic entry see Field 5C.
W85-04540

DECLINE OF ZOOBENTHOS THROUGH FIVE DECADES OF EUTROPHICATION IN LAKE ESROM,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 5C.
W85-04541

LIGHT PENETRATION AND SOME RELATED CHARACTERISTICS IN SMALL FOREST LAKES IN SOUTHERN FINLAND,
Loughborough Univ. of Technology (England). Dept. of Human Sciences.
R. I. Jones, and L. Arvola.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 811-816, October, 1984. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Finland, *Lakes, *Light penetration, *Water color, Chlorophyll a, Zooplankton, Phytoplankton, Euphotic zone, Organic carbon, Turbulence.

Water color is a conservative parameter which is easily measured and is consequently of great value if water color can be used to predict light extinction and euphotic zone depth, variables which occur in several limnological models. A survey was conducted of 14 small forest lakes in the Evo district of Southern Finland which were selected to give the widest possible range in water color (5-335 mg Pt/l). Penetration of total photosynthetically active radiation (PAR) was measured during early August at the time of most intense stratification of the water columns. The extinction coefficient for total PAR (ePAR), and hence the depth of the euphotic zone, was strongly correlated with water color, which provided a better prediction of ePAR than either dissolved organic carbon or absorbance at 260 nm. Chlorophyll alpha concentration in the lakes had no significant influence on ePAR. The depth of the mixed layer showed a strong inverse relationship to water color so that the effective light climate experienced by phytoplankton was much less variable between lakes than might be expected from the variability of water color and ePAr. Most of the lakes contained a very high proportion of motile or buoyant forms in their phytoplankton, but there was no evidence for any trend of increasing representation of flagellated phytoplankton with increasing water color. In these small lakes the lack of turbulence is probably of more importance in promoting the development of populations of motile phytoplankton. (Collier-IVI)
W85-04542

PHYTOPLANKTON IN 151 EASTERN FINNISH LAKES: SPECIES COMPOSITION AND ITS RELATIONS TO THE WATER CHEMISTRY,
Helsinki Univ. (Finland). Dept. of Botany.
K. Ilmavirta, P. Huttunen, and J. Merilainen.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 822-828, October, 1984. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Lakes, *Finland, *Phytoplankton, *Species composition, Chemical properties, Stratification, Oligotrophic lakes, Eutrophic lakes, Mesotrophic lakes, Humic lakes, Algae.

An extensive study of 151 lakes in Eastern Finland was started in 1978. The aim of this work was to study the chemical status of lake water and the properties of the catchment area and relate their physicochemistry to the community structure of the present phytoplankton and to the recent assemblages of organisms in the sediment, all parameters being measured in every lake within as short a time period as possible. Phytoplankton during the summer stratification in 1980 are described. The lakes are grouped according to their water chemistry into eight classes and their characteristics are discussed in comparison with phytoplankton. The phytoplankton species composition is presented from each group for one characteristic lake. Flagellates are the most important contributors to biomass and had highest species numbers in the darkest and most oligotrophic lakes. Eutrophic lakes are characterized by Chlorophyceae, Cyanophyceae and also by Diatomophyceae. Flagellates occurred in all types of lakes, the Cryptophyceae species being more characteristic for oligotrophic than mesotrophic waters. The cell number of Chrysophyceae is more variable than that of Cryptophyceae. It is remarkable that these flagellated species are almost the only ones able to grow in the acidic lakes. The broad ecological amplitude of flagellates is one of the most important characteristics of phytoplankton in humic lakes and it seems to have fundamental effects on the production ecology and the structure of humic lake ecosystems. (Baker-IVI)
W85-04543

LOOSDRECHT LAKES RESTORATION PROJECT, AN INTRODUCTION,
Limnologisch Inst., Nieuwersluis (Netherlands).
L. van Liere, S. Parma, L. R. Mur, P. Leentvaar, and G. B. Engelen.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 829-834, October, 1984. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Lake restoration, *Netherlands, *Loosdrecht Lakes, Eutrophication, Peat, Water management, Planning, Water resources development, Polders, Phytoplankton.

The shallow Loosdrecht Lakes are located 20 km south-east of Amsterdam. The lakes are partly man-made, and situated in a strip of lowlying peatlands between the Holocene coastal sand dunes to the west and the Pleistocene ice-pushed ridge of Het Gooi. The total catchment area of the lake system consists of 44.4 sq km. The reclamation of deep lying polders in the south and the west induced an extension of the groundwater flow system to deep polder outlets to the south and west. The largest part of the upward migrating groundwater in the eastern part of the catchment area is presently extracted and used for drinking water supply. In the north-western part of the lake system a storage basin was constructed that is fed with water from Polder Bethune. This, together with initially untreated sewage from expanding surrounding inhabited areas and an explosion of water-based recreation, resulted in drastic limnological changes. Phytoplankton biomass increased substantially by the highland protracted phosphorus load, and light irradiance attentuation brought about by this increase led to a disappearance of a large part of the submerse macrophytes and characeans. Diversity of phytoplankton diminished. The zooplankton community structure and grazing indicate increasing trophy. The top layer of the lake sediments now consists of dy, which is gyttja mixed with humic substances from the remnants of the eroded banks. During the next years the waterworks expects to increase their supply capacity, implying a higher demand for water from Polder Bethune. Careful monitoring of the project will be undertaken as there is a decided difference of opin-

ion on how best to achieve this increase in capacity. (Baker-IVI)
W85-04544

LOOSDRECHT LAKES RESTORATION PROJECT: HYDROLOGY AND PHYSICO-CHEMICAL CHARACTERISTICS OF THE LAKES,
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
B. F. M. Kal, G. B. Engelen, and T. E. Cappenberg.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 835-841, October, 1984. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Lake restoration, *Netherlands, *Looosdrecht lakes, Hydrology, Physicochemical properties, Hydrology, Eutrophication, Groundwater.

The Loosdrecht Lakes area consists of a series of lakes, which have become eutrophic over the past decades. To restore them, changes in water management are planned. The main compartments or subsystems of the lake system include central open lake, peripheral open lakes, and bank and cut areas. All lakes in the system are too shallow for thermal stratification. Horizontal mixing is usually strong enough to keep concentration nearly uniform within each subsystem, with the exception of Kievitsbuurt. Each of the subsystems has its own hydrological regime and water quality. Accurate water and nutrient balances of the whole system or any subsystem require a separate evaluation of gains from and losses to groundwater. A groundwater flow model of the entire catchment area is being constructed. The input of polluted Vechtwater does not adequately explain the present patterns of nutrient concentrations and of trophic state. It remains to be investigated if the intended elimination of Vecht-water intake is sufficient for complete restoration. Additional measures should be studied on the basis of a better understanding of the hydrological regime and the water quality patterns in surface and groundwater. To gain that understanding, separate balances of water, chloride, and nutrients for every subsystem on a monthly basis are needed. (Baker-IVI)
W85-04545

SESTON-EPIPELON INTERRELATIONSHIPS IN THE SHALLOW EUTROPHIC LOOSDRECHT LAKES (THE NETHERLANDS),
Limnologisch Inst., Nieuwersluis (Netherlands).
J. C. Kromkamp, and H. J. Gons.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 853-857, October, 1984. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Seston, *Epipelon, *Loosdrecht Lakes, *Netherlands, *Nutrients, Carbon, Nitrogen, Aquatic drift, Eutrophic lakes, Resuspension.

Samples were collected along a stretch of sandy bottom at 0.5, 1.0, and 1.5 m depth in the central part of the lake. The differences in chemical composition between epipelon and seston were small. Probably there is an intensive exchange between the two compartments. The C/N ratio of the seston is, however, significantly lower during the summer than the C/N-ratio. The differences must be even larger if epipelon samples are corrected for the presence of seston. If the exchange between the two compartments is intensive, only slight difference in the C/N-ratio's are expected. Since the differences were larger, resuspension of the epipelon does not seem to have occurred. Calculations predict a considerable increase in the C/N-ratio of the seston if full resuspension were to occur. Alternatively, the epipelon may be resuspended but could quickly resettle: indeed a fraction of the epipelon sedimented rapidly. It seems likely that resuspension of epipelon was not important during the summer months. (Baker-IVI)
W85-04547

ZOOPLANKTON AND ITS GRAZING AS MEASURES OF TROPHY IN THE LOOSDRECHT LAKES,
Limnologisch Inst., Nieuwersluis (Netherlands).
R. D. Gulati.
Verhandlung Internationale Vereingung Limnologie, Vol. 22, p 863-867, October, 1984. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Zooplankton, *Grazing, *Netherlands, *Loosdrecht Lakes, Lakes, Population dynamics, Species diversity, Trophic level, Crustaceans, Rotifers, Biomass.

The study was carried out in the main Loosdrecht Lakes and at Lake Breukeleveen. Of the ten species of crustaceans and nineteen species of rotifers recorded in 1981 through 1982, some have persisted in low densities since 1955. A ten-fold rise in the rotifer numbers since 1955 is striking and involves both increased densities of Keratella cochlearis and Polyarthra sp., and the appearance of new species, viz. Anuraeopsis fissa and Pompholxy sulcata. The total zooplankton biomass has increased about 6 times. Important in relation to the zooplankton grazing activity is the high food concentration, dominated by filamentous blue-greens, paticularly in Lake Breukeleveen. The grazers are predominantly small-sized crustaceans, Bosmina spp., and Chydorus sphaericus, and rotifers. The average grazing rates of between 13 and 22%/d in the Loosdrecht Lakes and 24% in Lake Breukeleveen are quite comparable with those in the mesotrophic Lake Vechten and also in the eutrophic Lake Tjeukemeer. (Baker-IVI)
W85-04548

SIZE CLASSES OF 'DISSOLVED' NUTRIENTS IN SHALLOW, ALKALINE, HUMIC AND EUTROPHIC TJEUKEMEER, THE NETHERLANDS, AS FRACTIONATED BY ULTRAFILTRATION,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 2K.
W85-04550

MODELLING EUTROPHICATION IN SHALLOW DUTCH LAKES,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 5C.
W85-04551

DISTRIBUTION, DYNAMIC AND STRUCTURE OF FREE DISSOLVED CARBOHYDRATES IN THE PLUSSSEE, A NORTH GERMAN EUTROPHIC LAKE,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
U. Munster.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 929-935, October, 1984. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Eutrophic lakes, *Carbohydrates, *Plusssee, *Germany (Federal Republic), Phytoplankton, Nutrients, Disaccharides, Monosaccharides, Dissolved solids, Diatoms, Bacteria, Plankton.

Water from the Plusssee was collected every 4 hours from 0.2, 1, 2, 3, 4, and 5 m depths. The distribution pattern of the total free dissolved carbohydrate fraction (TCHO), disaccharides fraction (DCHO) and monosaccharides fraction (MCHO) in the 0.2 m water layer followed generally the light depending photosynthesis and dark depending respiration periods. But in the deeper water layers (1-5 m), some deviations in distribution and dynamic were observed. These deviations could be responsible for the different adaptations and compositions of the microbial communities at the corresponding depths. The high concentrations and variations of the DCHO fraction at the 1 and 4 m depths were due to the contributions of cellobiose and sucrose at 1 m and cellobiose and melibiose at 4 m. The dynamics of the carbohydrate fraction appear to be related to the activity of the phytoplankton and bacterial communities. The plankton population was dominated by diatoms and to a lesser extent by flagellates. The diatom population showed a strong shift from 4 cell colonies to 2 cell colonies, especially at the 2 to 4 m depths. At the same time, a rapid depletion of dissolved silica from 150 micro-g Si/liter to 50 micro-g Si/liter was noted. On April 1 at 6 am, the TCHO, DCHO, MCHO and some individual carbohydrates like cellobiose, sucrose, glucose, and galactose showed the highest variation in 3 and 4 m depths. The carbohydrate composition at this depth may be influenced by a break-down of diatoms and discharge of their storage products and cell wall material into the water. In the dissolved organic carbon, carbohydrates and proteins are always accompanied by humic substances with different molecular weights and strong pH-dependent surface activities. (Baker-IVI)
W85-04552

METHANOGENESIS IN SEDIMENTS OF EUTROPHIC LAKES; 2. COMPARATIVE INVESTIGATIONS ON THE METHANE-PRECURSOR PREFERENCE,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
M. Naguib.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 951-955, October, 1984. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Methane, *Lake sediments, *Eutrophic lakes, *Kleiner Ukleisee, *Plon, *Germany (Federal Republic), Lakes, Chemical reactions, Acetate, Ammonium chloride, Peptone.

Sediment methanogenesis was estimated for surface sediment samples collected from the 'Kleiner Ukleisee,' a 20,000 sq m eutrophic forest lake in Plon, Germany (Federal Republic). Methane production was at maximum in the presence of methanol as a methane precursor compared to acetate and H2/CO2. Maximum production from methanol was in the range of 12 micro moles CH4/g wet wt. of sediments compared to 0.5 and 0.4 micro moles from acetate and H2/CO2. Further increases up to 17 and 32 micro moles were reached in the presence of ammonium chloride and peptone, respectively, corresponding to a methanol conversion efficiency of 35 and 63%. With acetate, only peptone caused a relative increase to 1.8 micro moles amounting to 35% conversion efficiency. Methanol was dominant among the methane precursors used and the combination of methanol and peptone gave maximal methane production. As a forest lake, the lake would receive allochthonous substances rich in substrates for methanol genesis. (Collier-IVI)
W85-04554

IMPACT OF SEDIMENTATION ON THE PHOSPHORUS CONTENT OF THE EUPHOTIC ZONE OF LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
H.-H. Stabel.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 964-969, October, 1984. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Phosphorus, *Sedimentation, *Lake Constance, *Euphotic zone, Particulate matter, Organic matter, Cycling nutrients, Mesotrophic lakes, Fate of pollutants.

Lake Constance is a large, deep, and mesotrophic pre-alpine lake, heavily fertilized in the last three decades. Water samples were taken weekly from 20 depths between 0 and 140 m from the Uberlinger See, which is a deep (147 m) northwestern bight of Lake Constance. The data obtained indicate that in Lake Constance phosphorus is mainly precipitated as a constituent of particulate organic matter. The increase in the sedimentation rates of P in 1981 coupled with the nearly unchanged content of total phosphorus in the water basin accounted for the enhanced loading. The P masses entering the lake comprise soluble reactive phosphorus (SRP) as well as unreactive mineral particulate phosphorus. While the latter is precipitated directly, the bulk of SRP is transferred into biomass, followed by a rapid cycling within the euphotic zone, and finally is deposited. Thus a surplus load of SRP over the past vegetational period is re-

duced and a metastable equilibrium concentration of SRP is maintained even though the input of phosphorus has varied widely. (Baker-IVI)
W85-04555

EXTERNAL AND INTERNAL LOADING AND RETENTION OF PHOSPHORUS IN THE R. JORKA LAKES (MASURIAN LAKELAND, POLAND) VS THEIR TROPHIC STATUS,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
A. Hillbricht-Ilkowska, W. Lawacz, and R. Wisniewski.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 973-977, October, 1984. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Phosphorus, *Lakes, *Lake sediments, *Poland, Lake Glebokie, Lake Majcz, Lake Jorzec, Lake Inulec, Great Masurian Lakes, Phytoplankton production, Lake sediments, Seasonal variation.

The annual input of phosphorus from external (point and non-point) and internal (released from bottom sediment) sources is compared with its retention and the change of P stock in waters of the lakes different in respect to watershed conditions, human impact, morphology, productivity and chemical nature of bottom sediments. The lakes under study are connected by the River Jorka, which enters one of the Great Masurian Lakes. The phytoplankton production is lowest in the stratified Lake Majcz located in the upper, forested part of the watershed. The results demonstrate the relative significance of internal and external loading in controlling the trophic status of a lake. The shallow and productive Lake Inulec is controlled by internal loading. The ratio release to sorption rate of P for the sediments is as high as 25:1 and the net sedimentation rate is quite low. Due to the great flushing rate (mainly in the spring) Lake Jorzec seems to be mostly controlled by internal loading during summer when sediments rich in Al and Fe release the available P; in other seasons they intensively sorb it. The R:S ratio is practically 1:1 and the assessed net sedimentation rate is quite close to the measured internal loading value. In Lake Majcz the release of P from sediments rich in Ca is ten times higher than the external load, but is practically limited to two months, and is balanced by sedimentation in other seasons. The same can be said about Lake Glebokie in which the high external loading is coupled with the heavy internal loading, with the latter limited to the second half of the year. Therefore the highest sedimentation rate is probably still effectively counteracting the increase of P in the lake water. (Baker-IVI).
W85-04556

OUTDOOR RECREATION - A NEW FACTOR DISTURBING LAKE ECOSYSTEMS, AS EXEMPLIFIED BY LAKE GIM, MAZURIAN LAKE DISTRICT,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 5C.
W85-04557

ROLE OF BIVALVES IN THE PHOSPHORUS AND NITROGEN BUDGET IN LAKES,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
A. Stanczkowska.
Verhandlung Internationale Vereinigun Limnologie, Vol. 22, p 982-985, October, 1984. 5 Tab. 8 Ref.

Descriptors: *Mussels, *Littoral zones, *Lakes, Phosphorus, Nitrogen, Cycling nutrients, Biomass, Eutrophication, Trophic level.

Dreissena polymorpha is one of the most numerous mussels in the littoral of lakes, and certainly the most important one regarding the biomass. Meso- and eutrophic lakes of Masurian Lakeland were used to determine whether mussels occurring in lakes in such great numbers as D. polymorpha may be of importance in counteracting the process of eutrophication. P and N contents of D. polymorpha bodies ranged from 0.85% to 0.93% and from 11% to 12.8%, respectively. The highest percentage of P in the mussels was noticed in the prereproductive period. The percentage of P and N in the body changed with the age of mussels, with the highest values in the youngest individuals. The quantities of P accumulated in mussel populations in a mesotrophic lake are similar to loading of P measured in the lake, but in a highly eutrophic lake, they are about 50 times smaller than the annual loading. The P and N accumulated in mussels is removed from cycling in the lake for a period of a few years (the lifetime of a mussel is estimated at 4-6 years, and about 20 years for shell decomposition). In lakes where D. polymorpha occurs in great density and occupies considerable surface on the lake bottom, its role in P and N cycling within lakes should not be neglected. This mussel was significantly more dominant in dimictic and less eutrophic polymictic lakes than in the rest of investigated lakes. The data suggest that the role of D. polymorpha in P and in cycling is important in meso- and moderately eutrophic lakes, but it is not significant in highly eutrophic or hypertrophic lakes. (Baker-IVI)
W85-04558

EFFECTS OF INTERNAL MEASURES IN BALDEGGERSEE: FORCED-CIRCULATION AND OXYGENATION OF THE HYPOLIMNION (DIE AUSWIRKUNGEN VON INTERNEN MASSNAHMEN IM BALDEGGERSEE: ZWANGSZIRRKULATION UND SAUERSTOFFBEGASUNG DES HYPOLIMNIONS),
Luzern Kantolales Amt fuer Gewasserschultz (Switzerland).
For primary bibliographic entry see Field 5G.
W85-04559

STREAM PHOSPHORUS EXPORTS FROM PREALPINE WATERSHEDS WITH RESPECT TO GEOLOGY AND LAND USE,
Osterreichisches Eutrophieprogramm, Projekt Salzkammergutseen, A-4852 Weyregg, Austria.
For primary bibliographic entry see Field 5B.
W85-04560

PHYTOPLANKTON AS BIOLOGICAL PARAMETER FOR THE TROPHIC CHARACTERIZATION OF LAKES,
Innsbruck Univ. (Austria). Botanisches Inst.
E. Rott.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1078-1085, October, 1984. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Trophic level, *Lakes, *Phytoplankton, Bioindicators, Water pollution effects, Eutrophication, Species composition, Succession, Biovolume.

An examination is made of how far structure and dynamics of phytoplankton assemblages and total biovolumes found in 40 Tyrolean lakes during 8 years of monitoring reflect their trophic conditions. The lakes investigated are situated in low mountain regions of Tyrol (Austria) and are mainly used for recreation such as swimming and rowing. In many cases a rapid stratification after ice-out and relatively low wind incidence and flushing, allows development of high maximum surface temperatures. The study suggests that qualitative phytoplankton investigations give valuable information on species composition and succession of phytoplankton assemblages; phytoplankton assemblages follow some general patterns which are determined in quality and quantity by the trophic status; phytoplankton biovolume is at least as valuable a component of lake eutrophication studies as chlorophyll-a; and in the light of general relationships phytoplankton constitutes a rather sensitive measure for clarifying the specific trends of development for each particular lake. (Baker-IVI)
W85-04561

EUTROPHICATION OF LAKE BALATON: MEASUREMENTS, MODELING AND MANAGEMENT,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
For primary bibliographic entry see Field 5C.
W85-04562

AVAILABILITY OF SEDIMENT P IN LAKE LUGANO,
Commission of the European Communities, Ispra (Italy).
G. Premazzi, and G. Zanon.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1113-1118, October, 1984. 3 Tab, 20 Ref.

Descriptors: *Lake sediments, *Phosphorus, *Algae, *Lake Lugano, Bottom sediments, Algal growth, Phosphate, Apatite, Available phosphorus.

The release of P available to algae associated with bottom sediments was quantified in Lake Lugano. The P available chemically by extraction techniques was characterized and the amount of P available was compared with that estimated from mass balance calculation. It was felt that in Lake Lugano, where a program of recovery from eutrophication was initiated in 1976, the effects of P reduction might be delayed by the release of phosphorus from sediments. The phosphate adsorbed onto bottom sediments can be important in the overall P budget of this basin of Lake Lugano. On the average, 12% of total P was available for algal growth. The nonapatite inorganic fraction contributed to the largest proportion (42-100%) of P immobilized by Selenastrum, with the except of summer sediments when a significant proportion (35%) of organic P was assimilated by algae. Some availability of apatite P was also noticed. Because of the great variations with season and water-column depth of the sediment P content, no correlations between the available P and the different forms of sediment P were found. Inorganic phosphate content of the sediment cannot be used to predict the potentially available P of sediments. It is important to developing strategies to determine available P rather than total P. (Baker-IVI)
W85-04563

IMPORTANCE OF MACROPHYTES IN TWO LAKES WITH DIFFERENT TROPHIC DEGREE: LAKE COMABBIO AND LAKE MONATE (PROVINCE OF VARESE, NORTHERN ITALY),
Commission of the European Communities, Ispra (Italy).
O. Ravera, C. Garavaglia, and M. Stella.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1119-1130, October, 1984. 6 Fig, 3 Tab, 31 Ref.

Descriptors: *Macrophytes, *Trophic levels, *Lake Monate, *Lake Comabbio, *Italy, Aquatic plants, Nutrients, Turbidity, Water pollution effects, Phosphorus, Eutrophication.

Because the role played by the macrophytes in the ecosystem varies according to the charateristics of the ecosystem, research was carried out on the vegetation of two small lakes laying in the same area but having different characteristics. A series of stations (12 for Lake Comabbio and 18 for Lake Monate) were chosen along the entire littoral zone from which macrophyte samples were collected. Lake Comabbio is very rich in species, if compared with Lake Monate, but in the latter there are 8 submerged species, whereas in Lake Comabbio there are only 4. In Lake Comabbio emergent species form the greatest part of the macrophyte biomass, whereas in Lake Monate the submerged have a biomass similar to that of the reeds. The most probable cause of this difference is the higher water turbidity in Lake Comabbio compared to Lake Monate. In the last decades the turbidity of Lake Comabbio has increased following an increase in municipal pollution. If the total amount of P immobilized in the macrophytes were released and homogeneously distributed in the lake water the total P concentration should increase by 10.9 mg/cu m in Lake Comabbio and by 0.5 mg/cu m in Lake Monate. If these values are related to unit

surface one would obtain 50 mg TP/sq m of lake surface for Lake Comabbio and 10 mg TP/sq m for Lake Monate. Because macrophytes are part of the lake ecosystem, the amount of P they release does not represent a true load to the lake. Larger quantities of nutrients discharged to Lake Comabbio support a greater biomass of macrophytes than in Lake Monate, which receives only one sixth of the P loading of Lake Comabbio. (Baker-IVI)
W85-04564

IMPACT OF NUTRIENT LOAD ON TOTAL BIOMASS AND SPECIES SUCCESSION IN LAKE SUWA, JAPAN,
MAXIMUS, Inc., McLean, VA.
For primary bibliographic entry see Field 5C.
W85-04565

RECENT CHANGES IN THE ECOLOGY OF LAKE NAIVASHA, KENYA,
Leicester Univ. (England). Dept. of Adult Education.
D. Harper.
Verhandlung Internationale Vereinigung Limnology, Vol. 22, p 1193-1197, October, 1984. 7 Ref.

Descriptors: *Lake Naivasha, *Kenya, *Ecology, Phytoplankton, Zooplankton, Nutrients, Invertebrates, Macrophytes, Fish, Birds, Water level fluctuations, Introduced species, Aquatic habitats.

Studies were carried out on aspects of the phytoplankton, zooplankton, benthic invertebrates, subaquatic macrophytes, fish and aquatic birds of Lake Naivasha, Kenya's second largest freshwater lake. Important for its commercial fishery, use for irrigation, aquatic bird populations and tourist value, the lake ecosystem is affected by extensive natural water level fluctuations. In addition to natural changes, several accidental or deliberate species introductions have altered the ecosystem in various ways in recent decades. During the period of study the northern and western half of the lake's surface and particularly the western quarter were covered by extensive rafts of papyrus and Salvinia molesta, which moved freely under the wind and currents. Changes observed during this short period of study include the loss of sub-aquatic macrophytes, the increase of Salvinia, the changes in diversity of littoral and benthic invertebrates and the stability of the phytoplankton and the zooplankton. (Baker-IVI)
W85-04566

DIURNAL CYCLE OF STRATIFICATION IN LAKE TITICACA: EDDY DIFFUSION,
California Univ., Davis. Div. of Environmental Studies.
T. Powell, M. H. Kirkish, P. J. Neale, and P. J. Richerson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1237-1243, October, 1984. 2 Fig, 2 Tab, 38 Ref.

Descriptors: *Lake Titicaca, *Diurnal variation, *Eddy diffusion, *Stratification, Diffusion, Thermoclines, Mixing, Model studies, Epilimnion.

The evolution of diurnal thermal structure was analyzed as a one dimensional (vertical) diffusion processes and the extent to which this simple formulation is capable of explaining the details of the diurnal variation in Lake Titicaca was examined. Beyond simplicity, this approach has the advantage that the detailed data sets needed for the well-mixed layer model studies are not necessary. Moreover, unlike the detailed mixed layer models, the results may be readily applied to biological studies for which some knowledge of surface layer stratification may be critical. Results are explained for approximate (bulk) diffusivity estimates, and depth-dependent vertical diffusion. Despite drawbacks, the eddy diffusion phenomenology provides a simple initial description of processes occurring in the epilimnion. The calculations are useful first estimates of the spatial and temporal scales of these processes. Eddy diffusion calculations have ready applications in ecological studies. (Baker-IVI)
W85-04567

AMAZON FLOODPLAIN LAKES: SHAPE, FETCH, AND STRATIFICATION,
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1278-1282, October, 1984. 3 Fig, 1 Tab, 11 Ref. NSF grants DEB78-23642 and DEB81-11398.

Descriptors: *Lake morphology, *Fetch, *Stratification, *Amazon floodplain, *Brazil, Wind, Mixing, Radar, Lakes.

The shape and maximum fetch of all lakes greater than 100 m across in the floodplain of the Rio Solimoes-Amazonas were determined from photographs made from side-scanning radar images. Shapes were divided into six categories: round to oval, dendritic, oxbow, crescent, levee, and composite. Both the number of lakes and the proportion of each shape vary in different regions of the floodplain. Most Amazon floodplain lakes have fetches of between 250 and 1000 m. About 10% are less than 250 m across but are still recognizable on the radar photographs. One likely consequence of the range in fetches is differences in the effectiveness of wind mixing and vertical stratification. A test of the hypothesis that vertical mixing in Amazon floodplain lakes is primarily a function of exposure to wind and that an increase in stratification should occur as fetch is reduced is in progress. (Baker-IVI)
W85-04568

VERTICAL MIXING IN AMAZON FLOODPLAIN LAKES,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
S. MacIntyre, and J. M. Melack.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1283-1287, October, 1984. 4 Fig, 2 Ref. NSF grants BED78-23642 and DEB81-11398.

Descriptors: *Mixing, *Lakes, *Amazon floodplain, *Lake Calado, *Brazil, Destratification, Temperature effects, Seasonal variation, Wind, Convection, Solar radiation.

The Amazon floodplain lakes lie in the humid lowlands of equatorial South America and rise and fall in level in concert with the annual river flood. Coincident with the changes in depth are variations in the frequency of vertical mixing. Vertical mixing was studied in Lake Calado, which is narrow and dendritic with a region enlarged by a lateral levee. During the period of low but rising water, the lake is turbid and only 3 m deep. Temperatures at the surface increased by as much as 2.5 C during the day, but each day the lake became isothermal by early morning. Mixing within the lake can occur during the day if wind speeds are sufficient to overcome buoyancy forces established by the stable density gradient. Mixing can occur at night as a result of forced convection by wind or free convection due to an unstable density gradient. Daytime mixing is more likely when incident radiation is low. When wind speeds are low, heat derived from the incoming radiation is largely distributed in the upper 2 m. Observations in January of 1981 and February 1983 suggest that once the lake is deeper than about 4 m, mixing to the bottom will only occur when incoming solar radiation is low. At night the region of isothermy or unstable temperature gradient usually extends to a depth of 2 to 2.5 m, although early in the restratification period it extended to the bottom. Because heat loss at night is not just confined to a shallow region at the surface, it appears that free convection augmented by forced convection occurs. These responses of the lake to incoming radiation, wind stress, and cooling illustrate how sensitive the lake is to its recent history. (Baker-IVI)
W85-04569

SEASONAL VARIATION OF THE MAJOR CATION CONTENT OF THE VARZEA-LAKE LAGO CAMALEAO, MIDDLE AMAZON, BRAZIL, IN 1981 AND 1982,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
K. Furch.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1288-1293, October, 1984. 3 Fig, 17 Ref.

Descriptors: *Seasonal variation, *Varzea lakes, *Lago Camaleao, *Brazil, *Cations, Chemical properties, Macrophytes, Aquatic plants, Rivers, Water level.

Seasonal variation in water chemistry was studied in Lago Camaleao, a varzea-lake on an island in the Amazon. Changes in cation content of the river were small and showed no seasonality, but there were large seasonal fluctuations in the cation content of the lake water. More than 15-fold differences between lake and river water were noted in the course of one year. Growth and decomposition of macrophytes occur simultaneously, but in different intensities during the year. In 1981 differences in the amount of major cations in the lake water between January and June were small, indicating that a large portion of cations, brought into the lake by inflowing river water and by lake internal processes, is lost to lake internal processes. The lake system acted as an effective element trap during the period of rising water level in 1981. In 1982 differences in the amount of major cations dissolved in the lake water between January and June were large, indicating a comparatively small lake internal loss of the cations gained from inflowing river water and released within the lake system. The field observation that macrophyte development was less in 1982 due to extreme high water of that year is thus directly reflected by the chemistry of the varzea-lake. (Baker-IVI)
W85-04570

NUTRIENT PROCESSING IN AMAZON FLOODPLAIN LAKES,
Washington Univ., Seattle. Inst. for Environmental Studies.
For primary bibliographic entry see Field 2K.
W85-04571

SENSITIVITY ANALYSIS OF RESERVOIR OXYGEN MODEL,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
W. J. Snodgrass, and M. F. Holloran.
Canadian Water Resources Journal, Vol. 8, No. 3, p 1-25, 1983. 5 Fig, 1 Tab, 44 Ref.

Descriptors: *Dissolved oxygen, *Reservoirs, *Sensitivity analysis, *Model studies, Reservoir sediments, Biochemical oxygen demand, Wind, Solar radiation, Water temperature.

A sensitivity analysis of a dissolved oxygen model currently being applied to several Canadian reservoirs is presented. The model's predictions for temperature show good agreement with observations on a reservoir whose vertical mixing is controlled by inflow-outflow differences, summer stratification and autumnal overturn. Of several hydraulic, meteorological and biochemical variables investigated, model predictions of hypolimnetic oxygen are most sensitive to sediment oxygen demand (SOD). The model is sensitive to land-based inputs of BOD, solar radiation and wind speed, but relatively insensitive to the temperature of inflowing water or the depth of bottom withdrawal. These results suggest criteria for engineering design and siting reservoirs and for priorities for experimental and field measurements of model parameters. For calibration studies, this sensitivity analysis suggests that much attention should be given to the measurement of SOD, and the next priority should be the measurement of the input rate of BOD. At approximately the same degree of importance are measurements of solar radiation, wind velocity and inflow temperature. (Moore-IVI)
W85-04585

ASSESSMENT OF HISTORICAL CHANGE IN TWO NORTHERN MINNESOTA LAKES,
Minnesota Univ.-Duluth. Dept. of Biology.
For primary bibliographic entry see Field 5B.

W85-04602

PHOSPHORUS IN THE BOTTOM SEDIMENTS OF SOME LAKES OF THE WORLD,
Akademia Rolnicza, Wroclaw (Poland). Dept. of Limnology.
J. Golachowska.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 3, p 175-205, 1984. 6 Fig, 13 Tab, 76 Ref.

Descriptors: *Bottom sediments, *Lake sediments, *Phosphorus compounds, Organic compounds, Nitrogen, Organic matter, Iron, Calcium, Aluminum, Sorption, Anaerobic conditions, Mineralization.

Samples of bottom sediments for examination were collected over the period from 1969 to 1975, from 27 lakes in various regions of the world. Concentrations of total phosphorus in the sediments ranged from 2.80 to 12.50 mg PO4/g and were independent to a great extent of the lake trophic type and climatic conditions. High concentrations of phosphorus and nitrogen are usually found in lakes with considerable amounts of organic matter. The total mineral phosphorus content ranged from 1.30 to 9.90 mg PO4/g of sediment; organic phosphorus content ranged from 1.10 to 4.60 mg PO4/g of sediment. The percent of mineral-P in total-P ranged from 25.8 to 84.9%. Mineral-P occurred in bottom sediment bound mainly with iron, calcium and aluminium. Organic-P was represented by phosphoproteins, and to a lesser extent by nucleic acid-P and by very small amounts of phospholipids. The presence of iron, aluminium and organic matter in bottom sediments affected the volume and rate of phosphorus sorption. A given sediment always bound the same amount of added phosphorus, in the same chemical compounds. The binding by certain sediments was a violent process. In tests, the release of phosphorus from bottom sediments (mainly from mineral compounds) was started by microorganisms and followed by physico-chemical and biological processes under oxygen-free conditions. Organic phosphorus compounds under laboratory conditions were highly resistant to mineralization. (Moore-IVI)
W85-04612

PROTOZOAN COLONIZATION RATES AND TROPHIC STATUS OF SOME FRESHWATER WETLAND LAKES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
M. S. Henebry, and J. Cairns, Jr.
Journal of Protozoology, Vol. 31, No. 3, p 456-467, August, 1984. 3 Fig, 9 Tab, 56 Ref.

Descriptors: *Wetlands, *Lakes, *Trophic levels, *Protozoa, *Michigan, Bogs, Eutrophication, Primary productivity, Chlorophyll, Phosphorus, Nitrogen, Nutrients, Trophic level, Artificial substrates.

The colonization dynamics of protozoan communities have been investigated in a variety of lentic and lotic habitats using polyurethane foam (PF) unit artificial substrates. Primary productivity, chlorophyll a, phosphorus and nitrogen nutrients, and other chemical and physical parameters were measured in 13 wetlands in northern lower Michigan. Colonization rates of PF units by protozoa in lakes associated with each of the four major wetland types were compared with water quality of the lakes determined by the other commonly used measures of trophic status. The hypothesis that these common measurements of trophic status would show that wetland lakes, including all bog lakes, were eutrophic was largely confirmed. The waters of all bog and fen sites, with the exception of Hoop Lake Bog, were more eutrophic than moderately eutrophic Douglas Lake and were, in fact, in the generally agreed upon eutrophic ranges for all of the above parameters. Since primary productivity is probably the single most meaningful indicator of the trophic status of a lake and since there was a highly significant positive correlation between primary productivity and colonization rates by protozoa, the hypothesis of a positive correlation between trophic status and colonization rate of PF units by protozoa was also supported. One of the significant results was the confirmation of the usefulness of PF unit artificial substrates both as collecting devices for protozoa and as tools that may give an indication of the trophic status of a body of water. (Baker-IVI)
W85-04657

AQUATIC MACROPHYTE VEGETATION OF AN ISOLATED ISLAND LAKE ADJACENT TO LAKE NIPIGON, ONTARIO: A COMPARATIVE STUDY AFTER A FIFTY-SIX YEAR INTERVAL,
Guelph Univ. (Ontario). Dept. of Botany and Genetics.
H. M. Dale, and C. E. Garton.
Canadian Field Naturalist, Vol. 98, No. 4, p 444-450, October-December, 1984. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Macrophytes, *Ontario, *Lakes, *Teapot Lake, *Nipigon Lake, *Aquatic weeds, Physicochemical properties, Beavers, Species composition, Vegetation regrowth.

The 1982 appearance of an isolated lake far from human disturbance in North West Ontario, matched the 53-year old report of the distribution and abundance of many aquatic taxa. Readings of the physical and chemical factors were not significantly altered although it was clear that there had been a temporary rise in the water level due to a Beaver dam. The decrease in abundance of Yellow Water Lily (Nuphar variegatum), a narrow-leafed pondweed (Potamogeton friesii), and several marsh plants - Mare's Tail (Hippuris vulgaris), Cowslip (Caltha palustris), Water Arum (Calla palustris), and Marsh Cinquefoil (Potentilla palustris) - was attributed to the raising of the water level. Plants known to be a food for Beavers decreased in abundance, those unpalatable increased. Since 1966, when the lake had returned to normal level, high reproductive capacity favored increased abundance of Stonewort (Chara globularis), Quillwort (Isoetes macrospora and I. echinospora), Northern Watermilfoil (Myriophyllum exalbescens), and Watermarigold (Megalodonta beckii). The opportunistic species on bare aquasoil, Water Starwort (Callitrich sp.) and Pipewort (Eriocaulon septangulare), flourished. The unbroken ring of aquatic vegetation of 1926 had declined in quantity. Differences between the flora of the small isolated lake (Teapot) and that of the large encompassing lake (Nipigon) are due to differences in the temperature of the water, alkalinity and wave action. The lack of suitable invading disseminules may have prevented the establishment in Teapot Lake of Red Pondweed (Potamogeton alpinus), Whitestem Pondweed (Potamogeton praelongus), and Flat-stemmed Pondweed (Potamogeton zosteriformis). The reasons for the absence of Slender Naiad (Najas flexilis) and Horned Pondweed (Zannichellia palustris), present in a bay a few kilometers to the west, remain unclear. (Author's abstract)
W85-04661

SPECIES RICHNESS IN STREAMS OF DIFFERENT SIZE FROM THE SAME DRAINAGE BASIN,
Idaho State Univ., Pocatello. Dept. of Biology.
G. W. Minshal, R. C. Petersen, Jr., and C. F. Nimz.
American Naturalist, Vol. 125, No. 1, p 16-38, January, 1985. 6 Fig, 3 Tab, 73 Ref. NSF grants BMS 75-0733 and DEB 7811671.

Descriptors: *Species diversity, *Invertebrates, *Streams, *Salmon River, *Idaho, Seasonal variation, Drainage basin, Stream order, Immigration.

The species richness of stream benthic invertebrates on rocks in the streams was studied along a longitudinal profile of the Salmon River Basin, Idaho, during spring, summer, and autumn. Replicate rocks were sampled and an analytical approach was used to calculate theoretical number of species present, relative immigration rate, and relative spatial heterogeneity. Species richness varied with stream size, being highest in midorder streams and lower in headwater and high order streams. This downstream shift in species richness conforms to the river continuum concept. Possible cause is associated with varying temperature regimes in the different-sized streams as well as other factors. Species richness also varied with season depending on stream size. Low order streams were more individualistic, probably because of a greater influence of local (terrestrial) environmental conditions, but showed a higher richness in summer than in autumn. Larger streams were more similar and showed a higher richness in autumn than in summer. Other community-level indicators, such as relative immigration rate and extinction rate, also showed seasonal differences. The different macroinvertebrate community types having characteristic of either nonequilibrium or equilibrium conditions can be found in streams from the same drainage basin depending on location along the river continuum and time of the year. These findings have important implications for future studies of stream communities as well as for those of predation and competition in streams. (Baker-IVI)
W85-04665

COMPARISON OF PERIPHYTON GROWTH ON ARTIFICIAL AND NATURAL SUBSTRATES IN THE UPPER SPOKANE RIVER,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
T. S. Nielsen, W. H. Funk, H. L. Gibbons, and R. M. Duffner.
Northwest Science, Vol. 58, No. 4, p 243-248, November, 1984. 2 Fig, 2 Tab, 19 Ref. DOE grant WF 80-002.

Descriptors: *Periphyton, *Substrates, *Spokane River, *Washington, Algal growth, Primary productivity, Bioindicators.

Periphyton are commonly regarded as indicators of water quality; both artificial and natural substrates have been used in studies of periphyton as water quality indicators. Algae selectivity for artificial or natural substrate was studied at 10 sites on the Upper Spokane River in Washington. No definable difference in density was noted between the algae colonizing glass and natural rock substrate. Once the periphyton were attached to the rock substrate, they were able to attain a greater ash-free dry weight and chlorophyll a level than the same density of algae on the glass substrate. Hence, the periphyton on the rock substrate had an advantage over the periphyton on the glass substrate in the process of primary production. It appears that consideration of artificial substrate composed of glass would lead to underestimation of periphyton productivity in flowing waters. (Baker-IVI)
W85-04666

PRELIMINARY INVESTIGATION ON EFFECTS OF FLUCTUATING FLOWS ON INVERTEBRATES OF THE HAWEA RIVER, A LARGE REGULATED RIVER IN NEW ZEALAND,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
J. R. Irvine, and P. R. Henriques.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 3, p 283-290, 1984. 3 Fig, 3 Tab, 10 Ref.

Descriptors: *Invertebrates, *Hawea River, *New Zealand, *Streamflow, *Benthos, Ecological effects, Periphyton, Midges, Caddisflies, Oligochaetes.

An experiment with flow changing at 3, 9, and 18 cu m/s/h on consecutive days failed to produce any measurable effect on benthic invertebrates in the regulated Hawea River, New Zealand, but did result in increased numbers of drifting chironomid larvae, trichopteran larvae, and oligochaetes compared to days when flow was stable. Drift densities were at least as high on the day flow changed at 3 cu m/s/h (minimum flow 15 cu m/s, maximum flow 30 cu m/s) as on subsequent days when flow changed at 9 and 18 cu m/s/h (minimum flows both 15 cu m/s, maximum flows 60 and 105 cu m/s respectively) indicating that rapid rates of change of flow may not necessarily cause more benthic invertebrates to enter the drift than slow rates of change. Fluctuating flows resulted in more animals

entering the drift at a site 5 km below a control dam than at a site 0.8 km below the dam. Drift of non-invertebrate organic matter (mainly periphyton) showed similar patterns to invertebrate drift. Most of the invertebrates displaced by the flow fluctuations were associated with periphyton in the river, and as such, these taxa may have been more prone to being swept away during flow increases than other invertebrate taxa. (Author's abstract)
W85-04668

TRENDS IN LAKE ROTORUA WATER QUALITY,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
J. C. Rutherford.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 3, p 355-365, 1984. 2 Fig, 1 Tab, 22 Ref.

Descriptors: *Lake Rotorua, *New Zealand, *Lakes, *Water quality, Eutrophic lakes, Stratification, Data interpretation, Water pollution effects.

Water quality data for Lake Rotorua, New Zealand, was obtained from three sources and analyzed for trends over the period 1966-1983. The probability density function of each determinand was plotted as a histogram to check visually for serious violations of normality. Those determinands which exhibited markedly skewed distributions were transformed by taking logarithms (base 10). Three periods were separately analyzed for trends - 1967-70, 1971-77, and 1978-83 - because of possible differences in analytical techniques used by the different data collection agencies. After transformation, monthly average values were calculated. A linear regression package was used, but additional manipulations were performed to remove seasonality, fill gaps, and correct for serial correlation. Lake quality deteriorated during 1967-1970 largely because meteorological conditions favored lake stratification. During 1978-1983, despite favorable meteorological conditions, quality again deteriorated at the same time as, and probably as a result of, an increase of available nutrient input from sewage effluent; during this period, oxygen depletion, nutrient, and chlorophyll showed increasing trends - a clear indication of increasing eutrophication. Were sewage nutrient inputs to be reduced to the 1976-77 levels, then a marked improvement in lake water quality would be expected back to the conditions prevailing at that time. (Collier-IVI)
W85-04669

FACTORS AFFECTING CLARITY OF NEW ZEALAND LAKES,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
W. N. Vant, and R. J. Davies-Colley.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 3, p 367-377, 1984. 4 Fig, 3 Tab, 30, Ref, 2 Append.

Descriptors: *New Zealand, *Lakes, *Optical properties, *Irradiance, *Opacity, Turbidity, Scattering coefficient, Color, Transparency, Secchi disks, Suspended solids, Algae, Seston.

Average values of inherent optical properties for the 400-700 nm waveband were estimated from quantum irradiance measurements on 27 New Zealand lakes of diverse optical character, using published nomograms. Secchi disc depths, turbidity, algal pigment, non-volatile suspended solids, and absorption by membrane-filtered samples at 440 nm (g440) were also measured. Turbidity (NTU) correlated closely with the scattering coefficient (per m) and these quantities were almost numerically equal, as found in other studies. The data were found to conform to an expression in the oceanographic literature relating Secchi disc depth to the beam attenuation and diffuse attenuation coefficients. Specific beam attenuation, scattering; and absorption coefficients were estimated from the coefficients of linear multiple regressions of the measured total coefficients on the variables: total pigment (chlorophyll a + phaeopigment), non-volatile suspended solids, and g440. The estimated values were in reasonable agreement with similar specific coefficients reported in the oceanographic literature. The coefficients provide a basis for predicting clarity in new impoundments or for predicting the effects of loading changes (e.g., of nutrients) on the clarity of existing lakes. The coefficients can be used for classifying lake waters into different optical types. (Author's abstract)
W85-04670

STUDIES ON THE CARBON FLUX FROM PHYTO- TO BACTERIOPLANKTON COMMUNITIES IN LAKE CONSTANCE,
Nagoya Univ. (Japan). Water Research Inst.
K. Kato, and H.-H. Stabel.
Archiv fur Hydrobiologie, Vol. 102, No. 2, p 177-192, December, 1984. 4 Fig, 4 Tab, 48 Ref. Deutsche Forschungsgemeinschaft grant AZ: Ti 115/10-2.

Descriptors: *Carbon flux, *Cycling nutrients, *Bacteria, *Plankton, *Lake Constance, *Germany (Federal Republic), Isotope studies, Carbon radioisotopes, Algae, Photosynthesis.

The initial phase of the carbon flux from photosynthetic organisms to heterotrophic bacteria was studied in the eutrophic zone of Lake Constance by use of in situ incubations with labeled $NaHCO_3$ and a differential filtration technique. After the light incubation period (4 or 6 hours) extracellularly released dissolved organic carbon covered 23.2% of the total C-14 that had been photoassimilated, while another 7% was found incorporated into planktonic bacterial biomass. During June (clearwater phase) nearly 60% of the total radioactivity was bound on extracellular material. During the dark incubations ca. 16% of the C-14 was lost from organisms exceeding 3 micro m in diameter. Respiration of algae was supposed to be the main factor affecting these losses. During the first hours from the onset of in situ incubation experiments the accumulation of extracellular organic C-14 always exceeded the rates of consumption by bacteria. Thereafter these two rates were not related. The concentrations of extracellularly released dissolved organic carbon generally declined during the dark phase, except for the experiments on 19 July and 9 November. Macromolecules were enriched relative to smaller molecules, although they were not refractory against bacterial utilization. Shifts in the patterns of molecular weight distribution suggested that planktonic bacteria preferentially utilized smaller compounds. (Author's abstract)
W85-04672

MICROELEMENT CONTENT OF SOME SUBMERGED AND FLOATING AQUATIC PLANTS,
Botanikai Kutatointezete, Vacratot (Hungary).
M. Kovacs, I. Nyary, and L. Toth.
Acta Botanica Hungarica, Vol. 30, No. 1-2, p 173-185, 1984. 12 Tab, 14 Ref.

Descriptors: *Aquatic plants, *Chemical composition, *Elemental composition, *Microelements, *Lake Balaton, *Hungary, Bioconcentration, Water pollution effects, Heavy metals, Myriophyllum, Ceratophyllum, Duckweed, Potamogeton, Cladophora, Lead, Zinc, Copper, Arsenic, Antimony, Copper, Bismuth, Cesium, Cobalt, Titanium, Dysprosium, Samarium, Neodymium, Iodine, Silver, Scandium.

Aquatic plants are capable of accumulating elements in great quantities that are present in only small quantities in the water or the sediment of lakes. Concentrations of microelements were determined in the most common floating and submerged aquatic herbs and a filamentous algae of Lake Balaton, Hungary. Water samples were taken from the zones of submerged and floating plants in front of reed stands and from the middle of the lake. The concentration of microelements in the plants was 10-1,000,000 times higher than in the environment. The species analyzed for microelements are: Ceratophyllum demersum, Hydrocharis morsus-ranae, Lemna trisulca, Myriophyllum spicatum, Potamogeton pectinatus, P. perfoliatus, Stratiotes aloides and the filamentous alga species Cladophora glomerata. The concentration of each element proved to be a function of the geochemical environment or of environmental pollution, as in the case of Pb, Zn, Cu and As. High content of Sb and Cu (82.02 and 17.45 ppm dry matter, respectively) in C. submersum specimens collected near Balatonalmadi suggest the existence of industrial pollution. Zinc and Cu accumulation in the Badacsony-Szigliget samples of M. spicatum are indicative of vineyard runoff contaminated with Zn- and Cu-containing fungicides. Water-milfoil can take up Zn at a concentration-factor of 1,000,000, wheras this factor is 100,000 for Cs, Co, and Ti. Several microelements, such as Bi, Dy, Cu, Sm, Nd, Ag, I, and Sc were detected only in plants. (Collier-IVI)
W85-04678

RELATIONSHIPS BETWEEN WOODY DEBRIS AND FISH HABITAT IN A SMALL WARMWATER STREAM,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
For primary bibliographic entry see Field 2E.
W85-04679

POSSIBLE RELATIONSHIPS BETWEEN SURFACE WATER CHEMISTRY AND AQUATIC PLANTS IN THE NORTHERN GREAT PLAINS,
South Dakota State Univ., Brookings. Dept. of Biology.
K. K. Sletten, and G. E. Larson.
Proceedings of the South Dakota Academy of Science, Vol. 63, p 70-76, September 1984. 5 Tab, 12 Ref.

Descriptors: *Water quality, *Aquatic plants, *Lakes, *Ecological distribution, Wetlands, Species composition, Alkalinity, Conductivity, Hydrogen ion concentration.

The possibility of establishing relationships between three surface water chemistry parameters and the occurrence of certain aquatic plant species was investigated on 281 wetland sites throughout the northern Great Plains. For the study, 97 species of aquatic plants were selected; selection was based on the direct association of these species with surface water and on the number of sites at which the species were found. The ranges and means of surface-water conductivity, total alkalinity and pH values were determined on a species by species basis. Of the three chemical parameters measured, conductivity of surface water appeared to have the greatest influence on the presence or absence of certain aquatic plants. Five species were found strictly in fresh water while 11 others were tolerant of subsaline conditions. Most species tolerated great variation in alkalinity, while 22 species were found strictly in highly alkaline waters. Little relationship was found between pH and aquatic plant occurrence, although the highest pH readings occurred in subsaline waters and the lowest readings in fresh waters. (Author's abstract)
W85-04697

GROUNDWATER SEEPAGE AND THE WATER BALANCE OF A CLOSED, FRESHWATER, COASTAL DUNE LAKE: LAKE WINDERMERE, JERVIS BAY,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 2F.
W85-04698

OCCURRENCE OF DNA IN RIVER SEDIMENT: ITS MEANING AND RELATIONS WITH BENTHOS RESPIRATION, ORGANIC LOAD AND MACROINVERTEBRATES BIOMASS,
Savoie Univ., Chambery (France). Lab. d'Ecologie.
For primary bibliographic entry see Field 5C.
W85-04699

INFLUENCE OF VARYING ENVIRONMENTAL CONDITIONS ON THE ACTIVITY OF HETEROTROPHIC BACTERIA,
Delta Inst. for Hydrobiological Research, Yerseke

(Netherlands).
A. B. J. Sepers.
Ergebnisse der Limnologie, Vol. 19, p 119-124, December, 1984. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Bacterial physiology, *Aspartate, *Biomass, *Ecology, Ribonucleic acid, Microorganisms, Respiration.

The heterotrophic bacterial strain HIS 53 was grown in an aspartate limited chemostat and in a continuous culture system at a variable dilution rate. Aspartate was the single carbon, nitrogen and energy source. In these cultures the protein level (biomass parameter), the cellular RNA content (an indication for the physiological state of the cell) and the respiratory capacity for aspartate were measured. The biomass was in all cultures roughly the same, indicating that the applied environmental conditions, including variations in the supply rate of the growth limiting nutrient, did not affect the yield of HIS 53. Due to the inaccuracy of the respiration measurements, the gathered data did not permit definite conclusions about the effects of variable dilution rates on the concentration of the respiratory system. However, there was a trend of higher respiratory capacities at variations in the aspartate addition rate. The variations in the dilution rate brought about higher RNA levels compared with the chemostat cultures. Within the chosen experimental conditions it did not matter if there was a sinusoidal or stepwise variation in the dilution rate. The periodicity in these variations, however, did influence the RNA level. The ecological importance of this increase of the cellular RNA is discussed. (Author's abstract)
W85-04700

MEASUREMENT AND COMPARATIVE VALUES OF THE SHORT CIRCUIT METABOLISM (SCM) OF LAKES BY POC RELATIONSHIP OF PRIMARY PRODUCTION OF PHYTOPLANKTON AND SETTLING MATTER,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
W. Ohle.
Ergebnisse der Limnologie, Vol. 19, p 163-174, December, 1984. 3 Fig, 8 Tab, 12 Ref.

Descriptors: *Cycling nutrients, *Nutrients, *Short circuit metabolism, *Organic matter, *Phytoplankton, *Lakes, Bacteria, Zooplankton, Carbon, Phosphorus, Euphotic zone, Hypolimnion, Sediments, Hypertrophic lakes, Eutrophication, Mineralization.

The biogenic energy flux of lakes is mainly ruled by primary production of phytoplankton and consumption of this potential energy by bacteria. The intensity of these two pathways of energy flux being maintained by participation of zooplankton was identified by determining primary production and the organic remains of organisms collected by traps at different depths of the hypolimnion. The methods used are briefly described. Carbon as well as phosphorus and other nutrient compounds are incorporated in organisms and mineralized again and so forth from two to eighteen times in the euphotic region per unit time, even if neglecting the organic remains deriving from littoral macrophytes and environmental inflow. This Short Circuit Metabolism (SCM) is very variable and specific, however, from lake to lake; strong seasonal changes occur depending on temperature and algal population as well as nutrient level and biogenic dynamics under participation of cladocera, copepods, rotifers and bacteria. The SCM plays a decisive role in the limnetic eutrophication processes, but nevertheless has been generally disregarded. There are euproductive and eudynamic lakes with high bioactivity of 30,000 KJ/sq m/a and more concerning the flux between kinetic and potential energy in the epilimnion. Hypertrophic lakes may have huge bioactivity values up to 70,000 KJ/sq m/a; however, deeper stratified lakes, are also characterized by a surplus of algal products. A great part of the surplus algal products settle out before being mineralized but are then broken down in the bottom sediment by anaerobic bacteria. (Author's abstract)
W85-04701

CARBON MINERALIZATION IN MICROAEROBIC AND ANAEROBIC STRATA OF LAKE VECHTEN (THE NETHERLANDS): DIFFUSION FLUX CALCULATIONS AND SEDIMENTATION MEASUREMENTS,
Limnologisch Inst., Nieuwersluis (Netherlands).
C. L. M. Steenbergen, and H. Verdouw.
Ergebnisse der Limnologie, Vol. 19, p 183-190, December, 1984. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Carbon, *Cycling nutrients, *Lake Vechten, *Netherlands, *Nutrients, *Sedimentation, Organic carbon, Oxygen, Nitrate, Sulfate, Denitrification.

Input of organic carbon into two profundal strata of Lake Vechten (The Netherlands) during summer stratification in 1982 was estimated using sediment traps suspended at various depths. Concomitantly profiles of electron acceptors (O2, NO3 and SO4) were measured. Dispersion coefficients were estimated on the basis of temperature profiles allowing provisional calculations of fluxes of the electron acceptors. The relation between carbon input and electron acceptor consumption expressed as carbon equivalents for the two strata was evaluated in 4 observation periods. Oxygen consumption dominated in the microaerobic strata during all periods and greatly exceeded the carbon input. Sulfate consumption dominated in the deepest stratum, but did not account for the measured carbon input. It seemed that denitrification occurred in early summer in the deepest stratum. It amounted to only 3-5% of the total electron acceptor consumption. The reliability of this method to estimate decomposition is discussed. (Author's abstract)
W85-04702

COMPARISON OF BACTERIAL SULFATE REDUCTION AND METHANOGENESIS IN THE ANAEROBIC SEDIMENTS OF A STRATIFIED LAKE-ECOSYSTEM,
Limnologisch Inst., Nieuwersluis (Netherlands).
T. E. Cappenberg, C. A. Hordijk, and C. P. M. M. Hagenaars.
Ergebnisse der Limnologie, Vol. 19, p 191-199, December, 1984. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Bacteria, *Sulfates, *Methane, *Anaerobic conditions, *Sediments, *Lake Vechten, *Netherlands, Sulfur radioisotopes, Isotope studies, Carbon, Mineralization, Nutrients, Lakes.

The importance of bacterial sulfate reduction in the anaerobic mineralization of organic matter in the warm, monomictic, meso-eutrophic Lake Vechten (The Netherlands) was quantified and compared with the rates of methanogenesis and sedimentation of particulate organic matter. Bacterial sulfate reduction was studied directly by using radioactive sulfate and was calculated mathematically by using vertical sulfate gradients at the mud-water interface. Special attention was paid to calculate the actual turnover rates of the various electron acceptors and donors by determining the in situ concentration profiles of these components in the micro M-range using HPLC-fluorescence and - indirect photometric chromatography. Methane production (c. 84-110 mg C/sq m/day) in the sediments and its flux by bubble ebullition and molecular diffusion was compared with the input of carbon by sedimentation (c. 480-940 mg C/sq m/day). The data suggest that sulfate reduction as a terminal process in anaerobic carbon mineralization plays a relatively more important role in freshwater sediments than previously is understood. (Author's abstract)
W85-04703

SEDIMENTOLOGY AND GEOCHEMISTRY OF MODERN SEDIMENTS IN THE KINGSTON BASIN OF LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario).
P. G. Sly.
Journal of Great Lakes Research, Vol. 10, No. 4, p 358-374, 1984. 11 Fig, 6 Tab, 30 Ref.

Descriptors: *Lake sediments, *Kingston Basin, *Lake Ontario, *Geochemistry, *Geomorphology, *Sediments, Nutrients, Heavy metals, Organic carbon, Sulfides, Clays, Iron oxides, Magnesium oxides, Mercury, Cobalt, Zinc, Copper, Phosphorus.

Accumulation of Recent fine sediment is limited to deep water areas in Kingston basin and thickness of more than 50 cm are found only in the St. Lawrence trough; elsewhere, sands and silty sands are largely composed of reworked material. Local sources provide little input of fine sediment to the Kingston basin. Statistical relationships derived from geochemical analyses indicate several forms of association between heavy metals and organic carbon, sulfides, clays, hydrous Fe and Mn oxides, and carbonates. A comparison between Kingston and Niagara sediments shows that the combined effects of riverine and lacustrine erosion have resulted in a generally greater content of carbonates in the Niagara sediments. The content of Fe (which is partly influenced by redox potential) is highest, however, in sediment of the Kingston basin, where higher P values are also associated with an increased clay content. Differences in the concentrations of heavy metals in Lake Ontario, except for Hg, Co, Cu, and Zn, are largely explained by variations in silt and clay contents. Contaminant loadings from the Niagara River are largely responsible for the anomalously high concentrations of Hg and, to a lesser extent, Cu and Zn. Cobalt occurs at higher concentrations in the sediments of eastern Lake Ontario, where its presence is thought to reflect dispersal patterns. (Author's abstract)
W85-04714

SEASONAL VARIATION OF NUTRIENT LIMITATION IN WESTERN LAKE ERIE,
Windsor Univ. (Ontario). Dept. of Biology.
J. H. Hartig, and D. G. Wallen.
Journal of Great Lakes Research, Vol. 10, No. 4. p 449-460, 1984. 3 Fig, 4 Tab, 44 Ref.

Descriptors: *Lake Erie, *Seasonal variation, *Limiting nutrients, *Nutrients, Phytoplankton, Phosphorus, Nitrogen, Trace metals, Silica.

Monthly nutrient enrichments were performed from April through October, 1983, to identify growth limiting nutrients of natural phytoplankton assemblages collected from a station in the Pigeon Bay waters off the north shore of Lake Erie's western basin. Data from these experiments suggest that silica was the major limiting nutrient in April, phosphorus was the major limiting nutrient in May-September, and trace metals were limiting in October. These results show that nutrient enrichment experiments should be performed often enough to account for seasonal changes in the physicochemical environment as well as seasonal succession in phytoplankton. The conclusion that phosphorus was the major limiting nutrient in summer is different from the conclusions of the late 1960s and early 1970s that nitrogen was the major limiting nutrient in the summer in the western basin and suggests a possible shift from nitrogen to phosphorus limitation. Pigeon Bay nutrient trend data show that summer nitrate:soluble reactive phosphorus ratios have increased from approximately 4 in the late 1960s to over 40 in the late 1970s and early 1980s, corroborating that a shift has probably occurred. This shift in nutrient limitation is probably due to reduced bioavailable phosphorus loadings and increased nitrate loadings to the western basin. The southern portion of the western basin is physicochemically different from the northern portion and may not have responded in the same manner. (Author's abstract)
W85-04719

MACROINVERTEBRATES AS 'DESCRIBERS' OF MORPHOLOGICAL AND HYDROLOGICAL TYPES OF AQUATIC ECOSYSTEMS ABANDONED BY THE RHONE RIVER,
Programme Interdisciplinaire de Recherche sur l'Environnement - PR2 Rhone.
E. Castella, M. Richardot-Coulet, C. Roux, and P. Richoux.
Hydrobiologia, Vol. 119, No. 3, December, 1984. 3 Fig, 4 Tab, 20 Ref.

Descriptors: *Rhone River, *France, *Macroinvertebrates, *Lones, *River beds, *Ecosystems, Species diversity, Backwater, Mollusks, Crustaceans, Insects, Coleoptera, Caddisflies.

Samples of aquatic macroinvertebrates were taken from abandoned beds of the river Rhone in the Bregnier-Cordon area. This sector of the French Upper Rhone is particularly rich in old beds of 'lones' which vary in age and morphological type and have more or less direct connections with the river. Samples were collected using a hand net in eight different 'lones'. The results concerned five groups of fauna: Mollusca, Crustacea, Ephemeroptera, Coleoptera, Trichoptera. The study revealed a wide range of fauna, and the fact that group of taxa can be used to describe types of 'lones' defined by morphological and hydrological characteristics. This kind of research adds to our understanding of how such aquatic ecosystems evolve, and may be applied in a more general way to other important river systems. (Author's abstract)
W85-04722

INTERNAL P LOADING IN LAKES: A DIFFERENT APPROACH TO ITS EVALUATION,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
G. Premazzi, and A. Provini.
Hydrobiologia, Vol. 120, No. 1, p 23-33, January, 1985. 5 Fig, 7 Tab, 26 Ref.

Descriptors: *Phosphorus loading, *Lake sediments, *Italy, *Lake Lugano, *Lake Monate, *Lake Varese, *Lake Alserio, *Lake Pusiano, *Sediment-water interface, Interstitial water, Nutrients, Fate of pollutants, Eutrophic lakes.

Phosphorus release in five different environments was studied in order to evaluate the importance of sediments in determining the P levels in lake water. Sediments of five lakes in the subalpine region of Northern Italy were studied over a two year period: lakes Lugano, Monate, Varese, Alserio, and Pusiano. The laboratory P release rates in Lake Lugano were compared with those evaluated from a mass balance study in situ. The mesotrophic Lake Monate can be considered as a sink for P as it did not show an appreciable release in any experimental condition. The P release in the other lakes is controlled by bacterial activity. In anaerobic conditions the P release was found not to be correlated with the concentration gradient, average interstitial P level or with the forms of P in the sediments. A good correlation was found between the P surface and release rate. The internal P loading can contribute phosphorus to overlying waters at levels comparable to the external sources (from 30 to 100%). Diffusion was found to be the main transport mechanism from aerobic sediments; the diffusional fluxes depend on the concentration gradient between pore and overlying water. When considering the recovery from eutrophication of the investigated lakes, the nutrient release from sediments is of critical importance. The recovery of these lakes following a phosphorus control program could take a long time. (Collier-IVI)
W85-04723

ANALYSIS OF CHANGES IN THE INVERTEBRATE COMMUNITY ALONG A SOUTHERN NEW ZEALAND MONTANE STREAM,
North Canterbury Catchment Board, Christchurch (New Zealand).
B. Cowie.
Hydrobiologia, Vol. 120, No. 1, p 35-46, January, 1985. 2 Fig, 2 Tab, 60 Ref.

Descriptors: *Invertebrates, *New Zealand, *Streams, *Species diversity, *Species composition, Rank correlation, Similarity indices, Population density, Stream biota, Insects, Plecoptera.

Changes in benthic community structure at four sites along a flood-prone montane stream continuum in the South Island of New Zealand were analyzed using rank correlation (Kendall's Tau and Spearman's r sub s) and a community similarity index (S sub c) developed initially for stream pollution assessment. Species richness was highest in a forested headwater stream, which is attributed to its relatively greater physical stability and habitat heterogeneity. Community similarity decreased with distance apart, and pairs of open and forested sites showed the greatest similarity. Species composition and relative abundance along the continuum changed least in the numerically dominant Ephemeroptera and Plecoptera, groups in which several species had broad habitat requirements. In contrast, a number of dipteran and trichopteran species had more restricted distributions. The more specialized niche requirements of some species in these orders are attributed to their generally small size, their ability to spin silk, and their holometabolous development. Physical rather than biological factors appeared to limit the distributions of most invertebrates, and there was little evidence of ecological segregation by either food resource partitioning or differences in life history patterns amongst many closely related species. Theories that stream communities are well ordered entities maximizing the efficiency of energy utilization cannot realistically be applied to such unstable stream systems. (Author's abstract)
W85-04724

METHODS OF PH CALIBRATION OF SEDIMENTARY DIATOM REMAINS FOR RECONSTRUCTING HISTORY OF PH IN LAKES,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 5C.
W85-04725

LAKE ONTARIO OXYGEN MODEL. 1. MODEL DEVELOPMENT AND APPLICATION,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
W. J. Snodgrass, and R. J. Dalrymple.
Environmental Science and Technology, Vol. 19, No. 2, p 173-179, 1985. 2 Fig, 3 Tab, 55 Ref.

Descriptors: *Lake Ontario, *Mathematical models, *Dissolved oxygen, Water circulation, Stratification, Aeration, Photosynthesis, Decomposition, Water temperature, Hypolimnion, Epilimnion.

A mathematical model for dissolved oxygen has been formulated for Lake Ontario. The lake is treated as one box during winter circulation but as two boxes (epilimnion, hypolimnion) during summer stratification; inflows, outflows, vertical transport across the thermocline, atmospheric reaeration, photosynthesis, and decomposition are considered. For each year, temperature data are used to estimate the vertical exchange coefficient and the thermocline depth as a function time. Predictions of the oxygen model show reasonable agreement with observations for a 9-year period. This agreement provides some verification for the model and for the application of the oceanic stoichiometry of Redfield to lakes. Model predictions and observations suggest that oxygen is transported from the hypolimnion to the epilimnion and from the epilimnion to the atmosphere during summer stratification. Vertical transport accounts for ca. 10% of the hypolimnetic loss of oxygen. (Author's abstract)
W85-04801

LAKE ONTARIO OXYGEN MODEL. 2. ERRORS ASSOCIATED WITH ESTIMATING TRANSPORT ACROSS THE THERMOCLINE,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
W. J. Snodgrass.
Environmental Science and Technology, Vol. 19, No. 2, p 180-185, 1985. 5 Fig, 2 Tab, 18 Ref, 1 Append.

Descriptors: *Lake Ontario, *Dissolved oxygen, *Mathematical models, Solute transport, Entrainment, Stratification, Water temperature, Hypolimnion, Epilimnion.

Errors associated with ignoring entrainment of hypolimnetic waters into the epilimnion in two-box models are examined for dissolved oxygen. The effects of entrainment upon modeling and estimating the mass transfer coefficient across the thermocline are also analyzed. Use of Eulerian and semi-Lagrangian box models are contrasted. For epilimnetic dissolved oxygen, neglecting the upward transport of oxygen by entrainment has a maximum error of 5%. A model for estimating the vertical transport coefficient, which uses a heat budget for the hypolimnion and which includes the entrainment process, is developed. For estimation of this coefficient, the temperature either in the hypolimnion or in the thermocline may be used; qualitative arguments are presented for selection of the thermocline temperature. Available data suggest that the entrainment rate in Lake Ontario varies from 1 to 6 m/month and that values for the seasonal vertical transport coefficient are of the order of 0.05-0.1 m/day. (Author's abstract)
W85-04802

DIATOMS OF THE JUKSKEI-CROCODILE RIVER SYSTEM (TRANSVAAL, REPUBLIC OF SOUTH AFRICA): A PRELIMINARY CHECKLIST,
National Inst. for Water Research, Pretoria (South Africa).
F. R. Schoeman.
Journal of South African Botany (Cape Town), Vol. 48, No. 3, p 295-310, 1982. 2 Fig, 2 Tab, 70 Ref.

Descriptors: *South Africa, *Diatoms, *Jukskei River, *Crocodile River, Benthic flora, Lotic environment, Species composition.

During 1972 to 1975, samples of benthic algae were collected from 22 selected river stations in the Jukskei-Crocodile River system. Some 250 diatom taxa were identified from these samples. The Jukskei-Crocodile River system in the Transvaal embraces an area between Johannesburg on the Witwatersrand in the south and the Hartbeespoort Dam below the Magaliesberg Mountains in the north. The southern catchment area is densely populated and heavily industrialized; the northern part consists mainly of agricultural areas. An alphabetical listing of the diatoms identified is provided. (Baker-IVI)
W85-04814

TEMPERATURE-GROWTH RATE RELATIONSHIPS OF AEROBIC HETEROTROPHIC BACTERIA ISOLATED FROM A SILT-LADEN IMPOUNDMENT,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
D. F. Toerien.
Journal of the Limnological Society of Southern Africa, Vol. 8, No. 1, p 1-4, 1982. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *South Africa, *Aquatic bacteria, *Reservoirs, Aerobic bacteria, Heterotrophic bacteria, Water temperature, Temperature effect, Bacteria, Growth, Activation energy, Mathematical models.

A quantitative understanding was sought of the temperature-growth rate relationships of bacterial isolates from Wuras Dam (reservoir). While it is known that only a portion of the total bacterial population of aquatic ecosystem can be cultivated on agar plates, development of a quantitative understanding of this relationship should contribute to the overall understanding of the Wuras Dam ecosystem. Activation energies varied from 10.15 to 29.59 kcal/mole, indicating a varied response to temperature changes. Since Q10 values of more than 3.0 were generally encountered, most bacterial isolates were very sensitive to changes in temperature. Increased temperature sensitivity existed for at least some isolates in the lower temperature ranges. The wide temperature ranges of most South African Impoundments coupled with these findings suggest that temperature is probably a major regulating factor for the heterotrophic activity in, and possibly bacterial composition of, these impoundments. (Baker-IVI)
W85-04815

LEAF AREA AS A MEASURE OF STANDING CROP OF FLOATING AQUATIC MACROPHYTES,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
P. C. Keulder.
Journal of the Limnological Society of Southern Africa, Vol. 8, No. 1, p 29-32, 1982. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Standing crops, *Floating plants, *Macrophytes, *Leaf area, Aquatic plants, Salvinia, Azolla, Plant growth, Leaves, Photography.

Leaf area of floating macrophytes as a standing crop is used as a nondestructive additional method for the determination of growth rates. This method is applied to the floating macrophytes Salvinia molesta and Azolla filiculoides. and compared to chloropyll extraction and fresh and dry weight determinations. Growth rates as derived from leaf area determinations agreed with pigment extractions and fresh and dry weight measures of S. molesta and in a reduced scale of A. filicuoides. Leaf area can be applied as an indication of standing crop populations or laboratory monocultures, and growth rates could be calculated from such measurements. The true value of this method lies in its non-destructive nature and the growth and development of a population could be studied without any physical alteration or disturbance. It also yields a permanent photographic record of the population development, which could be useful for later references. (Baker-IVI)
W85-04817

STUDIES ON THE ZOOBENTHOS OF SOME SOUTHERN CAPE COASTAL LAKES. SPATIAL AND TEMPORAL CHANGES IN THE BENTHOS OF SWARTVLEI, SOUTH AFRICA, IN RELATION TO CHANGES IN THE SUBMERGED LITTORAL MACROPHYTE COMMUNITY,
Cape Town Univ. (South Africa). Dept. of Zoology.
B. R. Davies.
Journal of the Limnological Society of Southern Africa, Vol. 8, No. 1, p 33-45, 1982. 6 Fig, 6 Tab, 42 Ref.

Descriptors: *Swartvlei Lake, *South Africa, *Macrophytes, Spatial distribution, Temporal distribution, Coastal waters, Littoral zone, Ecosystems, Invertebrates, Benthic fauna, Species composition.

Swartvlei is the largest of a chain of coastal lakes, lying on the southern tip of Africa, in the Wilderness area between Knysna and George. The lake is oligotrophic, unpolluted, and connected to the Indian Ocean by a shallow meandering estuary. The lake lies on quaternary sands and is of recent origin. Changes which occurred in Swartvlei between 1978 and 1980 were associated with a collapse of the submerged littoral macrophyte community and took the form of a major decline in total standing stocks. This decline was predominantly influenced by a one to two orders of magnitude reduction of the Musculus virgiliae population. A simultaneous change in species composition also took place. Development of epipsammic algal mats subsequent to the die-back of the littoral macrophytes was not sufficient to provide food, and surface area for attachment and shelter from predators and wave action, for the originally predominant suspension-feeding invertebrate community. (Baker-IVI)
W85-04818

FIRE AND HERBIVORY IN A GREAT SALT LAKE MARSH,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2L.
W85-04825

PREDICTING THE EFFECT OF MACROBENTHOS ON THE SEDIMENT/WATER FLUX OF METALS AND PHOSPHORUS,
Connecticut Univ., Storrs. Biological Sciences Group.
For primary bibliographic entry see Field 2K.
W85-04839

RESPONSES OF BENTHIC MACROINVERTEBRATE SPECIES TO MANIPULATION OF INTERSTITIAL DETRITUS IN CARNATION CREEK, BRITISH COLUMBIA,
Calgary Univ. (Alberta). Dept. of Biology.
J. M. Culp, and R. W. Davies.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 1, p 139-145, January, 1985. 6 Fig, 2 Tab, 29 Ref.

Descriptors: *Detritus, *Invertebrates, *Carnation Creek, *British Columbia, Benthic fauna, Ecological distribution, Biomass, Microbial degradation, Interstitial detritus.

Experimental manipulations were conducted in Carnation Creek, British Columbia, to determine the response of macroinvertebrate distribution and abundance to differences in detritus source and quantity. Four treatments (no detritus, low hemlock (Tsuga heterophylla), low alder (Alnus rubra), high alder) with a standardized substrate were established in a riffle and left for 28 d. Densities and/or biomasses of 12 of the 20 colonizing macroinvertebrate taxa were significantly different among the detritus treatments. Microbial activity, detritus processing, and macroinvertebrate abundances were highest in substrate patches with alder detritus. Compared with the no detritus and low hemlock treatments, the low alder treatment increased the abundances of nine taxa and decreased three taxa, while the high alder treatment increased the abundance of six taxa and decreased six taxa. Thus, detritus source and quantity strongly influenced macroinvertebrate community composition within the streambed. Although most of the macroinvertebrates in all treatments were either collector-gatherer or shredder detritivores, these macroinvertebrates responded to changes in detritus in a species-specific manner. Therefore, the Carnation Creek experiments emphasize the importance of interstitial detritus in the substrate as a factor that influences the microdistribution of the benthos at the species, rather than trophic feeding, assemblage level. (Author's abstract)
W85-04841

QUANTIFICATION OF STREAM DRIFT,
Maryland Univ., College Park. Dept. of Zoology.
J. D. Allen, and E. Russek.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 210-215, February, 1985. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Drift, *Invertebrates, *Sampling, Mayflies, Streams, Aquatic animals.

Although the purpose of many drift studies is to describe quantitatively the abundance of drifting invertebrates and make comparisons between seasons or sites, almost no investigations have employed replicate sampling. Drift collections from a Rocky Mountain stream were analyzed in order to investigate the variability of drift sampling. The data were normalized and the variances stabilized for each taxon examined by data transformation. The fourth root transformation was favored for five taxa and the logarithmic transformation for three. Using the 95% confidence limits on 24-h drift density for an abundant mayfly (Baetis bicaudatus), it is found that six to seven replicates are required to obtain 95% CL +/- 50% of the mean. Drift sampling appears to require fewer replicates than benthic sampling for comparable precision. Investigators may fail to replicate drift samples because they elect to sample frequently over 24 h in order to quantify the diel periodicity of drift. However, when comparison between sites or dates is the principal goal, it is recommended that the effort normally put into frequent sampling over 24 h be invested instead in replicated sampling just after dark, when drift normally is greatest. When drift from the first night sample was regresses against total drift from the remainder of the 24-h period, 60-90% of the variation in the latter was predicted from the single nighttime sample. Thus, little information appears to be lost by this recommended procedure. (Author's abstract)
W85-04842

MODELLING WINTER OXYGEN DEPLETION RATES IN ICE-COVERED TEMPERATE ZONE LAKES IN CANADA,
Alberta Univ., Edmonton. Dept. of Zoology.
J. Babin, and E. E. Prepas.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 239-249, February, 1985. 5 Fig, 7 Tab, 34 Ref.

Descriptors: *Oxygen depletion, *Iced lakes, *Alberta, *Manitoba, *Ontario, Mathematical equations, Model studies, Dissolved oxygen, Phosphorus, Productivity, Chlorophyll a, Ice cover.

Winterkill is a common phenomenon in lakes in central Alberta, so considerable interest exists in factors controlling winter oxygen depletion rates (WODR) in these lakes. WODR were determined for 13 lakes in central Alberta during the winter of 1982-83. The lakes are located in central Alberta within a 160-km radius of Edmonton. Just prior to freeze-up, dissolved oxygen levels were surprisingly low in 12 of the 13 lakes. Although dissolved oxygen decreased in all lakes for the first 3.5 mo after freeze-up, the decreases were nonlinear. The highest WODR were observed just after freeze-up. The nonlinear WODR were significantly correlated with two estimates of lake productivity (total phosphorus (TP) and chlorophyll a) but were not significantly correlated with morphometry. When the WODR from the Albertan lakes were treated as linear, to enable a comparison with other studies, correlations were found between WODR and morphometry, and WODR and estimates of summer productivity. These relationships were significantly different from observations by previous investigators who worked on ice-covered lakes in two other regions. To develop a model to predict WODR over a wide range of lake types, estimates of WODR, open-water productivity, and morphometry from 48 lakes in Alberta, Ontario, and Manitoba were combined. Estimates of productivity were stronger single predictors of WODR than morphometry. An equation was developed which permits the prediction of WODR for a greater range of lake types than previous models. (Moore-IVI)
W85-04843

GAS SUPERSATURATION AS A CAUSE OF EARLY SPRING MORTALITY OF STOCKED TROUT,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. A. Mathias, and J. Barica.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 268-279, February, 1985. 6 Fig, 5 Tab, 27 Ref.

Descriptors: *Trout, *Mortality, *Supersaturation, Iced lakes, Dissolved oxygen, Fish stocking, Freezing, Nitrogen, Freeze-out, Gas bubble disease, Fishkill, Ice cover.

Rainbow trout (Salmo gairdneri) fingerlings, stocked through the ice of shallow prairie lakes, experienced high mortality even though algal photosynthesis had returned whole-lake oxygen concentrations to normal levels prior to ice melting. Fish caged beneath the ice showed symptoms of asphyxiation or gas bubble disease, depending on depth. Asphyxiation occurred at oxygen concentrations below 4 mg/L. Total dissolved gas tension is identified as the primary cause of bubble disease and resulting mortality, and the relative contributions of oxygen and nitrogen to total gas tension are demonstrated. Significant mortalities were associated with oxygen relative partial pressures (gas partial pressure relative to total hydrostatic pressure) exceeding 0.2, but only when accompanied by nitrogen relative partial pressures above 1.1. Total relative gas tension under these circumstances exceeded 1.3. An increase in nitrogen partial pressures over the winter was attributed to the physical freeze-out of nitrogen from the ice in shallow lakes where reduction of lake volume due to ice formation is substantial. (Author's abstract)
W85-04844

CELLULAR PHOSPHORUS CONCENTRATION AS A CRITERION FOR TROPHIC STATUS IN RAPIDLY FLUSHED LAKES,
Maine Univ. at Orono. Land and Water Resources Center.
P. D. Uttormark, and M. L. Hutchins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 300-306, February, 1985. 5 Fig, 7 Ref.

Descriptors: *Phosphorus, *Algae, *Trophic level, *Flushing, Lakes, Washout, Mathematical equations, Nutrients, Aquatic plants.

Mass balance equations for calculating steady-state P concentrations have been used to estimate the degree of P abatement necessary to achieve various levels of water quality improvement, including the reduction of algal populations. The relationship between steady-state P values and the severity of problems due to excessive algal growth potentially breaks down for lakes with high flushing rates. For these lakes, cellular losses throught the outlet reduce algal populations to levels below that which could be supported by the amount of P present. By using the steady-state concentration of cellular phosphorus (P) as the indicator of a lake's trophic status, equations are derived that describe the flushing rate at which cellular washout might be expected, and the range of flushing rates in which cellular P concentrations would be reduced significantly below those of total P. Calculated concentrations of cellular P and total P are virtually identical for lakes with flushing rates below about 10/yr; at higher rates they may differ substantially. The transfer of P from available to cellular forms is described by Michaelis-Menten growth kinetics. Periphyton and rooted aquatic plants are not subject to washout, so that problems due to excessive plant growth are possible even though populations of pelagic algae may be reduced. (Moore-IVI)
W85-04846

RADIOTRACER ESTIMATION OF MICROBIAL BIOMASS IN LAKE SEDIMENT,
East-West Environment and Policy Inst., Honolulu, HI.
G. G. Marten.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 373-379, February, 1985. 6 Fig, 20 Ref.

Descriptors: *Carbon radioisotopes, *Biomass, *Microorganisms, *Lake sediments, Radioactive tracers, Marion Lake, British Columbia, Sediments.

The measurement of biomass with radiotracers is based upon the principle that, given sufficient time, a radiotracer will distribute itself throughout an ecosystem in proportion to the element it is tracing. If a carbon tracer is introduced to a sediment core sample, the tracer should eventually distribute itself in proportion to the actively circulating carbon in the core. The vertical distribution of the tracer should reflect the vertical distribution of actively circulating carbon in the sediment core, and the distribution of tracer between particulate and dissolved fractions should reflect the amount of carbon in living biomass compared with other froms of actively circulating carbon. This method was applied to sediment from Marion Lake, British Columbia. Most of the sediment microorganisms were concentrated in the top 2 cm of sediment, where the total biomass of microorganisms was estimated to be 183 micro-g C/sq cm. The radiotracer estimate compared favorably with independent measurements based on ATP and direct microscopic counts of sediment microorganisms. (Moore-IVI)
W85-04848

INFLUENCE OF LIGHT ON THE ALKALINE PHOSPHATASE ACTIVITY OF SELENASTRUM CAPRICORNUTUM (CHLOROPHYCEAE) IN STREAMS,
State Univ. of New York Coll. at Cortland.
R. L. Klotz.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 384-388, February, 1985. 2 Fig, 5 Tab, 34 Ref.

Descriptors: *Selenastrum, *Solar radiation, *Alkaline phosphatases, Streams, Algal growth, Phosphates, Limiting nutrients, Enzymes.

Algae respond to limiting inorganic P conditions by producing alkaline phosphatases which cleave inorganic phosphate groups from certain organic P compounds, making them available to the algae. High alkaline phosphatase activity (APA) does not necessarily indicate P limitation, for there may be sufficient enzyme hydrolyzable phosphate in the water for the algae. Selenastrum capricornutum, originally isolated from a river, was incubated in dialysis chambers in situ in four streams in New York State and analyzed for APA and growth rate. Selenastrum APA increased with the degree of shading. APA was inversely related to total insolation when measured under controlled conditions in the same stream reach. APA was not correlated with stream molybdate reactive phosphorus over the range of concentrations encountered. Selenastrum showed no diel cycle of APA. The phosphorus fraction made available by the activity of alkaline phosphatases, enzyme hydrolyzable phosphorus (measured for the first time in streams), increased the phosphorus supply to organisms with high APA. If APA can be considered a good measrue of P limitation, then the mechanism responsible for increased APA under low light intensity may be linked to P uptake, which is an energy-dependent reaction. (Moore-IVI)
W85-04849

PHYSICAL MODEL OF THE AQUATIC ECOSYSTEM,
Moscow State Univ. (USSR). Dept. of Marine Physics.
V. V. Alekseev, A. O. Kokorin, and M. Ya. Lyamin.
Ecological Modelling, Vol. 25, No. 1/3, p 31-46, October, 1984. 6 Fig, 20 Ref.

Descriptors: *Model studies, *Ecosystems, *Aquatic environment, Dissolved oxygen, Phosphates, Nitrates, Hydrogen ion concentration, Mathematical models.

The basic facts on ecosystems have been obtained by observations in nature. Observation is an essential preliminary in any study but to be most effective, experiments are necessary to obtain as much quantitative information as possible and enable the development of a mathematical model of a given phenomenon. In this paper the experimental ecological installation 'ETECOS' is described. It is a physical model of a freshwater reservoir (36 cu m in volume) with the basin and the air chamber above it isolated from the environment. The results of ecological experiments are presented. It has been possible to obtain a vertical distribution pattern of oxygen, phosphates, nitrates, pH and other hydrochemical parameters, predominantly due to biochemical processes where the role of water dynamics is insignificant. On the basis of the experiments conducted on the ETECOS, a mathematical model was constructed, which imitated the gaseous regime of a freshwater reservoir during the warm spring-summer period. The model took account of the processes of diffusion, photosynthesis, oxidation, sedimentation of algae to the bottom, its growth and die-off. Theoretical data obtained by means of the mathematical model are in good agreement with experimental results. A method of describing the physical and biological processes in a reservoir has been suggested, and some numerical characteristics presented. (Author's abstract)
W85-04850

QUIESCENCE, GROWTH AND SENESCENCE OF EGERIA DENSA IN LAKE MARION,
Clemson Univ., SC. Dept. of Botany.
K. D. Getsinger, and C. R. Dillon.
Aquatic Botany, Vol. 20, No. 3-4, p 329-338, December, 1984. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Elodea, *Lake Marion, *South Carolina, Reservoirs, Macrophytes, Population dynamics, Seasonal variation, Plant growth, Aquatic plants, Aquatic weeds.

The submersed aquatic macrophyte Egeria densa (Brazilian elodea) has become a prominent weed in lakes and rivers of the southeastern US. The life history of the plant, E. densa, and the timing of its growth phases in Lake Marion were investigated. Lake Marion is a 39,366 ha hydroelectric reservoir in the Santee-Cooper River System, located in the coastal plain of South Carolina. It has a mean depth of 4 m and a mean hydraulic retention time of 44 days. Summer plants comprised both aged stems and new parts produced in the spring and summer of 1980. In June, new growth consisted of stems with 1, 2, and 3 degree branches. Quaternary branching occurred from July through September. Autumn was characterized by the production of new branches from summer stems and of new stems from the rootcrowns. Winter was marked by the proliferation of new, short stems (an average of 9.9 per rootcrown). Spring was marked by an acceleration of growth. Aged parts deteriorated rapidly. Prior to penetration of the sediment, roots produced from elevated double nodes were devoid of root hairs, which were produced subsequently. The success of Egeria in South Carolina is a function of its ability to reproduce vegetatively by means of specialized structures such as rootcrowns or double nodes, and to initiate a growth resurgence following sloughing and fragmentation induced by exposure to the stress of elevated surface water temperatures. (Baker-IVI)
W85-04858

BIOLOGY OF BRACHYCENTRUS SUBNUBILUS CURTIS (TRICHOPTERA) IN THE RIVER FROME, DORSET,
Freshwater Biological Association, Wareham (England). River Lab.
R. J. M. Gunn.
Hydrobiologia, Vol. 120, No. 2, P 133-140, January, 1985. 6 Fig, 3 Tab, 23 Ref.

Descriptors: *Caddisflies, *Brachycentrus, *Aquatic weed control, *River Frome, *England, Larval growth stage, Aquatic plants, Macrophytes, Life history studies.

The caddisfly Brachycentrus subnubilus was studied in the River Frome, England. Data were collected on the life-history, oviposition and microdistribution within beds of Ranunculus penicillatus var. calareus. B. subnubilus has one generation each year, with five larval instars. Larvae favor sites beneath the weedbeds for most of the year, migrating to more exposed areas in the spring to pupate. Pupation, emergence, oviposition and eclosion are completed in just over two months. Eggs are usually laid on submerged marginal vegetation but any semi-submerged object may be utilized. Larvae appear to disperse mainly as first instars. Initial development is rapid to fourth instar. Larvae overwinter as fifth instars. Sex ratios show a predominance of males. The weedcutting activity in the River Frome must seriously affect the population of B. subnubilus; each of two weedcuts every year removes about 2/3 of the plant material from 43 km of river. While disturbed larvae may drift and find new sites of attachment, the practice of cutting progressively downstream must cause larvae to be disturbed repeatedly. (Moore-IVI)
W85-04887

NITRATE CYCLING IN LAKE TITICACA (PERU-BOLIVIA): THE EFFECTS OF HIGH-ALTITUDE AND TROPICALITY,
California Univ., Davis. Inst. of Ecology.
W. F. Vincent, C. L. Vincent, M. T. Downes, and P. J. Richerson.
Freshwater Biology, Vol. 15, No. 1, p 31-42, February, 1985. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Nitrates, *Cycling nutrients, *Altitude, *Tropical zone, *Lake Titicaca, *Peru, *Bolivia, Dissolved oxygen, Stratification, Anoxic conditions, Mixing, Nitrification, Denitrification, Lake sediments.

The vertical distribution of dissolved oxygen and inorganic nitrogen differed considerably between three stratification cycles in Lake Titicaca, a tropical lake (latitude 16 degrees S) in the high Andes

(3800 m altitude). In 1980/81 an anoxic layer of water extended from 200 to 275 m and contained high levels of NH4 but zero NO3. During the annual deep mixing period in 1981 this layer was substantially eroded, and was completely eliminated during deep-mixing in 1982. Nitrapyrin assays of nitrification demonstrated highest activity in the surface mixed layer, lowest activity just beneath the thermocline, and then increasing nitrification rates with increasing depth towards the bottom anoxic zone. Denitrification rates were slow, but detectable, in the surficial sediments of Lake Titicaca during late 1982. Much faster rates were estimated for the water column anoxia. Lake Titicaca is a productive lake with low saturation levels of oxygen because of its high altitude. These features favor hypolimnetic anoxia, and thus denitrification which varies in magnitude from year to year. (Author's abstract)
W85-04896

ZOOPLANKTON DYNAMICS IN LAKE MENDOTA: SHORT-TERM VERSUS LONG-TERM CHANGES,
Universidad Autonoma de Barcelona (Spain). Dept. de Microbiologia.
C. Pedros-Alio, and T. D. Brock.
Freshwater Biology, Vol. 15, No. 1, p 89-94, February, 1985. 1 Fig, 2 Tab, 11 Ref. NSF grants DEB 82-12450 and DEB 8012313.

Descriptors: *Zooplankton, *Population dynamics, *Lake Mendota, *Wisconsin, Eutrophic lakes, Standing crop, Crustaceans.

Lake Mendota, Wisconsin is highly eutrophic and has been the object of extensive research over the past 100 years. Data from a study of zooplankton dynamics in Lake Mendota for the years 1976-80 were compared with those of E. A. Birge, obtained in the years 1894-96. The zooplankton annual cycles and sizes of standing crop were similar in both studies. There was more year-to-year variation within each study than there was between the two studies separated by over 80 years. Statistical comparison indicates that 1895 was very diffferent from 1896 and close to 1978. Also, 1976 differed more from 1979 and 1980 than from 1895 and 1896. Certain species were much more common in some years than in others; this indicates the importance of study over a number of years before any conclusions can be made about long-term changes in a lake ecosystem. As far as species of crustacean zooplankton are concerned, Lake Mendota is quite similar now to what it was 80 years ago. (Moore-IVI)
W85-04897

SHREDDER ABUNDANCE AND LEAF BREAKDOWN IN AN APPALACHIAN MOUNTAIN STREAM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
E. F. Benfield, and J. R. Webster.
Freshwater Biology, Vol. 15, No. 1, p 113-120, February, 1985. 3 Tab, 45 Ref.

Descriptors: *Leaves, *Stream order, *Invertebrates, *Shredders, Decomposition, Mountain streams, Feeding rates.

Low-order streams in deciduous woodlands are known to be energetically dependent on leaf material from riparian vegetation. Biological processing of leaf material in most cases follows the general sequence of leaching followed by microbial colonization and conditioning and invertebrate feeding. Breakdown rates of dogwood, red maple and white oak leaves were investigated at two first-order and two second-order sites in an Appalachian Mountain stream. Leaves exposed in mesh bags were sampled on eight occasions over a 207 day period and breakdown rates were compared using an exponential decay model. There was a consistent ranking in leaf breakdown rate within each site, i.e. dogwood > red maple > white oak, and all species broke down faster at second-order than at first-order sites. Shredder number and density were analyzed for a leaf species effect within each site on each sampling date. Shredder number and density were also analyzed for site differences for each leaf species on each sampling date. Significant site effects occurred on about 70% of the dates. When all leaf species were combined at each site, shredder number and density were significantly higher at the two second order sites. Differences in species-specific leaf breakdown rates were apparently largely a function of shredder abundance on the leaves. (Moore-IVI)
W85-04899

MODEL OF DIATOM DYNAMICS IN THE EPILIMNION OF LAKE JEZERO ON THE ISLAND OF KRK,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
T. Legovic, and D. Justic.
Periodicum Biologorum, Vol. 86, No. 3, p 269-276, November, 1984. 5 Fig, 7 Ref.

Descriptors: *Diatoms, *Population dynamics, *Orthophosphates, *Yugoslavia, *Lake Jezero, Primary productivity, Phytoplankton, Epilimnion, Hydrologic budget, Phosphorus.

Lake Jezero is a small and shallow accumulation on the island of Krk (Yugoslavia). Since the lake is largely used for water supply, it is important to assess the main factors controlling primary productivity, which in turn affects the quality of the water. There are two dominant phytoplankton groups in the lake: diatoms and dinoflagellates. A water balance and an orthophosphate-phosphorus balance were calculated. A model explaining dynamics of diatoms versus orthophosphate was constructed. The model includes: uptake of orthophosphate, based on the Michaelis-Menten function and limitation by light; sinking of diatoms; variable inflow of orthophosphate; outflow of orthophosphate and diatoms from the lake. The nominal dynamics of the model reasonably agrees with measured orthophosphate and diatom concentrations. In the model, biomass of diatoms attained a maximum of 1.25 mg p/cu m at the beginning of June, a week earlier than the peak in the data. (Moore-IVI)
W85-04900

EFFECTS OF ECOLOGICAL PERTURBATIONS ON DIATOM DYNAMICS IN THE MODEL OF LAKE JEZERO,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
T. Legovic, and D. Justic.
Periodicum Biologorum, Vol. 86, No. 3, p 277-286, November, 1984. 12 Fig, 6 Ref.

Descriptors: *Diatoms, *Orthophosphates, *Lake Jezero, *Yugoslavia, Lakes, Population dynamics, Mathematical models, Solar radiation, Inflow.

A mathematical model developed to simulate orthophosphate and diatom dynamics in Lake Jezero, Yugoslavia was analyzed at nominal and perturbed states. An assessment is given of the effect that various ecological parameters have on the dynamics of orthophosphate and diatom concentrations in Lake Jezero. The following parameters were analyzed: lake volume, inflow, orthophosphate concentration in the inflow, sinking of diatoms, maximum assimilation rate, half-saturation constant and timing of the light optimum. Special attention was payed to the appearance of two biomass maximums which result as a consequence of an increase of orthophosphate in the inflow, a decrease in half-saturation constant or a delay in optimum light conditions. A general result which follows from perturbation trials is that it is necessary to know ecological properties of the present biological species in the lake as well as the water and phosphorus balance in order to be able to predict the most likely outcome of planned management procedures. (Moore-IVI)
W85-04901

SEDIMENT COMPOSITION, MUD-WATER INTERCHANGES AND THE ROLE OF MACROPHYTES IN DAL LAKE, KASHMIR,
Kashmir Univ., Srinagar (India). Dept. of Botany.
C. L. Trisal, and S. Kaul.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 5, p 671-682, 1985. 7 Fig, 2 Tab, 20 Ref.

Descriptors: *Lake sediments, *Macrophytes, *Mud-water interfaces, *Dal Lake, *India, Cycling nutrients, Nitrogen, Phosphorus, Potassium, Carbon, Seasonal variation, Plant growth, Aquatic plants, Decomposition.

An attempt was made to follow the changes in the concentration of nutrients both in the particulate sediments and water of Dal Lake, Kashmir. Twelve station were selected in different basins of Dal Lake where sediment, water, macrophyte and phytoplankton samples were collected monthly for a year. The particulate phase of lake sediments showed a marked reduction in the concentration of N, P, K and C during late spring and summer. Larger amounts of these elements were found towards the autumn, and these higher levels were maintained through winter until early spring. The reduction in the concentration of these mineral nutrients was greatest during the growing season of the macrophytes considerable quantities of these nutrients are thus released at times of biological growth. These losses from the sediments are not reflectd in increased concentrations of the nutrients in the water. Autotrophic utilization of the nutrients provides a biological sink resulting in their lower concentrations in the sediments. The concentrations of these nutrients in the sediments increase during the fall due to microbial decomposition, adsorption, deposition and subsequent partial mineralization of large quantities of dead plant material. (Moore-IVI)
W85-04904

QUALITATIVE AND QUANTITATIVE ENTOMOFAUNISTIC INVESTIGATION OF AN OPENCAST RESIDUAL LAKE NEAR LEIPZIG (GDR),
Karl-Marx-Univ., Leipzig (German D.R.). Sektion Biowissenschaften.
U. Jacob, B. Klausnitzer, and H. Walther.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 5, p 701-713, 1983. 8 Fig, 6 Tab, 14 Ref.

Descriptors: *Aquatic insects, *Kulkwitz Lake, *Germany (Democratic Republic), *Opencast residual lakes, Lakes, Surface mines, Physicochemical properties, Land reclamation.

The desire to put water-filled lignite opencast residual pits to some practical use makes it necessary to obtain sufficiently exact knowledge of such artificially enclosed waters which, in contrast to the terrestrial landscape left behind after closing down lignite mines, are subject mainly to spontaneous colonization. The Kulkwitz lignite opencast mine in the Leipzig lignite district (German Democratic Republic) was closed down in 1962. The lake was banked up in 1960/61, and its water level is still 3 m below the projected level. The physico-chemical characteristics of the water were recorded and qualitative and quantitative entomofaunistic inventories carried out. A floating emergence trap was used, which caught a total of 8,397 insects above a water area of 2.25 sq m during the summer and autumn of 1979. These insects belong to 12 families and 4 orders. For the littoral, the 3,733 emerging insects/sq m/yr can be considered a minimum. The Chironomidae account for 3,204 of this number, followed by Trichoptera (369), Brachycera, Ephemeroptera, and Odonata. For the Trichoptera, the structure of dominance, diversity and equity are very low due to the eudominance of Ecnomus tenellus. (Moore-IVI)
W85-04906

RESPONSES OF THE PHYTOPLANKTON COMMUNITY OF A TROPICAL RESERVOIR (SAO PAULO, BRAZIL) TO THE ENRICHMENT WITH NITRATE, PHOSPHATE AND EDTA,
Universidade Federal de Sao Carlos (Brazil). Lab. of Limnology.
R. Henry, and J. G. Tundisi.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 6, p 853-862, 1983. 4 Fig, 3 Tab,

25 Ref.

Descriptors: *Nitrogen, *Phosphates, *EDTA, *Phytoplankton, *Lobo Reservoir, *Brazil, Limiting nutrients, Reservoirs, Suspended solids, Chlorophyll a, Trace metals,.

An enrichment experiment was conducted in Lobo Reservoir (Sao Paulo, Brazil) to investigate nitrogen and phosphorus as possible limiting factors and the action of EDTA on phytoplankton growth. Samples of surface water from the oligotrophic region of the reservoir with their phytoplankton populations were placed in flasks. KNO3, KH2PO4 and EDTA were added at two concentrations. After 14 days of in situ incubation, the amounts of suspended matter and chlorophyll a, the carotene/chlorophyll ratio, and the phytoplankton cell counts were recorded for all the water samples. The addition of nitrate and phosphate to water samples produced significant effects on the chlorophyll a and cell counts, while EDTA acted only on the cell production. Both nitrate and phosphate, when analyzed individually, caused a decrease in the value of the carotene/chlorophyll ratio. There was synergistic effect of the addition of EDTA and N on the suspended matter. A three-way interaction of enrichment by EDTA + N + P was responsible for a significant increase in cell counts. The EDTA probably made trace metal chelation and assimilation possible. This did not affect chlorophyll biosynthesis. (Moore-IVI)
W85-04908

BLUE-GREEN DOMINANCE IN LAKES: THE ROLE AND MANAGEMENT SIGNIFICANCE OF PH AND CO2,
Minnesota Univ., Minneapolis. Limnological Research Center.
J. Shapiro.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 765-780, 1984. 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Cyanophyta, *Chlorophyta, *Carbon dioxide, *Hydrogen ion concentration, Nutrients, Water circulation, Lakes, Lake management, Competition, Cyanophages.

Field and laboratory experiments show that when nutrients (N and P) are added to a mixed population of algae, blue-greens predominate. However, if CO2 is added also, or if pH is lowered with HCl, greens predominate. The phenomenon is reproducible, and works with most lakes. Although most successful at pH 5.5, the shift to greens can be made to happen at pH values as high as 8.5. Most blue-greens appear to susceptible to the shift, and Scenedesmus and Chlorella are the predominant greens resulting. If pH is raised, the shift is reversed. The reason for the shift is not known. It may involve competiüon by the algae for CO2, but other evidence suggests that the lowered pH stimulates cyanophage production and lysis of the blue-greens, with release of nutrients which then are used by the greens. Analysis of results of lake circulation data from the literature and from experiments suggests that the algal shifts resulting from circulation may involve the same phenomena. Understanding of these phenomena should lead to predictable use of circulation as a lake-management tool. (Author's abstract)
W85-04909

EXPERIMENTAL LAKE FERTILIZATION IN THE KUOKKEL AREA, NORTHERN SWEDEN. PHYTOPLANKTON BIOMASS AND ALGAL COMPOSITION IN NATURAL AND FERTILIZED SUBARCTIC LAKES,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
S. K. Holmgren.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 781-817, 1984. 7 Fig, 16 Tab, 81 Ref.

Descriptors: *Phytoplankton, *Biomass, *Subarctic lakes, *Algae, *Nutrients, Sweden, Nitrogen, Phosphorus, Species composition, Seasonal variation, Wind, Solar radiation, Water temperature.

Four small subarctic lakes in the Kuokkel area near Abisko in northern Sweden were used to study the effects of artificially increased N and P loadings. Based on 500 quantitative algal analyses from 1971-1980, the seasonal variations of phytoplankton biomass and species diversity were evaluated. Seasonal average phytoplankton biomass was positively correlated to nutrient concentrations and negatively to wind speed, while no correlations were found with temperature, insolation, and length of the vegetation period. Enrichment with P alone did not cause any biomass increase and inhibited dinoflagellates and Dinobryon. Enrichment with N alone stimulated Uroglena and Gymnodinium and the biomass increased. No species were inhibited. Enrichment with both N and P made the biomass increase 50-60 times. In all fertilized lakes monocultures of chlorococcal green algae finally developed. When the fertilizations ceased the algal biomass and species composition returned to close to normal by the next year. When nutrients are available, the phytoplankton in subarctic lakes can build up to about the same biomasses as in temperate and tropical lakes, in spite of low temperature, poor light conditions, and a short vegetation period. (Moore-IVI)
W85-04910

COMPARISON OF PLANKTON-WATER CHEMISTRY RELATIONSHIPS IN THREE ACID STRESSED LAKES IN NOVA SCOTIA, CANADA,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
A. C. Blouin, P. A. Lane, T. M. Collins, and J. J. Kerekes.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 819-841, 1984. 2 Fig, 7 Tab, 37 Ref. Canadian Wildlife Service contracts OSC80-00057, OSC81-00129 and OSC81-00210.

Descriptors: *Plankton, *Acid precipitation, *Kejimkujik Lake, *Pebbleloggitch Lake, *Beaverskin Lake, *Nova Scotia, Oligotrophic lakes, Dystrophic lakes, Chemical properties, Algae, Zooplankton, Biomass.

A field program was conducted in 1980 and 1981 on three lakes in Kejimkujik National Park, Nova Scotia, to study plankton-water chemistry relationships in a region of potential acid precipitation stress. Among lake and between year comparisons were made. The three study sites represent two different types of lakes. Kejimkujik Lake (pH 4.8) and Pebbleloggitch Lake (pH 4.5) are both high-colored, dystrophic acid lakes. Beaverskin Lake is a clear, oligotrophic lake which is not as acidic (pH 5.4). The phytoplankton of Kejimkujik Lake was dominated by diatoms which Pebbleloggitch Lake was dominated by chlorophytes and chrysophytes, and Beaverskin Lake was dominated by cyanophytes. Kejimkujik Lake had the highest total algal cell volume per liter, and Pebbleloggitch Lake the lowest. Rotifer populations composed the majority of the zooplankton communities, while the crustacean zooplankton were dominated by the acid-tolerant copepod Diaptomus minutus. Kejimkujik Lake had the lowest zooplankton biomass and Pebbleloggitch Lake the highest zooplankton biomass per cu m. A pattern of highest algal density in Beaverskin Lake, but highest zooplankton density in Pebbleloggitch Lake emerged in both years. This is likely an effect of abundant, but unsuitable food (blue-green algae) in Beaverskin Lake and important detrital food resources in Pebbleloggitch Lake in both years. Multiple regression analysis of water chemistry variables with plankton species produce many significant effects, but failed to show clear patterns. Cause and effect relationships in aquatic ecosystems are poorly delineated by such techniques. (Author's abstract)
W85-04911

SEASONAL VARIATIONS IN FOUR BACTERIAL SIZE FRACTIONS FROM A HYPERTROPHIC POND IN TOKYO, JAPAN,
Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
T. Konda.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 843-858, 1984. 8 Fig, 51 Ref.

Descriptors: *Plankton, *Bacteria, *Seasonal variation, Suspended solids, Particulate matter, Microcystis, Biomass.

The planktonic bacterial populations in the surface water of the hypertrophic Himon-ya Pond (Japan) were separated into four fractions (> 35 micro-m, 35-5 micro-m, 5-1 micro-m, and < 1 micro-m) by size fractionation of suspended particles in the water. The seasonal variations in bacterial numbers over a two year period differed for each of the four fractions. The bacterial counts in the >35 micro-m fraction were mainly dependent on the biomass of Microcystis colonies. Their peaks were observed in summer. In the 35-5 micro-m and 5-1 micro-m fractions, several peaks in bacterial numbers were observed, influenced by the quality and quantity of the particles associated with the bacteria. The bacterial counts in the < 1 micro-m fraction contributed a high proportion of the total throughout all seasons except summer. (Author's abstract)
W85-04912

COLORADO COOPERATIVE FISHERY RESEARCH UNIT STUDIES OF TWIN LAKES, COLORADO: 1980 REPORT OF FINDINGS,
Colorado Cooperative Fishery Research Unit, Fort Collins.
For primary bibliographic entry see Field 5C.
W85-04937

2I. Water In Plants

RAINFALL INTERCEPTION ON A SMALL FORESTED WATERSHED WITHIN THE KAWARTHA LAKES REGION,
Kawartha Region Conservation Authority, Fenelon Falls (Ontario).
T. Mathers, and C. H. Taylor.
Canadian Water Resources Journal, Vol. 8, No. 1, p 120-129, 1983. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Vegetation, *Interception, *Rainfall, *Ontario, Forest watersheds, Throughfall, Stemflow, Rainfall disposition, Trees, Mathematical equations.

Plants that intercept precipitation alter its amount, timing and areal distribution, as well as the quality of the water input to the basin as a hydrologic system. In order to quantify the disposition of precipitation by vegetation within the Kawartha Lakes region (Ontario), precipitation, interception, soil moisture and streamflow data were collected on a small forested watershed from September 13, 1977 to September 12, 1978. The watershed is approximately 47 ha in size. Trees cover approximately 60% of the total basin area. The remainder of the basin consists of open pasture and cultivated fields. Interception was determined by measuring throughfall and stemflow, sampling 18 storms. Regression equations were developed to describe the atmospheric and surface characteristics influencing interception. Gross rainfall was the only independent variable significantly correlated with throughfall. During the dormant season, gross rainfall was also the only independent variable significantly correlated with stemflow. During the growing season, both duration and gross rainfall were significantly correlated with stemflow. Approximately 12% of gross rainfall is intercepted and returned to the atmosphere. While this amount does not appear to be of major hydrologic important it must be recognized that interception and the redistribution of precipitation by vegetation can be an important part of the water budget and could significantly affect water yield. (Moore-IVI)
W85-04578

COMPARISON OF FIELD- AND LABORATORY-MEASURED AND PREDICTED HYDRAULIC PROPERTIES OF A SOIL WITH MACROPORES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.

W85-04617

STREAM WATER LEVELS AFFECT FIELD WATER TABLES AND CORN YIELDS,
Agricultural Research Service, Florence, SC.
For primary bibliographic entry see Field 2F.
W85-04726

WATER-TABLE CONTRIBUTION TO ALFALFA EVAPOTRANSPIRATION AND YIELDS IN SANDY SOILS,
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 2D.
W85-04727

CORN SILAGE RESPONSE TO SUBSURFACE DRAINAGE ON ALLUVIAL SOIL,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W85-04738

STOMATAL RESPONSES TO LEAF WATER POTENTIALS OF DRIP IRRIGATED PEACH (PRUNUS PERSICA),
Tarleton State Univ., Stephenville, TX.
J. F. Punthakey, M. J. McFarland, and J. W. Worthington.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1442-1449, September-October, 1984. 8 Fig, 1 Tab, 46 Ref.

Descriptors: *Drip irrigation, *Leaves, *Water potential, *Stomata, Peach trees, Water stress, Transpiration, Leaf resistance.

This study evaluated the effect of varying levels of water stress on leaf resistance, leaf water potential and transpiration of drip irrigated peach (Prunus persica (L.) Batsch). Leaf resistances were significantly higher for the 1-emitter tree indicating it to be the most severely stressed. Leaf water potential and transpiration rates were also lower in these trees. Leaf resistances decreased exponentially with increasing solar radiation and curvilinearly with increasing vapor deficit. Stomata responded slower in stressed trees. Leaf resistances were lower at leaf water potential above -20 bars and increased at leaf water potential below -21 for the well watered trees. In stressed trees the threshold value was lowered to -25 bars. Leaf resistance and leaf water potential decreased until its threshold value, after which both increased. (Author's abstract)
W85-04746

D/H RATIOS OF SAP IN TREES: IMPLICATIONS FOR WATER SOURCES AND TREE RING D/H RATIOS,
Lamont-Doherty Geological Observatory, Palisades, NY.
J. W. C. White, E. R. Cook, J. R. Lawrence, and W. S. Broecker.
Geochimica et Cosmochimica Acta, Vol. 49, No. 1, p 237-246, January, 1985. 3 Fig, 6 Tab, 18 Ref. NSF grant ATM 83-13954.

Descriptors: *Water sources, *Trees, *Hydrogen isotopes, Deuterium, Rainfall, Seasonal variation, Groundwater, Soil water, Tree rings, Plant physiology, Plant tissues.

The source water for trees with access to groundwater (which includes soil moisture) is a mixture of growing season rain, and groundwater. The relative amounts of growing season rain and groundwater taken up by a tree can be quantified. Trees on sites with insignificant inputs of groundwater and soil moisture have been found. Measurements of D/H ratios of tree sap can be used to determine the source water for a tree. Based on these measurements, trees can be separated into three categories: those which rely solely on summertime rainfalls, those which rely solely on groundwaters, and those which use both water sources. For trees in the last category, D/H ratios of sap can be used to quantify the relative contributions to the tree's source water of summertime rainfalls and groundwaters. These measurements can be used to select trees for ring isotope studies. Single source trees, those which rely solely on summertime rain or groundwaters appear to be the best choices for measuring long records of tree ring D/H ratios. (Baker-IVI)
W85-04758

SENSITIVITY OF STONE FRUIT ROOTSTOCKS TO WATERLOGGING,
Fruit and Food Technology Research Inst., Stellenbosch (South Africa).
P. J. Stassen, and H. J. Vanzyl.
Deciduous Fruit Grower (Cape Town), Vol. 32, No. 7, p 270-271 and 274-275, 1982. 1 Fig, 1 Tab, 10 Ref. (in Afrikaans and English).

Descriptors: *South Africa, *Waterlogging, *Plant growth, Fruit crops, Root zone, Trees, Sensitivity, Soil water.

Die-back of stone fruit trees in particular is a very common phenomenon in the Western Cape area. The two main causes of die-back are bacterial canker and too much groundwater. Seven rootstocks commonly used for growing stone fruits in the Western Cape were subjected to waterlogged conditions to determine their relative sensitivity to waterlogging. Royal and Nemaguard were the most sensitive to waterlogged conditions, followed by Kakamas, Varkperske and Du Plessis. Myrobalan was considerably more resistant to waterlogging and Marianna most resistant of all. Thus Royal and Nemaguard cannot be considered at all as rootstocks on soils where there is any likelihood of waterlogged conditions. Marianna, on account of its shallow root system, is admittedly able to use an uncompacted and well aerated topsoil layer of 20-30 cm well and can perform optimally in a depth of 45 cm. Practices such as ridging may also be applied to improve the effective depth of shallow soil. Apricot rootstock requires a well aerated soil depth of 60 cm and peach rootstock one of 90 cm. Due to its shallow root system Marianna is more sensitive to ineffectual irrigation and malnutrition on deep sandy soils than peach rootstock. (Baker-IVI)
W85-04812

COARSE FRACTION OF SOILS: THE ROLE IT PLAYS IN PLANT NUTRITION, LIMING AND IRRIGATION,
For primary bibliographic entry see Field 2G.
W85-04823

WATER RELATIONS OF JAMAICAN UPPER MONTANE RAIN FOREST TREES,
Washington Univ., St. Louis, MO. Dept. of Biology.
V. Kapos, and E. V. J. Tanner.
Ecology, Vol. 66, No. 1, p 241-250, February, 1985. 6 Fig, 2 Tab, 41 Ref.

Descriptors: *Rain forests, *Plant water potentials, *Jamaica, Leaves, Plant growth, Drought resistance, Leaf temperature, Leaf resistance, Solar radiation, Xeromorphic leaves.

The water relations of an upper montane rain forest at an elevation of about 1550 m in the Blue Mountains of Jamaica were studied to investigate whether the growth of the forest is limited by water shortage and/or whether the characteristically hard, leathery leaves of tropical montane rain forest trees are an adaption to water shortage. Daily courses of leaf water potential, leaf relative water content, leaf resistance, and leaf temperature were followed for nine tree species at the driest time of year. The lowest leaf water potential measured was -1.7 MPa. Leaf resistance was usually low and rarely showed increases that might be attributed to water shortage; it was significantly correlated with light levels. Leaf relative water content was always > 86% and was not correlated with leaf water potential. Leaf sublethal water deficits (SLD) averaged 27% (12 species). There was no relationship between SLD and leaf structural characteristics. Water supply rarely, if ever, seriously limits the growth of these montane forests and their xeromorphic leaves are not an adaptation to water limitation. (Author's abstract)
W85-04824

THROUGHFALL AND STEM FLOW IN MATURE AND YEAR-OLD WET TROPICAL FOREST,
Florida Univ., Gainesville. Dept. of Botany.
J. W. Raich.
Tropical Ecology, Vol. 24, No. 2, p 234-243, Winter, 1983. 2 Fig, 3 Tab, 30 Ref.

Descriptors: *Throughfall, *Stem flow, *Tropical forests, *Costa Rica, Rainfall, Trees, Palm trees, Interception, Succession, Tropical regions, Forests.

Rainfall in the open, throughfall, and stem flow were measured over a six-month period in mature lowland wet forest and a nearby one-year-old successional area of Costa Rica. Throughfall was highly variable both from day to day and from point to point within both sites, but averaged 52% of rainfall in the forest and 68% in the young successional area. Despite the rainy environment, some microsites consistently received no precipitation. Stem flow in the forest averaged 9% of rainfall; 92% of this was collected by palm trees, and > 74% was collected by trees < 10 cm in diameter. Stemflow in the young successional area averaged 4% of rainfall, of which 61% was collected by monocotyledons. Interception of rainfall was greater in the forest than in the successional area by about one-third. The large amount of interception by the one-year-old vegetation is attributed to the rapid development of a high leaf area, and indicates a very rapid functional recovery of the community. (Author's abstract)
W85-04853

WATER AND NUTRIENT OUTFLOW FROM CONTRASTING LODGEPOLE PINE FORESTS IN WYOMING,
Wyoming Univ., Laramie. Dept. of Botany.
D. H. Knight, T. J. Fahey, and S. W. Running.
Ecological Monographs, Vol. 55, No. 1, p 29-48, March, 1985. 13 Fig, 5 Tab, 88 Ref. NSF grants DEB 78-050311, DEB 80-11024 and DEB 81-13546.

Descriptors: *Nutrients, *Water, *Forest hydrology, *Pine trees, *Wyoming, Evapotranspiration, Habitats, Nitrogen, Transpiration, Snowmelt, Water quality, Hydrographs, Succession, Logging.

Factors affecting water and nutrient outflow beyond the rooting zone were studied during a 3 yr period using data from eight contrasting stands of lodgepole pine forest in southeastern Wyoming and the output of a hydrologic simulation model based on tree physiology. Nutrient outflow during a specific time period was estimated by multiplying simulated water outflow times element concentrations in the soil solution, the latter determined from samples collected periodically near the bottom of the rooting zone. The results indicate that stands differing in site or habitat type experience different rates of water and element losses at different times during the snow melt season, and contribute differentially to streamwater quality and hydrograph shape. Factors affecting outflow are discussed in the context of successional trends, common perturbations including timber harvest, and hypotheses pertaining to nutrient conservation in terrestrial ecosystems. Nutrient retention in the snow-dominated lodgepole pine ecosystem appears to be primarily dependent on evergreen leaf area, duration of the vernal transpiration period, and high carbon/nutrient ratios of the forest floor. (Baker-IVI)
W85-04882

EFFECTS OF SOIL WATERLOGGING ON THE ENERGY STATUS AND DISTRIBUTION OF SALIX NIGRA AND S. EXIGUA (SALICACEAE) IN THE ATCHAFALAYA RIVER BASIN OF LOUISIANA,
University of Southwestern Louisiana, Lafayette. Dept. of Biology.

C. P. Dionigi, I. A. Mendelssohn, and V. I. Sullivan.
American Journal of Botany, Vol. 72, No. 1, p 109-119, January, 1985. 5 Fig, 5 Tab, 44 Ref.

Descriptors: *Willows, *Waterlogging, *Atchafalaya River Basin, *Louisiana, Ecological distribution, Plant water potential, Leaves, Flood tolerance, Water stress, Soil-water-plant relationships, Drought tolerance.

The influence of soil waterlogging on the distribution and energy status of Salix nigra and S. exigua were studied in the field and laboratory. Differential flooding in natural stands of Salix spp. and under controlled conditions in the greenhouse demonstrated that S. nigra was more tolerant of waterlogged soil conditions than was S. exigua. Salix nigra exhibited a significantly higher leaf energy status and greater ability to oxidize waterlogged soil when flooded than did S. exigua. However, S. exigua appeared to be more tolerant of moisture stress than S. nigra as indicated by the significantly higher leaf resistances to water vapor exchange and higher leaf water potentials of S. exigua. These data support the theory that the reason S. nigra inhabits lower elevations sites than S. exigua in the Atchafalaya River Basin may be the differential tolerance of these two species to soil waterlogging on one extreme and moisture deficiencies on the other. (Author's abstract)
W85-04943

2J. Erosion and Sedimentation

KINEMATIC STRUCTURE OF FLOW IN A TRAPEZOIDAL CHANNEL,
For primary bibliographic entry see Field 8B.
W85-04421

INVESTIGATION OF THE STABILITY OF RIVER AND CANAL CHANNELS,
I. S. Kuul'.
Hydrotechnical Construction, Vol. 18, No. 3, p 128-132, March, 1984. 6 Fig, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 27-31, March, 1984.

Descriptors: *Channel scour, *Channel erosion, *Channels, *Canals, Stability, *Volga River, *USSR, Hydraulics, River beds, Erosion.

Analysis of hydraulic and hydrologic data from the Volga-Akhtuba floodplain and the Volga delta shows that the rate and extent of channel deformations depend not only on the flow velocity but also on the rate of rise and fall of stages and other factors. The data indicate a decrease of the erosion resistance of the bed depositions after recession of the flood. This is related to a change in the physical, mechanical, and strength properties of the soils during passage of the flood. On the falling limb of the flood, the lifting forces of the turbulent channel flow and vertical component of the buoyant uplift pressure are added to the other forces, as a result of which the channel soils are decompressed and lose their structural strength and erosion resistance. (Keenan-IVI)
W85-04422

CONSIDERATION OF SEDIMENT TRANSPORT WHEN CALCULATING LOCAL SCOUR,
G. A. Arkhipov.
Hydrotechnical Construction, Vol. 18, No. 4, p 149-153, April, 1984. 5 Fig, 1 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 14-16, April, 1984.

Descriptors: *Bridges, *Design criteria, *Scour, *Sediment transport, Mathematical equations, Piers, Flow paths, Sediment erosion, Velocity, Currents.

To study the general picture of flow past a cylindrical pier, visual observations were carried out by means of a colored liquid released through a special movable needle attached on the rod of a point gauge. A study of the paths of the flow around the pier shows that in the front of any face on the axis of symmetry the flow is stratified into through-going and descending currents. The descending currents form reversed currents in the form of rollers with a horizontal axis of rotation. The most intense is the bottom roller which scours the bottom in the region of the front part of the pier, forming a scour zone, the boundary of which depends on the velocity of the oncoming flow, width of the pier, and material composing the channel. Scour occurs in the region of the front part of the pier, and the remaining part of the pocket forms due to sliding of the slope of the local scour pocket. The sediment sliding into the scour zone is removed by the bottom currents. The depth of the local scour pocket was calculated by several formulas and results were compared with actual data. A formula was developed which gives satisfactory results, and can be recommended for use when designing bridges. (Baker-IVI)
W85-04427

WATERSHED REHABILITATION PROGRAM RELATED TO THE MANAGEMENT OF RIVER AND RESERVOIR SEDIMENTATION IN INDONESIA,
Ministry of Forestry, Djakarta (Indonesia).
For primary bibliographic entry see Field 4D.
W85-04438

RESERVOIR SEDIMENTATION IN INDIA -- ITS CAUSES, CONTROL, AND FUTURE COURSE OF ACTION,
Land Use Consultants (International), New Delhi (India).
For primary bibliographic entry see Field 6G.
W85-04439

MANAGMENT OF SEDIMENTATION IN BANGLADESH,
Bangladesh Water Development Board, Dacca.
G. R. Choudhury.
Water International, Vol. 9, No. 4, p 155-157, December, 1984.

Descriptors: *Sedimentation, *Bangladesh, *Management, Floods, Bay of Bengal, Ganges River, Brahmaputra River, Meghna River, Channel migration.

Bangladesh lies in the southeast corner of the south Asian subcontinent, having an area of 144000 sq km and has within her territory the confluence of the three great river systems - the Ganges, the Brahmaputra and the Meghna. Each year during the flood season the waters overtop the banks and flood some 30% of the total land area of Bangladesh. The country being flat, the horizontal and vertical tides from the Bay of Bengal penetrate far inland. Past and present changes of hydrological setting are reviewed. The sediment movement process in Bangladesh is studied from the following aspects: sedimentation as a channel process, bank caving and channel migration, sedimentation and its effect on distributaries, and sedimentation in the tidal flood plains. (Baker-IVI)
W85-04440

SEDIMENTATION IN NEW ZEALAND HYDROELECTRIC SCHEMES,
Ministry of Works and Development, Wellington (New Zealand).
I. Jowett.
Water International, Vol. 9, No. 4, p 172-176, December, 1984. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Sedimentation, *New Zealand, *Hydroelectric projects, Erosion control, Reservoir storage, Reservoir sedimentation, Sediment managment.

Sedimentation of New Zealand hydroelectric reservoirs has not been a great problem mainly because development has concentrated on rivers where a large proportion of the sediment is trapped by large upstream lakes. Catchments of major schemes have yielded less than 200 t/sq km of sediment annually. Smaller schemes have encountered problems when catchment sediment yields approach 2000 t/sq km/yr and fortunately no schemes have been built on the few New Zealand catchments eroding at rates approaching 20,000 t/sq km/yr. The annual cost of regaining reservoir storage lost through sedimentation can be high. The cost of maintaining reservoir intakes free of sediment is not so high as low level sluices of reasonable discharge capacity are installed and used to pass sediment during floods. The extra costs incurred are for abrasion resistant linings and the cost difference between sluice and alternative spillway designs. Environmentally the effects of sediment on the management of reservoirs have not been great. Sluicing of sediment from reservoirs or settling basins creates a problem for recreational users and benthic invertebrates but both recover quickly. Planning for and management of sediment is a long-term problem. (Baker-IVI)
W85-04445

SEDIMENT STORAGE AND TERRACE FORMATION IN COYOTE GULCH BASIN, SOUTH-CENTRAL UTAH,
California Univ., Santa Cruz. Dept. of Earth Sciences.
P. J. Boison, and P. C. Patton.
Geology, Vol. 13, No. 1, p 31-34, January, 1985. 4 Fig, 17 Ref. NSF grants EAR 77-23025, EAR 81-00391 and EAR 81-19981.

Descriptors: *Coyote Gulch, *Utah, *Sediment storage, *Terraces, Alluvial deposits, Stratigraphy, Fluvial sediments, Sedimentation, Streams, River basins.

Coyote Gulch and its major tributaries, Big Hollow Wash, Hurrican Wash, and Dry Fork, drain an area of 373 sq km on the western side of the Escalante River basin. The basin is characterized by high gradient ephemeral stream channels and slopes ranging from 0.005 to 0.018 m/m. Runoff occurs during the spring from snowmelt on the Kaiparowits Plateau and during the summer and fall from high-intensity localized thunderstorms. The stratigraphic data from the Coyote Gulch drainage document rapid aggradation of a stream system resulting from sediment loading in the headwaters of a drainage. This large volume of sediment was subsequently incised, creating in the process two terraces in upper Coyote Gulch and as many as three terraces in Dry Fork. The terraces differ in number, morphology and sedimentology, depending on their location within the drainage network. Aggradation began about 2300 B.P. and lasted for about 1300 yr. The major period of aggradation in the Dry Fork was not continuous but was interrupted by incision, presumably when a higher gradient sand-transporting stream was established across this fill. Beginning about 900 B.P. this alluvium was incised, creating two terraces in upper Coyote Gulch which eventually incised to form a single terrace. Rapid sediment loading thus produced different fluvial responses depending on the location of a channel segment in the drainage network. Such studies can provide insight into the magnitude and rate of sediment storage in stream valleys as well as the timing and processes by which sediment is ultimately transported out of a basin. (Baker-IVI)
W85-04646

SEDIMENTOLOGY AND GEOCHEMISTRY OF MODERN SEDIMENTS IN THE KINGSTON BASIN OF LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W85-04714

RANGELAND EROSION MEASUREMENTS FOR THE USLE,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. W. Johnson, M. R. Savabi, and S. A. Loomis.
Transactions of the American Society of Agricultural Engineers, p 1313-1320, 1984. 2 Fig, 7 Tab, 29 Ref.

Descriptors: *Erosion, *Rangeland, *Idaho, *Nevada, *Erodibility, Simulated rainfall, Sagebrush, Shadscale, Range management.

A rotating-boom rainfall simulator was used on sagebrush and shadscale rangeland sites in southwest Idaho and north-central Nevada to obtain USLE soil erodibility, K, and cover-management, C, factor values. A good relationship, r squared = 0.89, was obtained between measured soil loss from tilled simulator plots at four different sites and predicted soil loss using the USLE soil erodibility nomograph. However, relationships between soil loss predictions using a cover-management subfactor procedure and soil loss measurements using the rainfall simulator were in poor agreement, r squared = 0.27, for all vegetated plots combined. Soil loss from simulation on plots ungrazed for ten years was consistently less than predicted, and plots on one site clipped of all standing vegetation produced more soil loss than predicted. Thus, the variability in predicted soil losses from sagebrush rangelands indicates a need for more accurate quantification of cover and management conditions. (Author's abstract)
W85-04728

PERFORMANCE OF GRASS FILTERS UNDER LABORATORY AND FIELD CONDITIONS,
Mississippi State Univ., Mississippi State. Dept. of Agricultural and Biological Engineering.
J. C. Hayes, B. J. Barfield, and R. I. Barnhisel.
Transactions of the American Society of Agricultural Engineers, p 1321-1331, 1984. 8 Fig, 6 Tab, 17 Ref, 1 Append.

Descriptors: *Erosion, *Sediment transport, *Runoff, *Model studies, *Grasslands, *Filtration, Sediment trapping, Deposition, Particle size.

A design model was demonstrated that estimates the filter effectiveness of grass subjected to sediment-laden runoff. A number of laboratory and field studies indicate that this model possesses the capability of serving as a working tool for estimating the fraction of sediment trapped and outflow concentration as a function of inflow hydraulic and sediment conditions. Additional necessary inputs for the model include the dimensions of the filter and vegetation. Analysis of complex situations, such as where either the channel slope or grass characteristics change along the filter length, is possible. An additional feature of the model is the capability to recalculate particle size distribution as a function of the sediment trapped in the filter. The developed relationships include the terms which would be anticipated to play an important role in filter phenomenon. Evaluation of the model based on verification studies using real grasses in laboratory flumes and in outdoor channels is described. The results from each set of tests indicated that more than 94% of the inflow sediment load was typically accounted for by this design. (Author's abstract)
W85-04729

CHEMICAL FLOCCULATION FOR SUSPENDED SOLIDS REMOVAL AT REMOTE MINE SITES,
Commonwealth Technology, Inc., Lexington, KY.
For primary bibliographic entry see Field 5D.
W85-04730

SEDIMENT DETENTION POND MODEL USING CSTRS MIXING THEORY,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5E.
W85-04731

PREDICTION OF SOIL EROSION BY WATER AND WIND FOR VARIOUS FRACTIONS OF COVER,
Missouri Univ.-Columbia. Dept. of Agricultural Engineering.
J. M. Gregory.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1345-1350 and 1354, September/October 1984. 5 Fig, 26 Ref.

Descriptors: *Soil erosion, *Wind erosion, *Rain, *Residue cover, *Crop canopies, Prediction, Mathematical equations.

Crop canopies and residues provide cover that reduces soil loss by water and wind erosion. An attempt is made to provide a model to explain how residue cover reduces soil detachment by raindrops and wind. Four concepts were used to develop equations to predict relative soil loss as a function of residue and canopy cover. Reductions in soil erosion due to canopy, residue and standing water were predicted based on the reduction in kinetic energy reaching the soil. Equations were derived for the effect of canopy and residue and for cover by standing water. The equations were combined into one equation to predict rates of soil loss relative to bare soil conditions. Comparisons were made between predictions and measured data reported in the literature. The final equations for erosion by water and wind are very similar and relatively easy to use. Both should be useful in evaluating the reduction in soil loss by canopy and residue cover. (Baker-IVI)
W85-04732

METHOD OF MEASURING AGGREGATE STABILITY UNDER WATERDROP IMPACT,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
R. A. Young.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1351-1354, 1984. 2 Fig, 1 Tab, 23 Ref.

Descriptors: *Soil erosion, *Rain, *Aggregate stability, Rill erosion, Interrill erosion, Soil properties, Clay, Organic matter, Sediment yield, Erodibility.

Soil erosion is the end result of two physical processes - the detachment of soil particles from a soil mass and the transport of these particles away from the point of detachment. A laboratory method has been developed to characterize the susceptibility of a soil to rill or interrill erosion. Tests showed the effectiveness of this measurement as an index of type or erodibility. The presence of high organic matter and high clay content have been inversely related to the susceptibiliy of soil to rill erosion and interrill erosion, respectively. Crofton silt loam, which is a loess soil with only 0.5% organic matter but relatively high clay content, had the smallest mean weight diameter of the five soils after wet sieving alone, indicating that it was the least stable soil when subjected to slaking. It was relatively stable under drop impact forces. Barnes loam had almost 6% organic matter, but less clay than Crofton. Barnes loam, under natural rainfall conditions, forms very few significant rills and most of the detached soil originates in the interrill area. Crofton silt loam is characterized by severe rilling even under moderate rainfall. Once the ratio of interrill erosion to rill erosion is known, it can be used to partition the rill and interrill erodibility factors in current erosion and sediment yield equations more accurately. (Baker-IVI)
W85-04733

RUNOFF AND SEDIMENT TRANSPORT WITHIN AND FROM SMALL AGRICULTURAL WATERSHEDS,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. M. Hamlett, J. L. Baker, S. C. Kimes, and H. P. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1355-1363 and 1369, September-October, 1984. 3 Fig, 4 Tab, 22 Ref.

Descriptors: *Sediment transport, *Agricultural runoff, *Runoff, *Iowa, Precipitation distribution, Tillage, Soybeans, Corn, Moldboard plowing, Disking, Rainfall-runoff relationships, Cultivation.

Precipitation, runoff, and sediment loads for six nested watersheds in a heavily row-cropped region in east-central Iowa were investigated. Spatial and temporal variations in precipitation were substantial. The watershed with the more intensive and/or most recent tillage had the least runoff except during severe events when rainfall-runoff amounts from the smaller, field-sized watersheds were nearly identical. The peak suspended-sediment concentrations preceded or occurred simultaneously with peak runoff rates. The storm-weighted sediment concentrations were generally greater for the watershed in soybeans which was moldboard plowed than for the watershed in corn which was disked. However, annual sediment loss was greater from the corn watershed than from the soybean watershed, except during severe storms when rainfall-runoff was comparable. The permanent pasture had neglible runoff and sediment losses. Sediment load decreased when comparing the field, intrabasin, and stream locations. Sediment deposition in pondage areas was often substantial. (Author's abstract)
W85-04734

HYDROLOGY AND SEDIMENTOLOGY WATERSHED MODEL. PART I: OPERATIONAL FORMAT AND HYDROLOGIC COMPONENT,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W85-04735

HYDROLOGY AND SEDIMENTOLOGY WATERSHED MODEL. PART II: SEDIMENTOLOGY COMPONENT,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W85-04736

TILLAGE INFLUENCES ON EROSION DURING FURROW IRRIGATION,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4C.
W85-04749

COMPOSITION AND POSSIBLE ORIGIN OF DETRITAL MATERIAL IN STREAMS,
Oregon State Univ., Corvallis. Dept. of Forest Science.
P. Sollins, C. A. Glassman, and C. N. Dahn.
Ecology, Vol. 66, No. 1, p 297-299, February, 1985. 1 Tab, 14 Ref. NSF grant DEB 81-12455.

Descriptors: *Detritus, *Stream sediments, *Chemical composition, Oregon, Organic matter, Particulate matter, Density, Floodplains, Wood, Leaves, Soil, Carbon, Nitrogen, Aluminum, Iron, Manganese.

Stream detritus consists in part of fragmented plant material, microbial biomass and by-products, and precipitated dissolved organic material. Streams, however, also transport and store mineral-soil particles on which large amounts of organic matter are already adsorbed when the particles enter the stream. Density fractionation is used to provide initial data on the composition of detritus from several small streams in Oregon. Density and chemistry of the stream and floodplain detritus are compared with those of materials that might serve as a source for the detritus: soil from the forest adjacent to the floodplain and submerged waterlogged wood and foliage. Most of the foliage (91%) and submerged wood (99%) was light material (F1 and F2). Every toe-slope soil sample contained >60%of its dry mass in the heaviest fraction (F3), which accounted for 30-80% of the total soil C and 40-85% of the total soil N. Floodplain and pool samples collected by excavation contained nearly all of their dry mass in the heaviest fraction (F3). The heaviest fraction also accounted for most of the C and N in all pool sediment samples. Al, Fe, and Mn concentrations in stream-channel and floodplain F1 and F2 fractions ranged from 0.9 to 2.2% for Al, 0.5 to 4.1% for Fe, and 0.017 to 0.11% for Mn. (Moore-IVI)
W85-04827

CONTRAST IN STREAM-CHANNEL RESPONSE TO MAJOR STORMS IN TWO MOUNTAINOUS AREAS OF CALIFORNIA,
Geological Survey, Menlo Park, CA.
K. M. Nolan, and D. C. Marron.
Geology, Vol. 13, No. 2, p 135-138, February, 1985. 3 Fig, 1 Tab, 31 Ref.

Descriptors: *Storms, *Channel geometry, *California, Mountain streams, Sediment transport, Landslides, Floods, Sediment erosion.

The effects of major storms on the geometry of intermediate- and high-order channels in northwestern California is contrasted with channel changes found in the Santa Cruz Mountains. Northwestern California was subjected to major regional storms in December 1964, December 1972, and March 1975. There was pervasive, long-lasting widening and filling of intermediate- and high order channels as a result of these storms. The Santa Cruz Mountains were subjected to a major flood-producing storm in January 1982. Although the storm was responsible for widespread flooding and damage to man-made features, major channel changes were found only in localized areas after the storm. Sediment delivery in northwestern California during storms overwhelms transport capacities throughout the length of the most intermediate- and high-order channels and causes long-lasting changes in geometry. Sediment delivery during storms in the Santa Cruz Mountains overwhelms transport capacities only in localized reaches. This contrast in channel behavior is at least partially caused by contrasts in the style of landsliding found in the two areas. In northwestern California, a positive feedback loop may exist between hillslope and stream-channel processes. (Moore-IVI)
W85-04836

COMPUTING DEGRADATION AND LOCAL SCOUR,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
E. L. Pemberton, and J. M. Lara.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Guideline, January 1984. 48 p, 12 Fig, 10 Tab, 45 Ref.

Descriptors: *Channel erosion, *Channel scour, *Scour, *Slope degradation, *Model studies, Flow measurement, Streambeds, Flow velocity, Mathematical models, Channel flow, Channel improvement, Erosion, Stream stabilization, Theoretical analysis, Channels, Flood channels, Slope stability.

These guidelines describe methods for computing general river channel degradation and local scour during peak floodflows for use in designing reclamation structures. The Meyer-Peter and Muller, competent bottom velocity, Lane's tractive force, Shields diagram, Yang incipient motion, and depth to armor and volume computation models are used to calculate degradation limited by armoring. The Schoklitsch, Meyer-Peter and Muller, Shields diagram, Lane's tractive force and stable slope and volume computation methods are used to describe degradation limited by a stable slope. Recommendation of a specific method for predicting channel degradation or local scour is difficult because of the complexity and variability of the many factors affecting the erosive action of the channel. It is suggested that several methods be tried before selecting the techniques to be used based upon engineering experience. Descriptions of appropriate bed sampling techniques are included to ensure accuracy in the collection of field data used in the analytical equations.
W85-04934

2K. Chemical Processes

DELTA 13C MEASUREMENTS AS INDICATORS OF CARBON FLOW IN MARINE AND FRESHWATER ECOSYSTEMS,
Indiana Univ. at Bloomington. Dept. of Biology.
B. Fry, and E. B. Sherr.
Contributions in Marine Science, Vol. 27, p 13-47, September, 1984. 4 Fig, 5 Tab, 187 Ref. NASA grant NGR 15-003-118, NSF grant PCM 7910747.

Descriptors: *Carbon radioisotopes, *Marine environment, *Ecosystems, Food chains, Organic carbon, Sediments, Particulate matter, Organic matter, Trophic level, Estuarine environment, Plants, Microorganisms.

Stable carbon isotopic measurements provide useful information about which autotrophs are important sources of carbon in marine and freshwater sediments, particulate organic carbon (POC), and food webs. Transect studies of sediments and POC often show clear-cut patterns of isotopic change that can be directly related to the proximity of various carbon sources; this has led to the use of simple mixing models to indicate the relative importances of plant carbon sources. Isotopic interpretations of delta C-13 data are not always easily made. Potential complications include isotopic changes during plant decomposition and multiple sources of organic matter. Isotopic measurements are particularly valuable in food web studies. Offshore studies of entire natural food webs uniformly indicate a cumulative increase in C-13 with increasing trophic level. Two major ideas have emerged from the use of stable isotope analyses in estuaries: photosynthesis by aquatic microorganisms is often the major source of organic carbon for estuarine POC and sediments; and food webs in salt marshes and seagrass meadows are not uniformly based on detrital macrophytes, but on algae in some locations. Combined with other isotopic and geochemical techniques, stable carbon isotope analysis can provide definitive answers to questions of the origin of fixed carbon in aquatic ecosystems. (Moore-IVI)
W85-04431

GEOCHEMISTRY OF INORGANIC GERMANIUM IN NATURAL WATERS,
Florida State Univ., Tallahassee. Dept. of Oceanography.
P. N. Froelich, G. A. Hambrick, M. O. Andreae, and R. A. Mortlock.
Journal of Geophysical Research, Vol. 90, No. C1, p 1133-1141, January, 1985. 5 Fig, 4 Tab, 56 Ref.

Descriptors: *Germanium, *Silicon, *Geochemistry, *Path of pollutants, Water pollution sources, Granite, Basalt, Spatial distribution.

The distribution of dissolved inorganic germanium in rivers, in the oceans, and in hydrothermal vents and plumes was surveyed. In the ocean, germanium cycling mimics that of silica, since siliceous organisms incorporate Ge as a trace constituent in biogenic opal. The vertical and horizontal distributions of Ge concentrations in seawater are thus identical to those of silica (Ge/Si approximately 0.0000007) and reflect uptake into and dissolution from the frustules of siliceous organisms. Germanium enters the ocean via dissolution of continental and seafloor silicates. The naturally weathered flux from continents to oceans carries a dissolved Ge/Si atom ratio in rivers of about 0.0000007 which reflects the ratio in average continental granites. Rivers draining industrial regions with significant coal combustion are contaminated with Ge leached from fly ash particles, resulting in Ge/Si ratios up to tenfold above the naturally weathered background. The flux to the oceans via high-temperature alteration of seafloor basalts (hot springs) produces a Ge anomaly in hydrothermal plumes over the East Pacific Rise (EPR) crest (20 degrees S). Combining the observed Ge and He-3 anomalies in plumes with He-3/Si observations in hot springs suggests that the Ge/Si hydrothermal flux to the oceans is about 0.000004, near the ratio for average oceanic basalts (approximately 0.0000026). Vent effluents from the Galapagos hot springs measured directly display Ge/Si ratios of 0.000016, suggesting that the ratio is variable between vent fields. Metalliferous sediments accumulating on the EPR crest (17 degrees S) are enriched in germanium, suggesting that a fraction of the hydrothermal germanium source on the rise crest is scavenged into these rapidly accumulating iron and manganese hydroxyoxide phases. (Author's abstract)
W85-04482

LOOSDRECHT LAKES RESTORATION PROJECT: SEDIMENT PHOSPHORUS DISTRIBUTION AND RELEASE FROM THE SEDIMENTS,
Limnologisch Inst., Nieuwersluis (Netherlands).
P. C. M. Boers, J. W. T. Bongers, A. G. Wisselo, and T. E. Cappenberg.
Verhandlung Internationale Vereinigung Limnology, Vol. 22, p 842-847, October, 1984. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Loosdrecht Lakes, *Netherlands, *Lake sediments, *Phosphorus, *Sediment-water interface, Lake restoration, Lakes, Chemical properties, Sediments, Nutrients.

The Loosdrecht Lakes are situated in the center of the Netherlands and are man-created by peat excavation. The lakes are highly eutrophic, with chlorophyll a maxima up to 320 mg/cu m. The main source of pollution of the lakes is a high external P loading, mainly from the river Vecht. The distribution of P in the Loosdrecht Lakes sediment is described together with results of experiments of chemical properties, release rates from sediments and availability for autotrophic growth of this P. At most sampling stations the lower layers of the bottom consist of firm peat, covered by variable amounts of very loose brown mud, accumulating at sheltered places. Chemical extractions proved unsuitable to determine bio-available P. The experimental evidence, collected so far, suggests that in spring considerable amounts of P are released from the Loosdrecht Lakes sediment. It is as yet impossible to estimate the effects of this release on the ecosystem. (Baker-IVI)
W85-04546

SIZE CLASSES OF 'DISSOLVED' NUTRIENTS IN SHALLOW, ALKALINE, HUMIC AND EUTROPHIC TJEUKEMEER, THE NETHERLANDS, AS FRACTIONATED BY ULTRAFILTRATION,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Hann, T. De Boer, J. Voerman, H. A. Kramer, and J. R. Moed.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 876-881, October, 1984. 4 Fig, 13 Ref.

Descriptors: *Limnology, *Lakes, *Lake Tjeukemeer, *Netherlands, *Nutrients, Chlorides, Ultrafiltration, Eutrophic lakes, Seasonal variation, Dissolved solids, Silicon, Iron, Phosphorus, Carbon, Nitrogen.

Ionic species are recognized to be the most available form of nutrients. To get an impression of the seasonal size class distribution of dissolved major elements and algal nutrients, Tjeukemeer water was subjected to ultrafiltration using filters of 200-5 nm nominal pore size. Fluorescence, UV absorbance and dissolved organic carbon were included in the study as Tjeukemeer is rich in metal chelating fulvic acids. The total dissolved concentrations of the parameters analyzed fluctuated seasonally and were either positively or negatively related with the chloride ion concentration, and hence with the hydrology of the lake. Throughout the sampling period all Si occurred in the smallest size class, and hence, in solution. In contrast most of the Fe and P was found in the two largest size classes. Especially the largest size class of these two elements was abundant in winter when the lake received humic polder water. This class contained little organic C and exhibited no fluorescence, suggesting that the colloidal Fe and P consisted of Fe(III)-hydroxide-phosphates which might have been peptized by the organic C. Additional evidence of the mainly inorganic nature of these colloids lies in their acid-lability. Concentrations of colloidal N fractions were highest in winter and corresponded with relatively high concentrations of colloidal organic C fractions. This suggests the occurrence of proteinaceous material. (Baker-IVI)
W85-04550

AVAILABILITY OF SEDIMENT P IN LAKE LUGANO,
Commission of the European Communities, Ispra

(Italy).
For primary bibliographic entry see Field 2H.
W85-04563

NUTRIENT PROCESSING IN AMAZON FLOODPLAIN LAKES,
Washington Univ., Seattle. Inst. for Environmental Studies.
B. R. Forsberg.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1294-1298, October, 1984. 3 Fig, 1 Tab, 11 Ref. NSF grant BSR-8003203.

Descriptors: *Nutrients, *Lakes, *Amazon floodplain, *Brazil, Chemical properties, Seasonal variation, Limiting nutrients, Phytoplankton, Macrophytes, Nitrogen.

An analysis of nutrient chemistry was made in two Amazon floodplain lakes and their tributaries. Preliminary bioassay experiments have indicated that the phytoplankton in these lakes is limited by different nutrients. Because a different pattern of nutrient dynamics is expected in each case, the results should provide a critical test of the assumptions involved in the analysis and additional support for the bioassay conclusions. Water samples were collected at biweekly intervals during the period February 1981 to February 1982. In each lake only one of the two major nutrients was significantly processed - that nutrient which had been indicated as the growth limiting nutrient in previous bioassay experiments. The high levels of dissolved organic nitrogen in the open water region may reflect the dominance of macrophytes in this system. Because the lake is highly turbid when river water is entering, the phytoplankton is unable to take advantage of the input of inorganic nitrogen. Most of these nutrients are apparently taken up by the floating macrophytes. Once incorporated into the macrophyte tissue, N would only be recycled to the open water either through excretion or decomposition which appears to occur on an annual basis in other white water lakes. In either case, the N would most likely be released in a dissolved organic form. A great deal can be learned about the pattern of nutrient limitation and dynamics in floodplain lakes by examining the nutrient chemistry in the lakes and their tributaries. (Baker-IVI)
W85-04571

SENSITIVITY ANALYSIS OF RESERVOIR OXYGEN MODEL,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2H.
W85-04585

INORGANIC NUTRIENTS OCCURRING IN THE OXYGEN-DEFICIENT BOTTOM WATER OF OSAKA BAY,
Osaka Prefecture Fisheries Experimental Station (Japan).
H. Joh, S. Yamochi, T. Abe, and A. Kawai.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 50, No. 10, p 1693-1700, October, 1984. 10 Fig, 1 Tab, 15 Ref.

Descriptors: *Nutrients, *Dissolved oxygen, *Osaka Bay, *Japan, Phosphorus, Nitrogen, Apparent oxygen utilization, Inorganic compounds, Sediments, Decomposition, Bays.

In summer, oxygen-deficient layer is being formed extensively in the waters of the lower strata of Osaka Bay, from the interior to the east part of the bay. A large amount of inorganic nutrients are found in such lower waters. Based on the accumulated data obtained from 1972 to 1982, a remarkable regularity was observed as to the concentrations of inorganic nutrients and dissolved oxygen (DO) in the water. Plots of dissolved inorganic phosphorus (DIP) versus apparent oxygen utilization (AOU) are approximately on two straight lines with an intersection at AOU ca. 2-4 ml/l, whereas dissolved inorganic nitrogen (DIN) is plotted versus AOU on a single straight line. However the abundance ratio of DIN in oxidized forms (NO2-N + N0s-N) decreases with the increase of AOU in the lower waters with AOU above ca. 4 ml/l. It may be concluded that the generation of DIP and DIN in the decomposition process of organic materials accompanies the DO consumption at a definite rate in oxic waters. In the oxygen-deficient lower waters, DIP increases in its concentration by the liberation from the lower sediments, and DIN remains in the reduced form (NH4-N) by the suppressed oxidation process. (Author's abstract)
W85-04606

PHOSPHORUS IN THE BOTTOM SEDIMENTS OF SOME LAKES OF THE WORLD,
Akademia Rolnicza, Wroclaw (Poland). Dept. of Limnology.
For primary bibliographic entry see Field 2H.
W85-04612

PHOSPHATASES AND THEIR ROLE IN ORGANIC PHOSPHORUS TRANSFORMATION IN NATURAL WATERS. A REVIEW,
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
W. Siuda.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 3, p 207-233, 1984. 10 Fig, 6 Tab, 91 Ref.

Descriptors: *Phosphatases, *Phosphorus compounds, *Microorganisms, Plankton, Enzymes, Natural waters, Lakes, Cycling nutrients, Organic compounds, Mineralization.

Both autotrophic and heterotrophic aquatic microorganisms produce alkaline and acid phosphatases. In the photic zone of lakes, adaptive alkaline phosphatases dependent on phosphate concentration are produced by the phytoplankton. In profundal waters constitutive acid phosphatases are mainly produced by microheterotrophs. These enzymes are independent of phosphate. Studies of the physical, chemical and biological factors which influence the activity of plankton phosphatases are important for understanding of the role of these enzymes in phosphorus cycling in aquatic environments. The ecological significance of phosphatases for mineralization of organic phosphorus compounds in waters is also discussed. (Author's abstract)
W85-04613

PRECONCENTRATION OF SUBMICROGRAM AMOUNTS OF METALS FROM NATURAL WATERS FOR X-RAY ENERGY SPECTROMETRIC DETERMINATION USING PYRROLIDINECARBODITHIOIC ACID,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 5A.
W85-04621

ION CHROMATOGRAPHIC DETERMINATION OF SILICIC ACID IN NATURAL WATER,
Kyoto Univ. (Japan). Dept. of Chemistry.
T. Okada, and T. Kuwamoto.
Analytical Chemistry, Vol. 57, No. 1, p 258-262, January, 1985. 8 Fig, 4 Tab, 25 Ref. Japanese Ministry of Education, Science and Culture grant 58470029.

Descriptors: *Ion chromatography, *Silicic acid, Natural waters, Water analysis, Chemical analysis.

A nonsuppressed ion chromatography using potassium hydroxide solution as an eluent was applied to the determination of silicic acid in natural water (lake water, river water, and tap water). Some anions eluted rapidly, such as fluoride ion and low molecular organic acids, were separated from silicic acid at the eluent concentration of < 1 mM. Fluoride, magnesium, and calcium loss depressed the peak of silicic acid but the other ions did not. However, the interference of fluoride ion was eliminated by adding boric acid into a sample solution and those of magnesium and calcium ions were reduced by the pretreatment with a H(+)-form strong acidic cation-exchange resin. The detection limit was 22 ppb (as Si) and was satisfactory compared with the other methods. The results obtained by this method agreed with those obtained by molybdenum blue method. (Author's abstract)
W85-04623

MULTISTAGE MODEL FOR THE DEVELOPMENT OF HYDROCHEMICAL ZONATION IN CHALK GROUND WATERS,
Toronto Univ. (Ontario). Dept. of Geology.
K. W. F. Howard.
Ground Water, Vol. 23, No. 1, p 4-16, January-February, 1985. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Cretaceous Chalk aquifer, *England, *Groundwater, *Chemical properties, Calcium bicarbonate, Calcite, Sulfates, Saline waters, Geochemistry, Groundwater movement.

Ground waters from the Cretaceous Chalk of east-central England display hydrochemical zonation comprising four water types. These are, in the general direction of ground-water flow: Type I - calcium bicarbonate (CaHCO3) waters undersaturated with respect to calcite, Type II - CaHCO3 waters saturated with respect to calcite, Type III - waters showing sulfate (SO4) reduction and softening by ion exchange, and Type IV - saline waters. At first appearance these water types may be interpreted as related members in the classically recognized, long-term sequence of natural chemical evolution of subsurface waters. This simple model, however, cannot be reconciled fully with all aspects of the hydrochemistry. For example, there is no satisfactory process that could explain an apparent depletion of chloride when moving from Type I to Type II waters, and transitional boundaries are absent between water Types II and III, and types III and IV. Furthermore, the model lacks credibility in an area where recent geological events have radically disturbed the regional ground-water flow regime. An alternative hydro-chemical zonation model is proposed in which each water type evolves independently of adjacent water types as a function of its own unique aquifer flow history. This multi-stage model is supported by tritium and radiocarbon evidence and can be related to probable changes in the regional flow regime during the past 125,000 years. (Author's abstract)
W85-04634

DISTRIBUTION OF CARBONATES, BICARBONATES, AND PH VALUES IN GROUND WATER OF THE NILE DELTA REGION, EGYPT,
Cairo Univ., Giza (Egypt). Dept of Chemistry.
M. F. M. El Ghandour, J. B. Khalil, and S. A. Atta.
Ground Water, Vol. 23, No. 1, p 35-41, January-February, 1985. 11 Fig, 6 Ref.

Descriptors: *Groundwater, *Carbonates, *Hydrogen ion concentration, *Egypt, Water quality, Bicarbonates, Carbon dioxide, Salinity, Water temperature, Lithology.

Water quality data were obtained from 114 wells in the Nile Delta region and its fringes. The wells were installed to depths varying from 25 to 120 m. Carbonate ions are present in the groundwater of the Nile Delta region in very small amounts (0-96 ppm). These ions decrease or may be absent in the northern parts of the Delta. The bicarbonate contents range between 0 and 738 ppm, depending on the amount of CO2 in water and following nearly the same trend as that of the carbonates. The variation in pH values with relation to salinity content is quite clear, as water with pH values ranging from 5.5 to 6.9 was found in wells which with a very high salinity (10,000 to 56,000 ppm). This confirms that the increase of salinity content in the northern parts of the Nile Delta leads to a reduction in the pH values, and the decrease of salinity in the southern parts gives a rapid rise in pH. The pH value is a very important indication of groundwater quality in the Nile Delta. The pH values are controlled by the dissolved CO2, carbonate, bicarbonate, and salinity content. the concentration and distribution of carbonate and bicarbonate contents in the area are mainly dependent on CO2 pressure, pH value, temperature, and salin-

ity content. The anomaly in ion concentrations in some localities may be related to the variation in the lithological characteristics of the aquifer strata at these localities. (Moore-IVI)
W85-04638

SPATIAL DISTRIBUTIONS OF PRECIPITATION ACIDITY AND MAJOR ION WET DEPOSITION IN NORTH AMERICA DURING 1980,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W85-04647

ARSENIC SPECIATION IN SOIL-PORE WATERS FROM MINERALIZED AND UNMINERALIZED AREAS OF SOUTH-WEST ENGLAND,
Thames Polytechnic, London (England).
S. J. Haswell, P. O'Neill, and K. C. C. Bancroft.
Talanta, Vol. 32, No. 1, p 69-72, January, 1985. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Arsenic, *Interstitial water, *England, *Mineralization, *Fate of pollutants, Soil contamination, Soil water, Aerobic conditions, Anaerobic conditions, Chemical analysis, Arsenite, Arsenate, Monomethylarsonic acid, Microorganisms, Chromatography.

The concentrations of arsenic species were determined in south-west England soil-pore water samples extracted from aerobic mineralized soil (from the Dartington and Trusham soil series) and from water-logged anaerobic unmineralized soil (from the Conway, and Yeolland Park soil series). Arsenate, arsenite and monomethylarsonic acid (MMAA) were characterized using a method based on HPLC anion-exchange chromatography with post-column continuous hydride-generation, followed by atomic-adsorption measurement. The method takes four minutes for a single analysis and gives enhanced detection limits by the use of a preconcentration column. The dominant arsenic species in aerobic soils was arsenate (approximately 90%) with small quantities of arsenite and MMAA in mineralized areas. In anaerobic soils arsenite was found to be the major soluble species. Chemical conditions in aerobic and anaerobic environments suggest that the arsenite levels will be increased in the latter owing to the chemical reducing conditions. At the negative redox potential found in anaerobic soils chemical reduction will override the microbial conversion of arsenate into arsenite. Though reduction of arsenate to arsenite is predominantly a chemically controlled reaction in both anaerobic and aerobic soils, methylation of arsenite to MMAA may be considered to be controlled by microorganisms. No clear relationship between the arsenite, arsenate, and MMAA levels is apparent from the results. As the MMAA levels increase, the levels of arsenite decrease, which may suggest that production of MMAA affects the residual arsenite levels in the soil. Chemical conversion of arsenate into arsenite may preclude microbial activity, thus reducing the production of MMAA. (Collier-IVI)
W85-04662

RADIUM VARIABILITY PRODUCED BY SHELF-WATER TRANSPORT AND MIXING IN THE WESTERN GULF OF MEXICO,
Oregon State Univ., Corvallis. School of Oceanography.
D. F. Reid.
Deep-Sea Research, Vol. 31, No. 12, p 1501-1510, 1984. 6 Fig, 4 Tab, 10 Ref.

Descriptors: *Coastal waters, *Radium radioisotopes, *Caribbean Sea, *Gulf of Mexico, Salinity, Water temperature, Radioisotopes, Path of pollutants, Water pollution sources.

Ra-226 and Ra-228 exhibit significant temporal and spatial variability in the near-surface western Gulf of Mexico. Concentrations of both isotopes during March 1976 were on the order of 22 to 26% greater than those observed during February 1973; analytical differences cannot account for this increase. Consideration of radium levels in the western Caribbean Sea indicates that there must be an internal source of radium that has a significant but temporally variable influence on near-surface radium concentrations in the western Gulf. Comparisons of radium, salinity, and temperature data from 1973 and 1976 provide evidence that advective transport and mixing of radium-rich shelf water with the interior water column of the western basin is responsible for the variability. By plotting Ra-228 vs Ra-226 from this region, estimates of the apparent shelf-water component in the upper water column can be made. The results indicate 36% over the northern slope, 10 to 18% in the central western Gulf, and 3 to 7% over Campeche Bank. In addition to explaining the observed short-term variations of radium in this region, this information should be useful for environmental impact assessments concerned with industrial discharges on the northern shelf. (Author's abstract)
W85-04712

TRACE METALS IN OXIC LAKE SEDIMENTS: POSSIBLE ADSORPTION ONTO IRON OXYHYDROXIDES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W85-04757

5-ALPHA(H)-CHOLESTAN-3-ALPHA-OL IN SEDIMENTS: CHARACTERIZATION AND GEOCHEMICAL SIGNIFICANCE,
Geneva Univ. (Switzerland). Mass Spectrometry Center.
F. Mermoud, F. O. Gulacar, and A. Buchs.
Geochimica et Cosmochimica Acta, Vol. 49, No. 2, p 459-462, February, 1985. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Lake sediments, *Epicholestanol, *Lake Leman, *Switzerland, Bacteria, Geochemistry, Stanols, Sterols, Eutrophication.

An unambiguous characterization is reported of epicholestanol and its diagenetic behavior in the top five centimeters of sediment collected at the deepest point of Lake Leman, Switzerland, 309 meters below water-level. The gas chromatogram revealed the presence of five C27 stanols in the first centimeter of sediment. The concentration of the five C27 stanols increased relative to the total sterol content down to a burial depth of 3 cm. Below, the trend reverses itself and the relative concentrations of most of them decrease to a value which is close to that observed in the first centimeter, except for epicholestanol which has completely disappeared below 5 centimeters. The two potential sources are an external source (either aquatic or terrestrial) and a bacterial in situ production. In all the sediment cores analyzed, no other stanol than epicholestanol completely disappears with burial below 5 cm, which corresponds to approximately 40 to 50 years of sedimentation. The appearance of epicholestanol is probably related to a change in the bacterial fauna which occurred around the middle of this century and which may be related to the growing eutrophication of the lake. This stanol was not observed in the more oxic sediments of Lake Leman which were studied. (Baker-IVI)
W85-04759

GEOCHEMICAL BEHAVIOR OF INORGANIC GERMANIUM IN AN UNPERTURBED ESTUARY,
Florida State Univ., Tallahassee. Dept. of Oceanography.
P. N. Froelich, G. A. Hambrick, L. W. Kaul, J. T. Byrd, and O. Lecointe.
Geochimica et Cosmochimica Acta, Vol. 49, No. 2, p 519-524, February, 1985. 3 Fig, 2 Tab, 20 Ref.
NSF grants OCE81-25223 and OCE82-00929.

Descriptors: *Ochlockonee Bay, *Florida, *Estuaries, *Germanium, *Silicon, Geochemistry, Seasonal variations, Silicates.

Ochlockonee Bay is a small, shallow, coastal-plain estuary whose only fresh water source is the pristine Ochlockonee River, which drains a forested watershed of which the lower 100 km is a natural wilderness. It is a vertically well-mixed estuary displaying simple dynamics, and showing no sign of anthropogenic contamination. The biogeochemical behavior of inorganic germanium was generally similar to that of silica, being taken up by siliceous organisms during the spring, and being regenerated in the fall. Excess Ge-input observed in the fall may be due to release from fluvial particulates transported into the bay. The Ce/Si ratio in the Ochlockonee River and the ratio transported out of the estuary to the sea are near the reported averages for global continent weathering; thus natural estuarine processes do not obscure the continentally-weathered Ge/Si ratio entering the ocean. (Baker-IVI)
W85-04760

EFFECT OF IONIC INTERACTIONS ON THE OXIDATION OF METALS IN NATURAL WATERS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
F. J. Millero.
Geochimica et Cosmochimica Acta, Vol. 49, No. 2, p 547-553, February, 1985. 7 Fig, 2 Tab, 37 Ref.
NSF OCE 8120659, ONR N014-80-C0042.

Descriptors: *Ionic interactions, *Iron, *Copper, *Oxidation, Natural waters, Seawater, Oxidation, Chlorides, Sulfates.

Most rate processes in natural waters take place in an ionic medium. The effect of ionic interactions of the major components of natural waters on the oxidation of Cu(I) and Fe(II) was examined. The various ion pairs of these metals have different rates of oxidation. For Fe(II), the chloride and sulfate ion pairs are not easily oxidized. The measured decrease in the rate constant at a fixed pH in chloride and sulfate solutions agrees very well with the values predicted. Equations are given for the effect of pH (6 to 8) on the oxidation of Fe(II) and Cu(I) in water and seawater. Unlike the results for Fe(II), Cu(I) chloride complexes have measurable rates of oxidation. The differences in the oxidation rates of Fe(II) and Cu(I) chloride complexes point out the importance of composition effects of natural waters. Further measurements are needed to elucidate these effects and lead to methods that can be used to estimate the rate of oxidation and reduction of ionic solutes in seawater from the results in pure water. (Baker-IVI)
W85-04761

MAJOR ION CHEMISTRY AND SENSITIVITY TO ACID PRECIPITATION OF SIERRA NEVADA LAKES,
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W85-04789

MODELING THE EFFECTS OF ACID DEPOSITION: ASSESSMENT OF A LUMPED PARAMETER MODEL OF SOIL WATER AND STREAMWATER CHEMISTRY,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W85-04792

LAKE ONTARIO OXYGEN MODEL. 1. MODEL DEVELOPMENT AND APPLICATION,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2H.
W85-04801

LAKE ONTARIO OXYGEN MODEL. 2. ERRORS ASSOCIATED WITH ESTIMATING TRANSPORT ACROSS THE THERMOCLINE,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2H.
W85-04802

RELATIONSHIPS BETWEEN ARSENIC AND OTHER ELEMENTS (IRON, ALUMINIUM, MANGANESE ETC) IN SURFACE SEDIMENTS OF BOHAI BAY (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
X. Ma, Q. Li, W. Shen, X. Zhang, and L. He.
Oceanologia et Limnologia Sinica, Vol. 15, No. 5, p 449-456, September, 1984. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Sediments, *Arsenic, *Bohai Bay, *China (Peoples Republic), Iron, Manganese, Titanium, Organic matter, Coastal waters, Heavy metals, Bays.

Total As, Fe, Mn, Ti and organic matter (Org) were determined in 50 surface sediment samples from the Bohai Bay. After extraction of the sediments with Tamm solution (a mixture of oxalic acid and ammonium oxalate) As, Al, Fe and Mn in the extracts and As, Mn, Fe and Ti in the residues were also determined. The distribution of total arsenic in the sediments of the Bohai Bay shows that arsenic contents are related to the type of sediment: lower in silty sediments, higher in muddy sediments. The arsenic in sediments of the Bohai Bay is mainly derived from suspended matter in river and other effusion from land, or coprecipitated with hydrous oxide of iron, aluminium and manganese from sea water. The Bohai Bay may be divided into two parts according to Eh: ranging from 0- -50 mV in the north and 0- +70 mV in the south. The multiple correlation coefficients of extractable elements in the surface sediments of the Bohai Bay are higher in the south part than in the north: the r for As (Fe, Mn, Al, Org) being 0.819 in the south, and 0.511 in the north. Extractable As in the south of the bay may be expressed as a regression equation: As = 1.23 + 0.928 Mn + 9.43 Al + 3.35 Fe - 0.903 Org where, As in x 10 to the -4%, Mn in x 10 to the -2%, Al, Fe, and organic matter in %. The regression equation shows coprecipitations of 1000 micro-g of Mn, Al, and Fe with 9.28 micro-g, 0.943 micro-g and 0.335 micro-g As respectively. The partial correlation cofficients of the extractable As, Al, Fe and Mn is also higher in the south than in the north, with the r for AlFe.AsMnOrg being the highest. Because of the partial and multiple correlation cofficients of Fe, Ti, Mn and As in residues of sediments extracted by Tamm solution being higher, it appears to be that they are intergrowth in aluminosilicates. (Author's abstract)
W85-04835

PREDICTING THE EFFECT OF MACROBENTHOS ON THE SEDIMENT/WATER FLUX OF METALS AND PHOSPHORUS,
Connecticut Univ., Storrs. Biological Sciences Group.
W. M. Starkel.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 1, p 95-100, January, 1985. 3 Fig, 2 Tab, 17 Ref. DOE contract DE-AC09-76SR00819.

Descriptors: *Benthos, *Invertebrates, *Sediment-water interface, *Metals, *Phosphorus, Mixing, Aquatic insects, Iron, Manganese, Dissolved oxygen, Carbon, Potassium, Sodium.

Exchange between sediments and water is an important aspect of the movement of materials and energy in lakes. The effect of macrobenthos on exchange processes was studied in a small, softwater lake. The profundal macrobenthos is composed mainly of Chaoborus larvae at densities often exceeding 20,000/sq m. Chiromomid larvae are much less abundant but account for 5% of the total mass of macroinvertebrates. The log-transformed flux rates of iron, manganese, and phosphorus were linearly related to the biomass of Chaoborus and chironomid larvae. Flux rates were measured by measuring the change in chemical concentrations in the water overlying the sediment of undisturbed cores incubated in situ for 1-2 d. Predicted flux rates of iron and phosphorus at average pelagic densities of animals were enhanced at least twofold over predicted fluxes for diffusion alone. Macroinvertebrates had no apparent effect on flux rates of dissolved oxygen, dissolved inorganic carbon, potassium, or sodium. Because both iron and phosphorus have concentration gradients across the sediment/water interface, a mixing effect, rather than excretion alone, is implicated for the effect of animals on phosphorus flux. (Moore-IVI)
W85-04839

CELLULAR PHOSPHORUS CONCENTRATION AS A CRITERION FOR TROPHIC STATUS IN RAPIDLY FLUSHED LAKES,
Maine Univ. at Orono. Land and Water Resources Center.
For primary bibliographic entry see Field 2H.
W85-04846

NITRATE CYCLING IN LAKE TITICACA (PERU-BOLIVIA): THE EFFECTS OF HIGH-ALTITUDE AND TROPICALITY,
California Univ., Davis. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W85-04896

EFFECTS OF ECOLOGICAL PERTURBATIONS ON DIATOM DYNAMICS IN THE MODEL OF LAKE JEZERO,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 2H.
W85-04901

WATER QUALITY OF THE COLORADO RIVER SYSTEM: HISTORICAL TRENDS IN CONCENTRATION LOAD, AND MASS FRACTION OF INORGANIC SOLUTES,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2E.
W85-04942

2L. Estuaries

PHYTOPLANKTON PRODUCTION IN THE CORPUS CHRISTI BAY ESTUARY,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
R. W. Flint.
Contributions in Marine Science, Vol. 27, p 65-83, September, 1984. 6 Fig, 3 Tab, 49 Ref.

Descriptors: *Phytoplankton, *Primary productivity, *Corpus Christi Bay, *Texas, *Estuarine environment, Limiting nutrients, Organic carbon, Seasonal variation, Salinity, Turbidity, Macrophytes, Algae, Cycling nutrients.

The Texas Gulf coast is characterized by a number of subtropical estuaries which have great economic and ecologic value in that they support important regional fisheries through production of new organic matter by phytoplankton photosynthesis. One of these estuaries, the Corpus Christi Bay ecosystem, was studied for a three-year period to define temporal and spatial variability in its primary production and to elucidate environmental factors important in regulating production. Mean annual phytoplankton production at the various sampling sites increased with distance from the riverine influence of the estuary. This pattern was most closely associated with deeper, less-turbid waters at the oceanic end of the estuary that provided a greater euphotic zone. Variability in measured primary productivity rates between sites was most influenced by water column nutrients in January and July and more significantly correlated to salinity changes in April and October. From the three years of data, annual phytoplankton production was estimated to be 174.1 g C/sq m/yr, which represented 52% of total new organic production in this estuary. In contrast, macrophytes and tidal flat algae comprised the remainder of new organic carbon production. Annual production was found to be most significantly affected by freshwater input from either river flow or rainfall, depending upon where production measurements were made in the estuary. High turbidity of this estuarine ecosystem was thought to limit production in contrast to other north American estuaries. Long-term maintenance of primary production in this estuary is accomplished through nutrient recycling while acute changes from both meteorologic and hydrologic forcing cause short-term increases in production that sustain steady-state and replenish lost materials to the system. (Author's abstract)
W85-04432

DEVELOPMENT AND USE OF A THEORETICAL MATHEMATICAL MODEL FOR THE MEDWAY ESTUARY,
Southampton Water Authority (England).
I. S. Gascoine, and K. M. Jury.
Water Pollution Control, Vol. 3, No. 1, p 31-41, 1984. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Estuaries, *Water quality control, *Medway Estuary, *England, Mathematical models, Model studies.

Theoretical models of the Medway Estuary are presented which have been an invaluable aid in examining the options available for achieving the criteria set for the estuary. The models have enabled the Water Authority to examine and cost the development of resources in the Medway Study Area and will continue to be used to this end, and for setting effluent standards in the future. The purpose of the theoretical model was to examine the physical, biological and chemical changes occurring within the estuary and thus be able to predict water quality (dissolved oxygen and chloride) resulting from changes in natural and imposed conditions. The natural condition variables examined included freshwater flow, tidal height, meteorological conditions, mud respiration and photosynthesis. Imposed conduits were the effluent condition needed to achieve the water quality criteria together with the discharge of effluents related to tide, discharging effluents further down the estuary, seawater recirculation and artificial reaeration. Three models were devised; the first for calculating water levels, a second which was a steady state water quality model which could be used when photosynthesis could be ignored, and the third which was a time-dependent model incorporating a model for photosynthesis. (Baker-IVI)
W85-04450

OYSTER REEFS AS PROCESSORS OF ESTUARINE MATERIALS,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
R. F. Dame, R. G. Zingmark, and E. Haskin.
Journal of Experimental Marine Biology and Ecology, Vol. 83, p 239-247, 1984. 4 Fig, 2 Tab, 25 Ref. NSF grant DEB-8119752.

Descriptors: *Estuarine environment, *Oysters, *Food habits, *Cycling nutrients, Ammonia, Organic carbon, Chlorophyll a, Filter feeders, Mollusks.

Oyster reefs are dense concentrations of filter-feeding animals in estuarine ecosystems. A flow-through plastic tunnel is a feasible method of determining significant changes in material concentrations in tidal waters passing over an oyster reef. The oyster reef reduces the amplitude of the particulate organic carbon and chlorophyll a signals while increasing the amplitude of the ammonia signal. The observations suggest that oyster reefs have one of the highest reported release rates of ammonia (1680-7250 micro g at/sq m/h), and thus are probably important in material cycles in marsh-estuarine ecosystems. The magnitude of particulate organic carbon removal by the oyster reef is many times greater than that expected from biofiltration alone, suggesting that removal due to physical factors may be important. (Author's abstract)
W85-04483

EVALUATION OF A MOVING-CO-ORDINATE SYSTEM MODEL OF SALINITY INTRUSION INTO THE MERSEY ESTUARY,
Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, and C. H. Lin.
Water Pollution Control, Vol. 82, No. 3, p 402-417,

1983. 15 Fig, 5 Tab, 16 Ref.

Descriptors: *Estuarines, *Mathematical models, *Saline water intrusion, *Moving coordinate systems, Salinity, Mersey Estuary, England, Model studies, Dispersion.

The Mersey estuary is used as an example to investigate the sensitivity of salinity predictions to various input parameters. A brief description of the available field data is followed by an estimation of the probable order of magnitude of numerical errors in the mathematical model to be used. Numerical experiments, for both an idealized and a real case, suggest that numerical errors can be contained so that useful results can be found. The relative merits of fixed and moving co-ordinate systems need to be examined for each application. For calculations covering several repeating tidal cycles the moving cordinate system will probably be the more economic. In a moving coordinate system, the use of a single longitudinal salinity profile for calculating dispersion coefficients is not advised for estuaries which have small depths at low water unless good quality hydrographic data are available. The use of a spatially and temporally mean value of dispersion coefficient was found to give fairly good results for salinity representation. This form of coefficient is preferred for solute transport models. A simple method of finding a mean value of D gave reasonable salinity model results. The method was based on bank-side samples which are usually fairly easy, and hence relatively cheap to collect. The salinity distribution in the Mersey estuary has been found to be sensitive to river flow, hydrography and values of dispersion coefficient. (Baker-IVI)
W85-04528

NOTE ON THE PREDICTION OF DISSOLVED OXYGEN CONCENTRATION IN ESTUARIES,
Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, and C. H. Lin.
Water Pollution Control, Vol. 82, No. 3, p 418-429, 1983. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Dissolved oxygen, *Estuaries, *Prediction, Water quality control, Management, Water quality, Oxygen, Model studies, Boundary conditions.

The objectives of investigating whether improvements in the predictive capability of dissolved oxygen-type (DO-type) water quality models would be useful, and if so, to see if the improvements can realistically be sought, have been achieved. A sensitivity analysis of the specific case of a DO-type time-dependent one-dimensional moving-coordinate estuary model showed that with several uncertain boundary conditions and rate coefficients the model can be tuned to fit field data. Model water quality parameters were particularly sensitive to reaeration coefficients, dispersion coefficients and pollutant loads. The river discharge, and the rate coefficients and boundary conditions associated with the major pollutant loads were also significant. The degree of sensitivity of the water quality parameters was such as to indicate that an improved accuracy is needed for the input parameters for predictive results in the context of water-quality management. Improvements in the pollutant load data should be achievable by an increase in data collection effort. Improvements in defining the correct mechanisms and in determining better estimates of rate and dispersion coefficients should be obtainable from further research effort. (Baker-IVI)
W85-04529

COMPARISON OF LEACHING LOSSES FROM DECOMPOSING LITTER OF THE TERRESTRIAL AND MARSH PLANTS ON LAND AND IN WATER,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
B. Gopal.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 947-950, October, 1984. 1 Fig, 2 Tab, 18 Ref.

Descriptors: *Litter, *Decomposing organic matter, *Leaching, Littoral environment, Organic matter, Intertidal areas, Marshes, Plants, Detritus.

Differences in leaching from terrestrial and marsh plant litter decomposing on land and in water are presented. Fresh plant litter of five species namely, Alnus glutinosa, Calamogrostis sp., Scirpus lacustris, Salix viminalis and Typha angustifolia, was collected from the Schohsee and its vicinity during November of 1982. In the first month, the five species differ considerably from each other in the rate and amount of weight loss. Typha angustifolia shoots released maximum amount of water soluble substances throughout the 30 day period. In Calamogrostis sp. the losses were smallest. In Alnus glutinosa more than 18% ash-free dry weight (AFDW) was lost within the first 3 days while nearly the same amount was lost in 7 days in T. angustifolia from the litter placed in water. The data on the changes in the ash content of the decomposing litter indicates the nature of the leached substances. In the three terrestrial species the ash content had increased while in the two marsh species it decreased greatly. The increased ash content can be partly due to contamination by silt, but it is likely that little of inorganic substances were leached. A fall in the ash content clearly shows release of inorganic substances together with the organic substances. Nitrogen content of the litter decomposing in water increased with time except in Alnus glutinosa where it decreased. It is possible that leaching is partly responsible for slow rate of decomposition and accumulation of detritus, more in aquatic environments than on land. (Baker-IVI)
W85-04553

NATURAL FACTORS AND HUMAN MODIFICATIONS CONTRIBUTING TO MARSH LOSS IN LOUISIANA'S MISSISSIPPI RIVER DELTAIC PLAIN,
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
L. A. Deegan, H. M. Kennedy, and C. Neill.
Environmental Management, Vol. 8, No. 6, p 519-528, November, 1984. 3 Fig, 3 Tab, 38 Ref.

Descriptors: *Coastal marshes, *Geology, *Habitat loss, *Environmental effects, *Mississippi River Delta, *Louisiana, Wetlands, Marshes, Canals, Construction, Spoil banks, Deltas, Statistical models.

The disappearance of coastal marshes in the Mississippi River Delta region of Louisiana is a chronic problem. The estimated annual loss is 10,200 ha of coastal land. Causes for the marsh loss can be divided into two general categories: the natural geologic process of delta decay; and human modifications in the coastal zone. Information on regional geology and human-induced habitat alterations are combined in a statistical model to evaluate the relative importance of human and natural factors to marsh loss. Data on marsh area and habitat type for 139 7.5-min quadrangles were calculated from maps based on aerial photographs from 1955/56 and 1978, and data on regional geology obtained from published maps were used to construct a multivariate model relating initial marsh area, change in urban and agricultural area, change in canal and spoil area, canal area in 1978, depth of sediment overlying the Prairie terrace, and subdelta age to marsh loss. Between 25.0% and 39.0% of the marsh loss that occurred during the 23-year period was related to canal and spoil construction, and between 9.5% and 12.7% was related to urban and agricultural development. These are minimal estimates of loss because they do not include many secondary effects that can also result in indirect loss. Depth of sediment, initial marsh area, delta lobe age by 1978 canal and spoil area interaction, and indirect effects not included in the model accounted for remaining marsh loss. The approach of combining data from aerial photographs with other local information to construct models to aid in developing regional management strategies has potential application to other locations. (Moore-IVI)
W85-04603

INORGANIC NUTRIENTS OCCURRING IN THE OXYGEN-DEFICIENT BOTTOM WATER OF OSAKA BAY,
Osaka Prefecture Fisheries Experimental Station (Japan).
For primary bibliographic entry see Field 2K.
W85-04606

CONCENTRATIONS OF SEABIRDS ALONG THE FACE OF GLACIERS AND OUTLETS OF RIVERS IN SVALBARD (KONSENTRASJONER AV SJOFUGL LANGS KANTEN AV ISBREER OG UTENFOR BREELVER PA SVALBARD),
Norsk Polarinstitutt, Oslo.
F. Mehlum.
Fauna, Vol. 37, No. 4, p 156-160, 1984. 4 Fig, 10 Ref.

Descriptors: *Seabirds, *Upwelling, *Glaciers, *Reaction currents, *Svalbard, *Norway, Birds, Kittiwakes, Fulmars, Feeding, Rivers.

Concentration of seabirds at fresh water outflows along glacier faces and at outlets of small rivers are reported from Nordaustlandet and Kongsfjord in Svalbard. The birds, primarily kittiwakes Rissa tridactyla and fulmars Fulmarus glacialis, were seen foraging in dense flocks on the sea surface. The aggregation of feeding organisms is presumed to be caused by passive upwelling. The outflow of fresh water generates a reaction current of salt water (below the fresh water) towards the glacier face or river outlet. (Author's abstract)
W85-04608

TYPHETUM ANGUSTIFOLIAE AND TYPHETUM LATIFOLIAE AS INDICATORS OF VARIOUS HABITATS,
Warsaw Univ. (Poland). Dept .of Phytogeography.
S. Klosowski, and H. Tomaszewicz.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 3, p 245-255, 1984. 3 Fig, 3 Tab, 26 Ref.

Descriptors: *Swamps, *Habitats, *Typhetum, *Poland, Wetlands, Vegetation, Nutrients, Bottom sediments, Ecological distribution, Plant populations.

Investigations carried out over the period 1978-1981 in northeastern Poland concerned habitat requirements of two common swamp communities, the Typhetum angustifoliae and Typhetum latifoliae communities. In comparing phytosociological data, and physical and chemical properties of water and substrate from 27 Typhetum angustifoliae and 26 Typhetum latifoliae phytocenoses, it was found that the swamp communities under investigation are linked with different types of habitat and hence possess a certain bioindicative value. Typhetum angustifoliae occurs in relatively clean waters characterized by narrow amplitudes of most parameters and on mineralized bottoms, poor in nutrients. Typhetum latifoliae is linked with considerably more nutritious waters characterized by broader ranges of most parameters and with organic or organic-mineral bottoms having higher values of practically all of the physical and chemical properties analyzed. In comparing the two swamp communities, the complex of physical and chemical properties of the bottom is of greater differentiating importance than properties of the water. The studies also justify of a narrow (based on floristic domination) classification of high swamp communities. (Moore-IVI)
W85-04614

MICROBIAL CONTRIBUTION TO THE MESOTROPHIC ECOSYSTEM OF THE CAMPBELL RIVER ESTUARY DURING SUMMER,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
H. Seki, A. Otsuki, S. Daigobo, C. D. Levings, and C. D. McAllister.
Archiv fur Hydrobiologie, Vol. 102, No. 2, p 215-228, December, 1984. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Microorganisms, *Mesotrophic ecosystems, *Estuarine environment, *Campbell River Estuary, *Vancouver Island, *British Columbia, Bacteria, Salmon, Aquatic habitats, Habitats.

The Campbell River Estuary on Vancouver Island (British Columbia) at the southern end of Discovery Passage receives freshwater discharge mostly from the Campbell and the Quinsam Rivers. The microbial role in the maintenance of the mesotrophic environment was studied during summer 1983. The system represents one common type of small complex partially modified estuary in the subarctic region. Physicochemical profiles in the water column inside the estuary were almost uniform down to the depth of 1 m. The intricate topography of this estuary was shown to have a reasonable relation with grouping of various small-scale habitats from the oligotrophic to eutrophic ends of the mesotrophic range. Generation times of heterotrophic bacteria, chiefly responsible for the turnover of organic solutes, were typical of the mesotrophic range. The uptake kinetics of a few substrates such as glutamic acid are almost identical with those on the boundary between eutrophic and mesotrophic systems. Young chinook were the dominant salmon in the estuary and transition zones, although juvenile chum, pink and coho salmon were seasonally important. Bacterial dynamics are expected to be relevant to salmonid ecology, as the factors controlling the elements of basic productivity should be relatively independent of the fish. Heterogeneity in environmental conditions was favorable for efficient trophodynamics in the estuarine ecosystem, supporting production of juvenile salmon migrating to the sea. (Collier-IVI)
W85-04673

METHOD TO MEASURE SUSPENDED LOAD TRANSPORTS IN ESTUARIES,
Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.).
G. Krause, and K. Ohm.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 6, p 611-618, December, 1984. 7 Fig, 7 Ref.

Descriptors: *Estuarine environment, *Suspended load, *Weser estuary, *Germany (Federal Republic), *Water currents, *Measuring instruments, Current meters, Optical properties, Tides.

An optical beam-attenuance meter integrated into an Aanderaa current meter was developed for measuring time series of fluxes of suspended material in turbid estuarine water. The light attenuation sensor is self contained and can be attached to any Aanderaa instrument with negligible modifications. The additional package contains the attenuation meter, an interface and a battery with a capacity to operate the package for the same duration as the current meter. A 30 day period of measurements at 10 min sampling intervals was carried out in the estuary of the River Weser. The daily inequality of the semidiurnal tides in the area are much more obvious from peak concentrations than from current velocities. This holds for spring tide and neap tide cycles and is also seen in the seston flux. Progressive vector diagrams of water velocity and seston flux show opposite residual displacements. The mean residual water velocity is 5 cm/s as computed from the progressive vector diagram. Multiplying with the total cross-section at the measuring site yields a transport of 400 cu m/s. This agrees well with river discharge and gives evidence that the measuring site is to some degree representative for the cross-section. Assuming this to hold also for the transport of suspended matter, the total transport into the landward direction would be 106,000 tons in 30 days. This is of the order of the amount of material which is regularly dredged out from above this section. The instrumentation provides a low cost method of data acquisition for both practical applications and also for the scientific requirements for testing existing mathematical models on the transport of suspended matter in the transition area between rivers and the sea. (Collier-IVI)
W85-04675

ECOLOGY OF MEIOFAUNA IN AN ORGANICALLY POLLUTED ESTUARINE MUDFLAT,
Groningen Rijksuniversiteit (Netherlands). Biological Research Ems-Dollart Estuary.
L. A. Bouwman, K. Romeijn, and W. Admiraal.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 6, p 633-653, December, 1984. 7 Fig, 3 Tab, 35 Ref.

Descriptors: *Ems-Dollart estuary, *Netherlands, *Germany (Federal Republic), *Estuarine environment, *Benthos, *Species composition, Mud flats, Water pollution effects, Nematodes, Oligochaetes, Species diversity.

The structure, distribution and seasonal changes of the benthic meiofauna in an organically polluted, tidal, brackish-water mudflat in the Ems-Dollart estuary (Federal Republic of Germany and The Netherlands) were analyzed. Towards the outfall of polluted fresh water, macrofauna disappeared, numbers of meiofauna increased but the diversity of the meiofauna decreased. In the area surrounding the outfall the numbers and biomass of nematodes and oligochaetes increased rapidly in spring and remained high until autumn (c. 1,000,000 individuals/sq m; c. 2g/sq Cm). The benthic fauna comprised small numbers of species, dominated by a few fast-growing diatom-feeding nematodes (Eudiplogaster pararmatus and Dichromadora geophila) and oligochaetes (Amphichaeta sannio and Paranais litoralis). Eudiplogaster pararmatus exhibits brood care and it tolerates low salinities. Dichromadora geophila which is oviparous, behaved similarly regarding tolerances, life cycle and feeding but this species was less successful than Eudiplogaster in colonizing the mudflats near the outfall. The success of the two naidid oligochaete species results from their method of reproduction by means of binary fission. Most organisms fed on benthic diatoms. In spite of intensive mineralization in the mudflat, only one bacteria-feeding organism was found in abundance (the nematode Leptolaimus papilliger). The absence of macrofaunal organisms, e.g. Nereis diversicolor, is probably also responsible for the development of high densities of meiofauna in the upper sediment layers of the mudflats in the vicinity of the outfall. The heavy load of organic waste entering the Dollart reduced the diversity within the benthic ecosystem, but nevertheless a simple system remained, based on the recurrent reoxidation of the sediment surface. (Author's abstract)
W85-04676

NEAR BOTTOM VARIATIONS OF TURBIDITY IN THE ST. LAWRENCE ESTUARY,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
B. d'Anglejan, and R. G. Ingram.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 6, p 655-672, December, 1984. 14 Fig, 22 Ref.

Descriptors: *St. Lawrence estuary, *Turbidity, *Water currents, *Suspended load, *Optical properties, *Measuring instruments, Optical properties, Suspended matter, Transmissometers, Attenuation, Advection, Resuspension.

Since the movement of sediment particles in estuaries by tidal currents largely takes place by alternation of resuspension and settling, quantitative estimates of suspended transport can only be obtained by synchronized measurement of particle concentration and velocity near the sediment surface. Observations of the turbidity and velocity fields in the near-bottom waters of the St. Lawrence estuary were obtained with a package which includes an Aanderaa RCM-4 current meter and a modified Partech Suspended Solid Monitor which is interfaced to a twelve-channel Aanderaa data logger. The former also measures salinity and temperature. Observations were made in the South Channel of the St. Lawrence middle estuary between Quebec and the Saguenay. Time series varying in length between 26 h and 26 days, and with repetition rates between one and 15 min were obtained for 3 typical open-channel and nearshore stations. Burst sampling of the turbidity field shows the importance of high frequency variability. With lower frequency records having lengths of one week to one month, contributions to the turbidity fluctuations due to the spring-neap oscillations, seasonal changes in run-off, and the sudden rise in solid discharge of local tributaries following storms, can be resolved. From turbidity polar diagrams, local onshore sources of particulate suspended matter can be identified. Among other advantages, it is possible from such records to time precisely the occurrence of turbidity peaks in relation to the ebb and flow velocities, to assess the importance of resuspension, and to specify exactly the time rate of change of the turbidity. The area sampled showed a dominance of advection over local resuspension in determining the medium time scale variations in turbidity. On the whole, self-recording equipment provides a wealth of information unavailable from more traditional hydrocast sampling techniques. (Collier-IVI)
W85-04677

PROPOSED FRAMEWORK FOR DEVELOPING A MULTIDISCIPLINARY WETLANDS VALUATION MODEL,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
J. A. Leitch, K. W. Easter, and W. C. Nelson.
Environmental Professional, Vol. 6, No. 2, p 117-124, 1984. 2 Fig, 15 Ref.

Descriptors: *Model studies, *Economic aspects, *Wetlands, *Value, Research priorities, Ecosystems, Economic evaluation.

The task of wetlands valuation cannot be completed by members of any one discipline. Output measurement and benefit evaluation of wetlands are so complex that a comprehensive investigation must be made of the myriad of biological, physical, social, and economic interactions. An overall research framework is needed that will involve input from economists, anthropologists, hydrologists, botanists, ecologists, and other specialists who are concerned with wetlands ecosystems. The lack of cooperative research has resulted in critical gaps in knowledge that have led to inefficient wetlands allocation by the government. A conceptual framework is presented which guides the researcher from a physical-biological component, through a user interface, to the policy objectives of economic efficiency, social well-being, and environmental quality. Management options and a feedback loop (for estimating the consequences of use in one period on outputs in the next period) are considered in the model. Successful monetary valuation of prairie wetlands will hinge on: successful simulation of the ecosystem and its outputs; identification of those members of society who derive benefits from wetlands products and services; and the ability to estimate those values. Independent researchers may follow the framework presented and contribute to the eventual implementation of the model by identifying the links between the ecosystem and the social system. (Collier-IVI)
W85-04684

BIOTURBATION AND MICROBIAL ACTIVITY,
Centre National de la Recherche Scientifique, Marseille (France). Lab. d'Ecologie et Biochimie Microbiennes du Milieu Marin.
R. Daumas, and M. Bianchi.
Ergebnisse der Limnologie, Vol. 19, p 289-294, December, 1984. 3 Fig, 12 Ref.

Descriptors: *Bioturbation, *Mollusks, *Microorganisms, *Clams, *Sediments, *Coastal waters, Ammonia, Adenylates, Nucleotides, Bacteria, Adenosine triphosphate, Adenosine diphosphate, Peptone.

Macrofauna can cause a notable change of biogenic activity in the sediments of coastal waters. Measurements of NH4, adenylates, nucleotides, and bacterial numbers were used to detect the influence of the bivalve Ruditapes decussatus on the bacterial population. The experiments were performed in a sediment composed of fine sand and mud sampled from the Mediterranean near Marseille, France, and placed in an experimental apparatus. In the containers with clams the number of bacterial colonies was notably lower than in the others while it remained stable, or decreased slightly in the control (blank). The blank showed a virtually stable rate in A.T.P., while A.D.P. increased regu-

larly, indicative of an equilibrium population. Development of autochthonous bacteria after enrichment of overlying water with peptone permitted observations on predation on bacteria by the bivalve; in the 'peptone' container, the rate of A.T.P. decreased beyond 12 hours, while A.D.P. remained stable, indicating a population moving towards a degradation phase. In the 'clams' container, adenylates decreased rapidly after 12 hours, particularly for the A.T.P. Adenylates increased exponentially in the blank container which received neither peptone or clams. A large part of the peptone has probably been made unavailable for the bacteria in overlying water, justifying use of high concentrations for experiments in the specific conditions of the superficial layer of sediments. Results of this study suggest that the classical methods of activity measurements may not adequately reflect the dynamics of some biochemical compounds. (Collier-IVI)
W85-04704

OPPORTUNITY COSTS OF PRESERVING COASTAL WETLANDS: A CASE STUDY OF A RECREATIONAL HOUSING DEVELOPMENT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W85-04754

GEOCHEMICAL BEHAVIOR OF INORGANIC GERMANIUM IN AN UNPERTURBED ESTUARY,
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 2K.
W85-04760

FLUID TRANSPORT PROCESSES IN UPPER SPENCER GULF,
Adelaide Univ. (Australia). Dept. of Mathematical Physics.
H. S. Green.
Marine Geology, Vol. 61, No. 2/4, p 181-195, November, 1984. 1 Fig, 28 Ref.

Descriptors: *Fluid transport, *Bays, *Upper Spencer Gulf, *Australia, Water circulation, Spills, Currents, Tidal effects, Path of pollutants, Harbors, Dichloroethane.

The modelling of tidal and residual currents in Upper Spencer Gulf was studied in response to an environmental problem. The Gulf is a navigable waterway, with many of the characteristics of a river estuary, between the Flinders Ranges, over 700 m high to the east and a chain of hills almost 300 m high to the west. The Gulf contains residual currents, superposed on the normal tidal currents, of considerable magnitude. The possible establishment of a petrochemical complex on the eastern shore raised a number of environmental questions. The principal product, dichloroethane, a toxic liquid, was to be loaded into ships from a jetty extending over the Gulf. A real danger was found to exist if the chemical were to spill into the Gulf as the transport processes within the water body are such as would carry the heavy, toxic, material in solution to reach the surface and evaporate from the neighborhood of Port Augusta. (Baker-IVI)
W85-04762

PHYSICAL PROCESSES AND POLLUTION IN THE WATERS OF SPENCER GULF,
Adelaide Univ. (Australia). Dept. of Applied Mathematics.
J. Noye.
Marine Geology, Vol. 61, No. 2/4, p 197-220, November, 1984. 7 Fig, 3 Tab, 81 Ref.

Descriptors: *Path of pollutants, *Spencer Gulf, *Australia, *Sediment transport, *Currents, Water circulation, Diffusion, Turbulence, Storm surges, Water temperature, Salinity, Thermal pollution.

Known information of the physical processes which occur in the water of Spencer Gulf (Australia) are reviewed. Circulation and turbulent diffusion are considered in detail as to their effect on pollutant and sediment transport. Sea-level variations in Spencer Gulf are mainly due to the propagation of tides and storm surges from the Southern Ocean through the entrance. These travel northward along the Gulf as long waves. Meteorological forces acting on the surface of the water in the Gulf, seasonal changes in temperature and salinity, and surface waves and swell, also affect the sea level. Tidal streams dominate the currents in this region. These are basically one dimensional and a quarter-cycle out of phase with the tidal elevations, except for the complex water movements which occur in the vicinity of Lowly Point. Wind induced currents, thermohaline circulation and wave driven current are much smaller in magnitude than the tidal streams, but the residual circulation they produce is important to the transfer of pollutants from the Gulf to the Southern Ocean. Waste heat from the original Port Augusta Power Station has raised the local water temperature and additional generators could have a profound, perhaps very detrimental, effect on the local environment. In any calculation of the dispersal of pollutants in Spencer Gulf, the limiting factor is a lack of detailed knowledge of the physical processes and of related sediment transport paths. (Baker-IVI)
W85-04763

REGIONAL VARIATION IN THE DISTRIBUTION OF TRACE METALS IN MODERN INTERTIDAL SEDIMENTS OF NORTHERN SPENCER GULF, SOUTH AUSTRALIA,
Adelaide Univ. (Australia). Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 5B.
W85-04764

FIRE AND HERBIVORY IN A GREAT SALT LAKE MARSH,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
L. M. Smith, and J. A. Kadlec.
Ecology, Vol. 66, No. 1, p 259-265, February, 1985. 3 Fig, 2 Tab, 52 Ref. DOE DE-AC09-76SR00819.

Descriptors: *Fire, *Grazing, *Marshes, *Great Salt Lake, *Utah, Standing crop, Primary production, Flooding, Macrophytes, Aquatic plants, Wetlands, Environmental effects.

The effects of fire and of herbivory by vertebrates on the standing crops and aboveground net primary production of Typha latifolia, Scirpus lacustris, S. maritimus, and Distichlis spicata were investigated in a freshwater marsh adjacent to the Great Salt Lake. Production of T. latifolia, S. lacustris, and S. maritimus vegetation responding after fire was not different from control areas, but flooding following fire eliminated D. spicata. Grazing by wetland vertebrates reduced net primary production of marsh macrophytes. Significant reductions occurred in previously burned areas of T. latifolia (48%), S. lacustris (25%), and S. maritimus (9%), illustrating the importance of the herbivory food chain for inland marshes. Evidence of increased protein in vegetation responding after fire and preferential grazing was consistent with the hypothesis that wetland vertebrates select vegetation of higher nutritive quality. However, alternative hypotheses such as increased foraging efficiency in burned areas could not be dismissed. (Author's abstract)
W85-04825

MINERAL DISTRIBUTION AND ECOLOGICAL ROLE OF A RECENTLY FORMED HALOPHYTE COMMUNITY IN THE GUANABARA BAY RIO DE JANEIRO,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
For primary bibliographic entry see Field 5C.
W85-04851

CHEMICAL SURVEY OF THE VOLTA ESTUARY,
Institute of Aquatic Biology, Achimota (Ghana).
C. A. Biney.
Tropical Ecology, Vol. 20, No. 2, p 284-291, Winter, 1983. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Volta Estuary, *Ghana, *Chemical properties, Estuaries, Salinity, Water pollution sources, Dissolved oxygen, Biochemical oxygen demand, Nutrients, Water temperature, Sediments, Oil pollution, Beaches.

The River Volta originates in Upper Volta and enters the Gulf of Guinea. The estuary is made up of a complicated series of islands and lagoons ranging from 1 to 15 km from the mouth. Water samples were collected from six sites from the river head to Agakpopanya, 13 km upstream. Within km 8 of the river head, the pattern of ionic dominance was similar to that of sea water, but the surface waters were fresh right to the head. The very low salinity of the surface waters suggest a kind of stratification typical of salt wedge estuaries. High dissolved oxygen levels, low biochemical oxygen demand and low inorganic nutrient concentrations all indicated an unpolluted estuary. Localized enrichment occurred in some areas along the water front. Horizontal variations in nutrient concentrations were mainly related to land runoff. The range of temperatures recorded ofr the estuary was 26.8 to 31.8 C, a reflection of tis tropical status. The surface waters were particularly clear, which is an effect of the Akosombo dam, behind which sediments collect. The clarity and warmth of the waters had encourage the proliferation of aquatic vegetation in the shallower areas. Beach pollutants were of two main types: plastic material trapped on the river side of the sandbar; and oil in the form of tarballs on the seaward edge, probably from tankers on the Gulf of Guinea. (Moore-IVI)
W85-04854

VEGETATION AND PRIMARY PRODUCTION IN A FLOATING FRESHWATER MARSH IN LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. E. Sasser, and J. G. Gosselink.
Aquatic Botany, Vol. 20, No. 3-4, p 245-255, December, 1984. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Floating marshes, *Vegetation, *Primary production, *Lake Boeul, *Louisiana, Floating plants, Aquatic plants, Marshes.

Floating marshes, known locally as flotant, comprise a large proportion of Louisiana's 1.6 million ha of coastal wetland. The freshwater floating marsh surrounding Lake Boeul, Louisianna, is a diverse plant community dominated by Panicum hemitomon (maidencane), with the ferns Thelypteris palustris and Osmunda regalis and the perennial vines Vigna luteola and Polygonum sagittatum. The 72 species noted in the area represent 57 genera. The production of this community (1960 g/sq m/yr) is low compared with values reported for many other marsh communities in the same area. The Spartina alterniflora salt marsh community has a production of about 2500 g/sq m/yr, while the Spartina-patens dominated brackish marsh products in excess of 4000 g/sq m/yr. These latter communities produce new growth year round, and considerable production occurs during the winter, when maidencane shoots are dead. Maidencane is more comparable in production to marsh species such as Phragmites australis (2300 g/sq m/yr) and Spartina cynosuroides (1350 g/sq m/yr) that have a similar growth habit. (Baker-IVI)
W85-04855

SUSPENDED SEDIMENTS AND NUTRIENTS IN WATER EBBING FROM SEAGRASS-COVERED AND DENUDED TIDAL MUDFLATS IN A SOUTHERN AUSTRALIAN EMBAYMENT,
Victoria Ministry for Conservation, Queenscliff (Australia). Marine Science Labs.
D. A. Bulthuis, G. W. Brand, and M. C. Mobley.
Aquatic Botany, Vol. 20, No. 3/4, p 257-266, December, 1984. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Suspended solids, *Nutrients, *Mud flats, *Seagrasses, *Australia, Nitrogen, Phospho-

rus, Silicates, Tide water, Ebb tide, Bays, Tidal flats.

The concentrations of suspended solids, nitrogen (NH(4+), NO3(-), NO2(-)), phosphorus (total phosphorus, PO4(-3)) and silicate were measured in water ebbing from seagrass-covered tidal mudflats and from adjacent ungrassed mudflats in Western Port, Victoria, Australia. Ebb water was collected on six occasions during January and February (summer) and once during July (winter). From both types of mudflats the concentrations of suspended solids, phosphorus and silicate increased during the last hour of ebb tide with maxima in concentrations reached 0.5 to 1 h before slack water ebb. During the last 1.5-2.5 h of ebb tide the suspended solids, phosphorus and silicate concentrations were higher in the water ebbing from denuded mudflats than from seagrass-covered mudflats. The concentration of nitrogen remained low in water ebbing from both types of mudflats during the day, but increased significantly during a night-time ebb; light-dependent biological uptake of nitrogen is implicated. It is suggested that denudation of seagrass-covered tidal mudflats would lead to increased efflux of suspended solids, phosphorus and silicate from sediments to overlying water. (Author's abstract)
W85-04856

DEGRADATION OF MACROMOLECULAR ORGANIC COMPOUNDS IN A TROPICAL LAGOON (CIENAGA GRANDE, COLOMBIA) AND ITS ECOLOGICAL SIGNIFICANCE,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
H.-G. Hoppe, K. Gocke, D. Zamorano, and R. Zimmermann.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 6, p 811-824, 1983. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Organic compounds, *Decomposition, *Lagoons, *Cienaga Grande, *Colombia, Mangroves, Microbial degradation, Coastal waters, Particulate matter, Primary productivity, Bacterial, Biomass, Enzymes, Dissolved solids, Organic carbon.

The lagoon, Cienaga Grande de Santa Marta, is situated on the Caribbean coast of Colombia. Cienage Grande is 450 sq km in area; 1.5-2.0 m deep, and surrounded by a belt of mangroves. The aim of the study was to determine the sites of highest microbial activity in the lagoon and to compare its activity with other coastal water bodies. Since the shallow water lagoon contains a large amount of particulate matter, it was of special interest to study the degradation of this material and its influence on the microbial population. Primary production and decomposition of organic substances were investigated during the rainy season. Production and mineralization were measured using the oxygen method. Total bacteria numbers and biomass were estimated with epifluorescence microscopy, and the enzymatic degradation capacity of model substrates was determined photometrically. These parameters were measured in the water and sediment of the lagoon itself and also in its effluents and incoming waters. Up to 14% of the bacteria colonized the particles and 62% of the respiration originated in the particle fraction > 8 micro-m. The highest exoenzymatic activities were measured in the sediment and water of the mangrove belt. The mangrove environment is the most productive area of the lagoon, and the abundance of bacteria, especially those adherent to particles, is positively related to the enzymatic activities, which are responsible for a continuous input of low molecular weight organic substances into the dissolved organic carbon pool. (Moore-IVI)
W85-04907

PEDOLOGIC PROPERTIES OF NEW JERSEY TIDAL MARSHES,
Fruit and Food Technology Research Inst., Stellenbosch (South Africa).
A. Z. Jaworski, and J. C. F. Tedrow.
Soil Science, Vol. 139, No. 1, p 21-29, January, 1985. 5 Fig, 5 Tab, 25 Ref.

Descriptors: *Tidal marshes, *Soil properties, *Marsh plants, *New Jersey, Coastal marshes, Salt marshes, Marshes, Salinity, Soil chemistry, Estuarine environment.

Tidal marsh soils of New Jersey are divided into two varieties, protected coastal and estuarine. The soils have an average of 14% organic matter, indicating that they are not organic in a strict sense. Particle-size distribution indicates that the estuarine marsh types have formed under much higher energy conditions than protected coastal types; also, the latter are more saline than the former. Humification in tidal marsh soils increases with depth. Sand grain morphology indicates that surfaces of the grains from the saline tidal marshes are more spherical and chemically weathered than nearby terrestric counterparts. Tidal marshes in New Jersey are estimated to be about 3000 years old and, due to coastal subsidence, are currently migrating landward. Carbon/nitrogen ratios in the tidal marshes range from about 14 to 21. Estuarine sites have greater percentages of expanding clay minerals than the protected marshes. Various plant species in the tidal marshes are associated with different levels of salinity. Phragmites australis and Panicum virgatum are associated with low levels, Spartina alterniflora and Spartina patens with high and moderate levels, and Salicornia europaea with high levels of salinity. (Author's abstract)
W85-04955

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

USE OF ICEBERGS TO SUPPLY WATER (DIE VERWENDUNG VON EISBERGEN ZUR WASSERVERSORGUNG),
Tongji Univ., Shanghai (China).
H. Hantke.
Wasserwirtschaft, Vol. 74, No. 11, p 519-522, November, 1984. 5 Fig, 17 Ref.

Descriptors: *Icebergs, *Water supply, *Antarctic, Melting, Satellite technology, Water resources development.

While the use of icebergs to supply water in central Europe is unnecessary and impractical, the idea is not too far-fetched for Australia, Chile, Peru, and the coast of south-west Africa. Table icebergs (those with a flat top surface) are most suitable for transportation and are abundant in the Antarctic; the Amery, West, and Shackelton ice shelves are in the best geographical location for transport to Australia, while the Ross shelf is suited to the Atacama desert and California, and the Filchner and Larsen shelves are suited to southwest Africa and the Middle East. These and other Antartic ice shelves cover 1.4 million sq km and produce about 1,000 cu km of icebergs/yr. Satellite photos can be used to simplify the process of locating suitable icebergs, which can be found up to 40 degrees south in the Atlantic and to 50 degrees in the South Pacific. Melting must be reduced if long transportation times are to be withstood. The iceberg could be insulated from seawater during transportation to decrease melting by an underwater protective coating or a covering for the entire iceberg. If special towing ships are built, the power:weight ratio should be small. Suggestions for iceberg utilization include increasing melting speed by 4-5 cu m/sec using waste heat from a 1,000-MW power plant; and using the temperature gradient between surface (20-28 C) and deep (3-7 C) ocean water to drive turbines to produce heat, part of which is used to melt the iceberg. The average iceberg towed to Australia with 50% of volume lost during transportation would produce 690 million cu m water. (Gish-IVI)
W85-04625

3C. Use Of Water Of Impaired Quality

BRACKISH GROUNDWATER AS AN ALTERNATIVE SOURCE OF COOLING WATER FOR NUCLEAR POWER PLANTS IN ISRAEL,
Geological Survey of Israel, Jerusalem.
For primary bibliographic entry see Field 4B.
W85-04599

SALINE IRRIGATION WATER: EFFECTS ON SOIL CHEMICAL AND PHYSICAL PROPERTIES,
Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
R. E. Zartman, and M. Gichuru.
Soil Science, Vol. 138, No. 6, p 417-422, December, 1984. 6 Tab, 18 Ref.

Descriptors: *Irrigation water, *Saline water, *Soil chemistry, *Soil physical properties, Wastewater irrigation, Blow-down water, Saline soils, Sodium, Calcium, Magnesium, Permeability coefficient, Bulk density, Water retention.

Irrigation is becoming a practical means to use saline waste water. The purpose of this paper is to determine the effects of saline irrigation water on soil chemical and physical properties of a Friona fine sandy loam (Petrocalcic Paleustoll). Field plots were furrow-irrigated for 4 years with two saline water of different quality at three quantity levels. Irrigation was with either blow-down water from an electrical generating plant (ECw = 12 dS/m, SAR = 11) or city water (ECw = 1.5 dS/m, SAR = 4.5). Soluble salts increased in all irrigated plots, with the highest concentrations in plots irrigated with blow-down water. ECe values increased from 0.4 dS/m in the control (nonirrigated) plots to 6.0 dS/m in plots irrigated with high levels of blow-down water. Soluble Na, Ca, and SAR increased in all irrigated plots, with the highest values occurring in plots irrigated with high levels of blow-down water. Soluble Mg was greatest in the plots irrigated with city water. Hydraulic conductivities (K) were significantly reduced in the Ap horizons of plots irrigated with high and medium levels of blow-down water. K values ranged from 2 mm/30 min in the Ap horizon of high-irrigation, blow-down water plots to 37 mm/30 min in the control plots. K value for the B horizons, were less significantly affected by irrigation treatments. Bulk density and water retention were not significantly affected by irrigation treatments. (Author's abstract)
W85-04618

3D. Conservation In Domestic and Municipal Use

PEAK USE CHARGE: AN EQUITABLE APPROACH TO CHARGING FOR AND/OR REDUCING SUMMER PEAK USE,
Fairfax County Water Authority, Merrifield, VA.
For primary bibliographic entry see Field 6C.
W85-04687

EMPIRICAL BASIS FOR MUNICIPAL WATER RATES MODIFICATION,
Toronto Univ. (Ontario). Dept. of Geography.
A. P. Grima.
Canadian Water Resources Journal, Vol. 9. No. 3, p 22-39, November, 1984. 3 Fig, 7 Tab, 15 Ref.

Descriptors: *Pricing, *Ontario, *Municipal water, *Metropolitan water management, *Economic aspects, Water management, Water conservation, Water demand.

An empirical understanding of the variables affecting water rates is crucial for the formulation of more rational policies in urban water supply and its pricing. A comparative analysis was made of the costs of supply and water rates in Ontario with an emphasis on developing empirical methods for comparing average costs and marginal costs of

water supply with 'average' rates charged to consumers. Previous studies in Canada and the U.S. demonstrate that water use is price responsive. However, water pricing has not often been used as a policy tool; water charges are typically used to recover construction and operating costs. The few empirical studies suggest that costs of supply explain less than 50 percent of the variance in water rates; this was confirmed in this study. Methods for computing two measures of the marginal cost of supply were applied; in nearly half the municipalities in the sample, water supply production was still a declining cost industry and the declining block rate structure was still appropriate. However, a comparison of marginal cost and water rates indicates that there was considerable underpricing of municipal water. (Author's abstract)
W85-04688

RETROFITTING APARTMENT BUILDINGS TO REDUCE COSTS AND WATER DEMAND,
Hargraft and Sons Ltd., Toronto (Ontario).
D. S. Barclay.
Canadian Water Resources Journal, Vol. 9, No. 3, p 45-47, November, 1984.

Descriptors: *Costs, *Water conservation, *Domestic water, Municipal water, Flow control, Flow rates.

Seventy to eighty percent of the water used in apartments is controllable. Such control can lead to substantial savings in water as well as in energy to heat hot water, making retrofitting of appliances with water efficient devices economically viable within a reasonable time period. Shower heads are the most rewarding to retrofit because of savings of water and fuel costs. Toilets and hot/cold fixtures for faucets in the kitchen and bathroom also provide real savings from retrofitting. However, retrofitting requires effort by the building owner, superintendent and tenants. Furthermore, since maintenance is required, retrofitting with water efficient devices must be viewed as an ongoing program in an apartment building. (Author's abstract)
W85-04690

DEMAND REDUCTION: WATER CONSERVATION THROUGH LEAK DETECTION,
Pitometer Associates, Chicago, IL.
P. W. Kroushl.
Canadian Water Resources Journal, Vol. 9, No. 3, p 48-50, November, 1984. 1 Ref.

Descriptors: *Water demand, *Water conservation, *Leakage, *Water mains, Water distribution, Water loss, Correlators, Geophones, Resource conservation, Municipal water.

A systematic program was developed for the reduction of demand by using several techniques to pinpoint leakage. A large percentage of unaccounted-for water (the difference between 100% and the metered ratio percentage) may disguise excess demand which reduces system pressure. Velocity reduction in water pipes will reduce head losses, raise the water levels and increase system pressure. It may be that the system can function economically by reducing demand. Sources of unaccounted-for water must be assessed to eliminate unnecessary demand; these include: accurate metered delivery, good estimates of main breaks, hydrant flushing and fire flow tests, metering of all facilities, and underground leakage. The first choice for methods of reducing demand caused by leakage would be to conduct a do-it-yourself sounding survey. This approach should be systematic in its approach and long-term in its horizon. If this approach is ineffective, a consultant may be employed to conduct either a sonic survey or a water audit survey. Special equipment such as correlators may be used for determining leak location. The correlator is an expensive device with great potential for improvement; it is very effective when used with an intensifier such as a geophone. (Collier-IVI)
W85-04691

WATER LEAKAGE CONTROL AND SONIC DETECTION,
Heath Consultants Ltd., London (Ontario).
G. W. Hennigar.
Canadian Water Resources Journal, Vol. 9, No. 3, p 51-57, November, 1984.

Descriptors: *Leakage, *Water distribution, *Water mains, Unaccounted-for water, Water loss, Water conservation.

To serve the growing water needs of the population, an emphasis must be placed on resource conservation and the reduction of unaccounted-for water. The greatest economic loss to the water utility industry normally occurs in the distribution system. Even today surveys indicate unaccounted-for figures as high as 50% in some water distribution systems in North America. By using sonic instruments and developing leak detection methods supported by prompt repair programs, European nations have reduced wasted water well below North American acceptance levels; an unaccounted-for figure of 5% is considered high in Europe today. Instruments such as the Globe Geophone and the Metrotech 200L were developed mainly to assist in pinpointing known or suspected leak locations. These work fairly well but are slow and cumbersome for leak search activities. Leak search instruments and procedures have been developed which are keyed to the fact that water leaks create vibrations or frequencies on the pipe wall as the water escapes through the leak orifice. Portable electronic instruments with electrical sound amplification are now commonly used. These are available with or without frequency filtering capabilities; the predominant leak sound frequency is amplified and all other frequencies generally are attenuated to aid in pinpointing and locating leaks in areas with noisy ambient conditions. A new method of sonic water leak detection is Leak Sound Correlation which detects and locates leaks in pipeline networks based on the cross correlation technique. This new method gives the exact position of leaks while showing complete insensitivity to other noises and multipath transmission of sound through the ground. Leakage control programs, practiced and promoted by utilities will encourage individuals to make efforts to conserve water. (Collier-IVI)
W85-04692

MANAGING SUMMER LAWN IRRIGATION DEMANDS: A WATER USE INDEX,
Waterloo Regional Municipality (Ontario).
J. D. Pawley.
Canadian Water Resources Journal, Vol. 9, No. 3, p 66-68, November, 1984. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Lawn irrigation, *Irrigation management, *Public relations, *Waterloo, *Ontario, Public policy, Water conservation, Water management, Domestic water.

As a consequence of citizen concerns relating to the apparent emergency nature of the imposition of the lawn irrigation bans, the Waterloo Regional Engineering staff devised an early warning and advisory system for water users. Water supplies, especially during periods of summer drought, are limited in the service areas of the Regional Municipality of Waterloo due to limitations on equipped well capacities and the physical condition of the wells between times of repair and rehabilitation. This situation is especially severe in the twin cities of Kitchener and Waterloo. The Regional Municipality of Waterloo now publishes a 'Water Use Index' in numerical and graphical form during the summer months to inform water users as to the current state of water pumpage capability with respect to demand. A graphic depiction of a water spheroid is used with a superimposed index; a 0 represents a full condition and 100 represents an empty condition. The index value of 80 was established as an early warning alert to water users that voluntary water use reductions should occur or a lawn irrigation ban would be imposed. To reduce confusion, the index range was later inverted and revised so that advisory messages begin when the index reaches 25. This index is published in the daily newspaper when a hot dry spell is well underway. At the end of the summer, the use of the index is discontinued when the rainfall is judged sufficient to preclude the possibility of a late summer peak from lawn irrigation. The Water Use Index is valuable as a public information and public relations tool but the actual effectiveness in forestalling lawn irrigation bans is difficult to assess. (Collier-IVI)
W85-04694

LAWN AND GARDEN WATERING REGULATIONS: CONSERVATION THROUGH A WATER USE INDEX,
Maine Univ. at Orono. Canadian-American Center.
R. C. McFarlane.
Canadian Water Resources Journal, Vol. 9, No. 3, p 69-73, November, 1984. 18 Ref.

Descriptors: *Lawn irrigation, *Water conservation, *Water use index, *Public relations, *Waterloo, *Ontario, Municipal water, Lawns.

In communities where water shortages occur, lawn and garden watering can be one of the first uses of water to be reduced or prohibited. The challenge for a water manager faced with this circumstance is to communicate those regulations to the users. One communication technique is a 'water use index', designed to show changing water supply capacity in relation to water shortage regulations. The purpose of this paper is to evaluate the effectiveness of a water use index in regulating public use of water. A case study was selected for analysis, that of a water use index employed by the Regional Municipality of Waterloo, Ontario. Over one thousand households (stratified and randomly selected) were solicited through a telephone questionnaire and the responses were analyzed with non-parametric statistics. The criteria used for the evaluation were: diffusion, saliency, clarity, validity and behavioral change. The results of the study indicate that (1) the dispersal medium for water conservation information must be comprehensive, (2) the saliency and clarity of a water use index are high when a diagram is used, and (3) and index alone is unable to act as an enforcer of regulations or as a modifier of behavior. Improvements have been suggested for more effectively communicating lawn and garden watering regulations to the public. (Author's abstract)
W85-04695

WATER USE REDUCTION THROUGH METERING COULD PROVIDE SIGNIFICANT ECONOMIC BENEFITS TO INUVIK, N.W.T.,
Associated Engineering Services Ltd., Edmonton (Alberta).
N. C. Gridley.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 110-124, 3 Fig, 7 Tab, 7 Ref.

Descriptors: *Water metering, *Water conservation, Water use, Cost analysis, Conservation, *Canada, Cold regions, Cost-benefit analysis.

A study of water use patterns was undertaken in the Town of Inuvik, North West Territory, Canada. Measured water use is compared to typical North American patterns. The value of the water supplied to Inuvik's consumers is estimated, and the cost-effectiveness of water use reduction through metering and other methodologies is determined. Inuvik's 1978 water consumption was approximately 652 L/person/day, or about 2.5 times the water use which would be expected in a similar North American community. Benefits of reduced water use in Inuvik are calculated based on annual operations costs of the water supply and distribution system and value of deferred investments. It is believed tha metering of all consumers and simultaneous modification of billing practices could reduce water use considerably. Economic analysis suggest benefit to cost ratios exceeding 1.0 would be achieved if water use were reduced by only 16 percent; a reduction of 73 percent to expected levels (272 L/person/day) would effect a B/C ratio exceeding 3. The study concludes with economic assessments of other water use reduction strategies expected to be effective in Inuvik.
W85-04919

WATER CONSERVATION IN THE NORTHWEST TERRITORIES - PUBLIC EDUCATION AND AWARENESS PROGRAM,
Environmental Protection Service, Edmonton (Alberta).
B. Armstrong, and B. Milburn.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 125-139, 3 Fig, 4 Ref.

Descriptors: *Water conservation, *Water use, Cost analysis, Conservation, Education, Cold regions, Public policy, *Canada.

A public education and awareness program designed to promote an understanding of the need to conserve water was initiated in the Canadian Northwest Territories (N.W.T.). The campaign is comprised of two segments: 1) seminars suitable for presentation to potential audiences throughout the N.W.T. and 2) a multi-media approach using the mails and television, radio, and newspapers. The objective of the seminars was to acquaint the northern peoples with easy, in-home water conservation methods. Despite a great deal of advertising, seminar attendance was less than expected. One reason may be that the residents of the N.W.T. pay a very low percentage for water and sanitation services and do not realize the direct subsidy they are receiving from the government. In the near future, the consumer will pay a increased percentage of this service. A follow-up media program is being planned, including films, brochures, and seminars.
W85-04920

STUDY OF WATER BLEEDER CONTROL ALTERNATIVES,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
A. Yee, and D. W. Smith.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 152-179, 7 Fig, 4 Tab, 24 Ref.

Descriptors: *Water bleeding, *Control systems, Cold regions, Cost analysis, Computer models, *Canada, Economic evaluation, Laboratory study, *Utilities, Water supply.

The development and evaluation of alternative methods for reducing the amount of water that must be bled from a distribution network for freeze protection are presented. The project involved studying an existing water bleeder system, developing some water bleeder control devices, and evaluating these devices in a laboratory situation. Computer simulations were also conducted in order to determine the effects of reduced bleeder flows on an existing system. The existing water bleeder system chosen for study was that of Whitehorse in the Yukon Territory. The current practice for operators of water bleeders has the City advising them via newspaper and other media ads when to turn on their bleeders each year and, again, when to turn them off. Due to carelessness, or the lack of an economic incentive, some bleeders are turned off later or left on year round. Various alternatives to conventional bleeders were identified for further study as long as the alternatives were compatible with the existing infrastructure; met public health requirements; were easy to install, operate, and maintain; and simple and easy to manufacture. The alternatives considered were: a temperature control device; a timer device; an orifice of flow restricter; and a storage tank that would fill from an existing bleeder line before discharging to a sewer drain. A fifth alternative was later chosen that might have industrial or large commercial applications. A laboratory analysis disclosed that the timer option becomes a feasible alternative to the orifice plate at a delivery/disposal rate of $1.73/cu m. The results of the computer modelling are not as definite as those from the laboratory.
W85-04922

OPERATION AND MAINTENANCE CONSIDERATIONS FOR THE DESIGN OF ARCTIC WATER SYSTEMS,
Alaska Area Native Health Service, Anchorage.
For primary bibliographic entry see Field 6A.
W85-04923

3F. Conservation In Agriculture

SEDIMENTATION PROBLEM IN WATER CONSERVANCY IN CHINA,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
For primary bibliographic entry see Field 4D.
W85-04446

INTEGRATED WATER-ENERGY MANAGEMENT SYSTEM FOR CENTER PIVOT IRRIGATION: FUNCTIONAL REQUIREMENTS,
Agricultural Research Service, Fort Collins, CO.
For primary bibliographic entry see Field 7C.
W85-04742

INTEGRATED WATER-ENERGY MANAGEMENT SYSTEM FOR CENTER PIVOT IRRIGATION: IMPLEMENTATION,
Agricultural Research Service, Fort Collins, CO.
For primary bibliographic entry see Field 7C.
W85-04743

IRRIGATION SCHEDULING UNDER SALINE HIGH WATER TABLES,
California Univ., Davis.
B. R. Hanson, and S. W. Kite.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1430-1434, September-October, 1984. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Irrigation scheduling, *Saline groundwater, Water table, Root zone, Leaves, Water potential, Groundwater movement.

Many areas in the San Joaquin Valley (California) have saline high water tables. Irrigation scheduling in these areas requires consideration of upward flow of groundwater in the root zone and of salinity levels in the root zone. The leaf water potential, as measured with a pressure chamber, appears to be a reliable and practical scheduling index which will allow for consideration of both upward flow and salinity. Pressure chamber measurements used to schedule irrigation for a grower in a saline high water table area resulted in an increase in the interval between irrigations. Day-to-day variability in climate appeared to have little impact on this method of scheduling irrigations. (Author's abstract)
W85-04744

SPRINKLER DROPLET SIZE DISTRIBUTION ESTIMATION FROM SINGLE LEG TEST DATA,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 8C.
W85-04745

EFFECTS OF ELECTRICITY RATES AND RATE STRUCTURES ON PUMP IRRIGATION: AN EASTERN COLORADO CASE STUDY,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. L. Gardner, and R. A. Young.
Land Economics, Vol. 40, No. 4, p 352-359, November, 1984. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Irrigation water, *Economic factors, *Rate structure, *Colorado, Water management, Energy, Irrigation practices, Water use, Water conservation, Pumping, Groundwater.

The effects of electricity rate policy on electricity demand, and the derived effect on irrigation water use, are examined using a case study in eastern Colorado. Empirical demand curves for electricity for pump irrigation are estimated. Alternative rate structures are tested for their effect on electricity and water use patterns, farm income, and utility revenue. Particular attention is given to the problem of modeling a declining block structure. Relative crop prices were found to be more important than electricity rate structures in influencing predicted farm management decisions regarding pump irrigation. Rate structures which charge higher marginal prices for electricity provide farmers with more flexibility in their irrigation decisions in the form of greater rewards for reduced irrigation. One way to prolong irrigation in eastern Colorado is to implement electricity rates that reflect both the higher incremental costs of energy and the increasing scarcity of water in the declining Ogallala aquifer. An increasing block rate structure that ends at long run marginal cost deserves serious consideration in those portons of the region that are expected to experience growing electricity demand. (Baker-IVI)
W85-04752

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

EXPERIENCE IN OPERATING THE BRATSK RESERVOIR,
A. V. Nazarov.
Hydrotechnical Construction, Vol. 18, No. 4, p 171-177, April, 1984. 3 Fig, 1 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 31-35, April, 1984.

Descriptors: *Reservoir operation, *Bratsk Reservoir, *USSR, Operation, Reservoirs, Karst, Lumber industry, Navigation, Hydroelectric power, Reservoir fisheries, Erosion, Seiches, Construction.

The Bratsk reservoir is the largest in the USSR and second largest in the world. Initially, the reservoir was expected to be filled by the end of 1966. However, the actual filling was not completed until September of 1967. During filling and in the first years of operation it was constantly necessary to deal with floating timber in order to ensure normal operation of the hydrostation, navigation safety, conditions for fishery, and fulfillment of the sanitary requirements. Under the effect of wind and currents the surfaced wood moved along the reservoir. Control of the floating wood required considerable expenditures. During seasonal variations of the reservoir level about 160 sq km of the shore zone was subjected to variable flooding and waterlogging. Maximum erosion occurred on expanded stretches, and within their limits on slopes composed of loam and sand deposits. Within the narrows, where the banks are composed mainly of hard and soft rocks and wave action is weak, erosion is negligible. Wind setup and setdown cause maximum denivellation of the water surface. The maximum increase of the level during setup reaches 232 cm and the maximum decrease during setdown is 24 cm. Seiche oscillations with various amplitudes and periods are observed on the reservoir surface. The main uses of the complex are hydropower, water transport, timber floating, water supply, and fishery. For the successful development of the shores of reservoirs it is necessary to select the construction sites with consideration of possible occurrence of karstic and landslide processes; the construction of heavy structures requires special karst-control measures. (Baker-IVI)
W85-04429

GARRISON DIVERSION UNIT - AN UPDATE,
Brandon Univ. (Manitoba). Dept. of Geography.
J. Welsted.
Canadian Water Research Journal, Vol. 8, No. 1, p 51-59, 1983. 1 Fig, 12 Ref.

Group 4A—Control Of Water On The Surface

Descriptors: *Garrison Diversion Unit, *North Dakota, *Manitoba, *International Joint Commission, *Missouri River, *Hudson Bay, Water resources development, Political aspects, Governmental interrelations, International agreements.

The Garrison Diversion Unit (GDU), a massive multi-purpose water resource scheme in North Dakota, has caused controversy between Canada and the United States resulting in a reference to the International Joint Commission (IJC). The IJC concluded that the project as authorized by the United States Congress would adversely affect some Canadian waters particularly with respect to biota transfer from the Missouri System to the Hudson Bay Watershed and therefore recommended against completion of those parts of the project that would affect Canada. However, concern about the project still exists in Manitoba and in North Dakota where, for some time, legal actions stalled the project. Negotiations between Canada and the United States aimed at achieving a final agreement have started, but little progress has been made. In view of continued opposition from Canadian sources and increasing opposition from within the United States, it seems likely that only a scaled down version of the original project will be completed. (Author's abstract)
W85-04574

ZERO SIDE YARD HOUSING, ACCEPTANCE AND STORMWATER MANAGEMENT IMPLICATIONS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
H. Ellis, G. Mulamoottil, and E. McBean.
Canadian Water Resources Journal, Vol, 8, No. 2, p 19-30, 1983. 1 Fig, 3 Tab, 8 Ref, 1 Append.

Descriptors: *Housing, *Storm wastewater, *Zero side yard housing, Urban runoff, Storm runoff, Runoff management, Water quality, Detention reservoirs.

There is expected to be an increased demand for medium-density housing in the next few years. One version of the traditional single-family unit that can be included in medium-density housing is the zero side yard or zero lot line unit. This design is characterized by reduced lot width and the placement of the house on one side of the lot. The zero side yard concept of housing has met with the approval of all concerned agencies in Canada. The potential stormwater management implications associated with zero lot line subdivision designs were investigated using hypothetical test scenarios. Stormwater quantity and quality runoff regimes were generated using the EPA SWM model. The increased runoff quantity and decreased water quality associated with zero lot line developments over that of conventional subdivisions can be significant. Stormwater retention or detention pond volume requirements can increase significantly. (Moore-IVI)
W85-04580

INTERNATIONAL WATER MANAGEMENT IN CANADIAN-AMERICAN RELATIONS, 1894-1907,
Royal Military Coll. of Canada, Kingston (Ontario).
For primary bibliographic entry see Field 6E.
W85-04588

PROBLEMS WITH TRADITIONAL SMALL RESERVOIR IRRIGATION SYSTEMS IN THE SEMI ARID TROPICS,
Sun Trac Corp., Glenview, IL.
P. N. Sharma, and O. J. Helweg.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1451-1454 and 1462, September-October, 1984. 5 Tab, 9 Ref.

Descriptors: *Irrigation efficiency, *Tanks, *India, Reservoirs, Developing countries, Semi-arid regions, Water use, Seepage, Evaporation.

In the semi-arid tropics (especially India), monsoon precipitation is collected in small reservoirs, called tanks, to supply water for supplemental irrigation during the rainy season and full irrigation in the dry season. The widespread use and popularity of tank irrigation systems is mainly due to the seasonality and extremely erratic distribution of the precipitation within the rainy season. Two of these systems were studied in detail to compare their potential overall water utilization efficiency (WUE) with their actual WUE. The overall system WUE's were three to five times lower than their potential WUE. In the traditional systems, three to five times more water is supplied to rice crops than required by its evapotranspirations needs, which results in a very low project water utilization efficiency (usually between 15 and 30 kg/ha/cm). The overall systems water utilization efficiency of traditional tanks is low when compared to the potential water utilization efficiency because of high seepage and evaporation losses in addition to the low project utilization efficiency. These traditional irrigation practices may be improved by use of appropriate cropping systems, better water control, and management. (Moore-IVI)
W85-04747

EFFECT OF DRAIN TUBE OPENINGS ON DRAINAGE AND SUBIRRIGATION,
Civil Engineering Dept., Sallah Al-Din University, Arbil, Iraq.
F. S. Mohammad, and R. W. Skaggs.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1455-1462, September-October, 1984. 12 Fig, 6 Tab, 15 Ref.

Descriptors: *Drainage, *Subirrigation, *Drain tubes, Hydraulic head, Water table, Drawdown.

A laboratory soil tank was used to determine the effect of the drain tube perforations on transient drainage and subirrigation processes. Seven corrugated plastic drain tubes with varying total perforation areas and locations were tested. Experiments were also conducted with a standard drain tube surrounded with a 5-cm thick gravel envelope. Drainage and subirrigation experiments were conducted for three combinations of initial and final water table positions. The pressure head distribution, drainage and subirrigation flow rates were measured continuously during each test and the results are reported. There was an increase in drain flow, drawdown and subirrigation rates with increase in total perforation area up to an area of 38.5 sq cm/m. Doubling the perforation area 79 sq cm/m further increased the drawdown rate and had about the same effect as the use of a 5 cm gravel envelope for the cases tested. Tubes with smaller perforation areas had a greater proportion of the total hydraulic head loss occurring near the drain for both drainage and subirrigation. The water table was backed up over the drain for tubes with smaller perforation areas (1.8 sq cm/m - 8.8 sq cm/m) for more than 40 h after drainage began for all conditions tested. Location of the drain tube perforations had only a small effect on drawdown, drainage outflow and subirrigation rates. More work is needed to determine the effect of hole locations on transient state drainage. (Author's abstract)
W85-04748

ALGORITHMS FOR OPTIMIZING HYDROPOWER SYSTEM OPERATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. C. Grygier, and J. R. Stedinger.
Water Resources Research, Vol. 21, No. 1, p 1-10, January, 1985. 2 Fig, 7 Tab, 44 Ref.

Descriptors: *Reservoir operation, *Hydroelectric plants, *Algorithms, Mathematical studies, Linear programming, Optimization, Systems analysis, Water resources development, Multireservoir systems, Computer models.

Three algorithms are compared for optimizing the operation of multireservoir hydrosystems over the medium term. The algorithms considered are a combination of linear programming and dynamic programming, an optimal control algorithm, and successive linear programming (SLP). Of these three, only SLP and the optimal control algorithm consistently found a locally optimal deterministic policy. The SLP algorithm is easier to implement and seems to converge to a global optimum. The optimal control algorithm was significantly faster. Computing costs are reasonable with both algorithms and should increase only as the square of the number of reservoirs in contrast to the exponential growth of dynamic programs. The efficiency of the algorithms, which may be improved further by extensions described in the text, allows the inclusion of multiple streamflow forecasts at modest cost. Since the reservoir operating problem is really a stochastic one, the extension of these algorithms to include uncertainties in inflows with the multiple futures method is important. Deterministic optimization algorithms on modern computers now yield optimal solutions for complex hydrosystems for only a few dollars per run. If this success can be transferred to stochastic or semistochastic algorithms, the benefits in terms of improved efficiency in hydropower generation and water supply could be substantial. (Baker-IVI)
W85-04786

WATER FOR THE FLATS.
Prospect (Johannesburg) Vol. 21, No. 2, p 10-13, 1982. 6 Fig.

Descriptors: *Water supply, *South Africa, *Rural areas, Irrigation, Water resources development, Pipelines, Plastic pipes, Reservoirs, Pumping stations.

The Duivenhoks Rural Water Supply Scheme, scheduled for completion during the 1982/83 financial year is expected to go a long way in improving the quality of life in the Overberg area of the South Western Districts of the Cape of South Africa. The scheme is designed to suply water for domestic purposes and for stock watering to 285 farms with a total of 157,000 hectares and to supply purified water to the settlement at Askraal as well as to the coastal resorts of Witsand, Port Beaufort and Oysterbeds. The primary souce of the proposed scheme is the Duivenhoks River dam with a net assured yield of 10.4-million cu m/annum, of which about 1.1 million cu m will be acquired by the scheme and the remainder can be used to consolidate and extend irrigation along the Duivenhoks River. The area to be supplied with water is generaly known as The Flats due to the level terrain. Water will be pumped from the Duivenhoks River to the purification works and then to a break-pressure reservoir. A gravity main will supply water to Heidelberg and Askraal, whle the remaining water will be pumped further to a main reservoir, from which the rural area and coastal resorts will be served. A further pumping station will lift the water for the northern region. Pipelines will consist mainly of PVC piping and will have an overall length of 470 km and range in diameter from about 50 mm to 350 mm. (Baker-IVI)
W85-04811

4B. Groundwater Management

BRACKISH GROUNDWATER AS AN ALTERNATIVE SOURCE OF COOLING WATER FOR NUCLEAR POWER PLANTS IN ISRAEL,
Geological Survey of Israel, Jerusalem.
A. Arad, and A. Olshina.
Environmental Geology and Water Sciences, Vol. 6, No. 3, p 157-160, 1984. 7 Fig, 2 Tab, 2 Ref.

Descriptors: *Groundwater potential, *Brackish water, *Cooling water, *Israel, Beer Sheva, Water supply, Nuclear powerplants, Groundwater recession, Salinity, Saline water intrusion.

The western Negev is being considered as a potential site for the location of a nuclear powerplant. Since this part of Israel has no surface water, the only alternatives for cooling water are piped-in water, Mediterranean water and local, brackish groundwater. The Judea Group aquifer was examined for its potential to provide the required amount of cooling water over the lifetime of the plant, without causing a drastic lowering of the regional water table. The salinity of the water

tends to increase from east to west. Flow within the aquifer is in the direction of Beer Sheva, where the extraction rate is 32 to 35 million cu m/yr. This has resulted in a salinity creep of 5-10 mg Cl per year in the Beer Sheva area, which poses a danger of deterioration of its water supply in the long term. Given the assumed range of aquifer properties, extraction of brackish water for cooling purposes will not result in large changes in the regional water table. Exploitation of the more saline water to the southwest of Beer Sheva could preserve the quality of Beer Sheva's water supply, at the expense of an increase in the depth from which it must be pumped. (Moore-IVI)
W85-04599

LGWRES - LIFE OF GROUND-WATER RESERVES,
Ministry of Planning, Riyadh (Saudi Arabia).
F. A. Rayner.
Ground Water, Vol. 23, No. 1, p 81-84, January-February, 1985. 2 Fig, 3 Tab.

Descriptors: *Groundwater mining, *Water use, Model studies, Safe yield, Water supply, Groundwater recharge.

LGWRES is a simplistic program, for the HP-41C series of programmable calculators, to determine the lifetime of ground-water reserves in years; total use over the lifetime of the reserves; percentage of domestic and agricultural uses; additional years of possible agricultural use realized by dedicating the domestic use to agriculture; and percentages of total use, domestic use, and agricultural use that could be sustained by annual replenishment to the ground-water reserves, within the 'safe yield' concept. (Author's abstract)
W85-04643

MAIN RESULTS OF A PROJECT FOR ARTIFICIAL GROUND-WATER RECHARGE FROM SECONDARILY TREATED SEWAGE IN THE MUNICIPAL FOREST OF THE CITY OF LANGEN (LOWER MAIN REGION) (DIE WICHTIGSTEN ERGEBNISSE EINES PROJEKTES ZUR KUNSTLICHEN GRUNDWASSER-ANREICHERUNG MIT WEITERGEHEND BEHANDELTEM ABWASSER IM LANGENER STADTWALD (UNTERMAINREGION)),
Hessische Landesanstalt fuer Umwelt, Wiesbaden (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W85-04809

4C. Effects On Water Of Man's Non-Water Activities

POTENTIAL EFFECTS ON GROUND WATER OF A HYPOTHETICAL SURFACE COAL MINE IN INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
K. J. Banaszak.
Ground Water Monitoring Review, Vol. 5, No. 1, p 51-57, 1985. 7 Fig, 18 Ref.

Descriptors: *Groundwater movement, *Surface mining, *Environmental effects, *Indiana, Water chemistry, Groundwater monitoring, Monitoring, Mining, Forcasting, Model studies.

The possible mine will remove a gently, less than 50 feet per mile, westerly dipping Springfield coal from an area covered by glacial till and some channel sands and gravel. The area is flat with less than 20 feet of relief in a square mile. The channel sands and gravels, the till and the bedrock are capable of yielding groundwater at 5 to 75, 3 to 10, and 1 to 10 gallons per minute (gpm), respectively. The groundwater in the drift and the shallow bedrock is calcium-bicarbonate type, contrasting with the sodium-bicarbonate type in the deep bedrock. The surface mine will feature selective handling of overburden. The probable hydrologic consequences of the mine will be 1) a short-term, areally limited dewatering, 2) an increase in dissolved solids, 3) a change in groundwater chemistry in some areas to a calcium-bicarbonate sulfate water, 4) an increase in groundwater storage, and 5) a new integrated surface water system. The proposed groundwater monitoring system will include seven monitoring wells in the glacial material and one in the bedrock. The primary effort in groundwater monitoring to the west of the mine will be to detect changes in the quality of the groundwater, whereas to the east, changes in both quality and quantity will need to be monitored intensively. (Author's abstract)
W85-04418

EFFECTS OF LAND DRAINAGE ON STREAM FLOW,
Guelph Univ. (Ontario). School of Engineering.
R. W. Irwin, and H. R. Whitely.
Canadian Water Resources Journal, Vol. 8, No. 2, p 88-103, 1983. 1 Tab, 49 Ref.

Descriptors: *Drainage effects, *Streamflow, *Ontario, Flood peak, Tile drainage, Subsurface drainage, Land use, Storage capacity, Rainfall runoff, Channel improvement, Agricultural watersheds.

Every commerical agricultural crop grown in Ontario requires a well-aerated soil for maximum economic production. Soil which does not drain quickly and naturally can be improved by the installation of a subsurface tile drainage system. Over half the agricultural land in Ontario needs this form of drainage improvement. The effects of land drainage on streamflow are reviewed. Conclusions on effects are difficult to establish because response varies with different types of drainage work and differing physiographic and climate situations. Coincident changes in land use, and the high variability of inputs, add complications. Tile drainage provides storage capacity in the soil profile. This storage acts as a reservoir which fills and reduces surface runoff for low intensity storms but will have only a minimum effect for medium and high intensity storms. Tile drainage decreases peak flow up to the point where the soil becomes saturated after which it probably only increases it slightly. If a large portion of a watershed is drained by enlarged surface channels, increased flood peaks may be expected. The effect is damped if contributions to the channel are not synchronized. Channel enlargement will increase flood peaks in unimproved channel sections downstream of the area of improved channel drains. Connection of swamps or enclosed areas to rivers by large arterial drains increases flood peaks. Over the range of rainfalls giving rise to floods, a combination of tile drains and outlet channel enlargement appears to be beneficial in modifying flood peaks. (Moore-IVI)
W85-04583

EFFECT OF ANTHROPOGENOUS CHANGES OF WATER CONDITIONS ON THE VEGETATION IN THE FOREST RESERVE LAS BIELANSKI IN WARSAW (WPLYW ANTROPOGENNYCH ZMIAN STOSUNKOW WODNYCH NA ROSLINNOSC REZERWATU LAS BIELANSKI W WARSZAWIE),
Warsaw Univ. (Poland). Zaklad Fitosocjologi i Ecologii Roslin.
J. M. Chojnacki, and W. J. Mroz.
Wiadomosci Ekologiczne, Vol. 30, No. 2, p 167-192, 1984. 6 Fig, 14 Ref.

Descriptors: *Las Bielanski forest reserve, *Poland, *Forests, *Hydrologic budget, Plant communities, Ecological distribution, Groundwater level, Environmental effects, Vegetation, Habitats.

Water relations at the Las Bielanski reserve in Warsaw were investigated to obtain an estimation of the range and effect of anthropogenic changes, and to consider the possibility of correcting the existing water budget. Investigations were conducted on a section of the reserve in the Vistula valley and on its terraces - the lowest flood terrace, the higher overflood terrace, and partly on the dune terrace. Two groups of plant communities are found: elm-ash forests of Ficario-Ulmetum type on flood terrace and in depressions of the overflood terrace; and oak-hornbeam forests (Tilio-Carpinetum association) on the highest parts of the overflood terrace. The communities dynamics are most visible in the composition and structure of forest stand regeneration. For several centuries man has been responsible for the water relations in Las Bielanski. Anthropogenic changes in water relations, especially the changes in depth of occurrence of ground water, varied both in intensity and their direction. In the last decades, these changes resulted in a gradual drying. The decrease in ground water level took place mainly on the overflood terrace. A decrease in ground water level, a change in its stability and greater drainage by brooks caused the formation of a new system of habitat factors, and a gradual transformation of communities by secondary succession. Former swampy alder forests were transformed into elm-ash forests of Ficario-Ulmetum type, typical moist oak-hornbeam forests and dry oak-hornbeam forests. The restoration of past water conditions may be quite dangerous for the stability of the present, developing system of plant communities. Present moisture relations in the root zone of trees remain within the limits of the physiological tolerance of forest stands. Thus the planned water project should not be put into use. (Moore-IVI)
W85-04610

BRACKISH WATER IN UNSATURATED CONFINING BEDS AT A TEXAS LIGNITE MINE,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2F.
W85-04639

EFFECT OF AGRICULTURAL LAND USE ON GROUND-WATER QUALITY IN A SMALL PENNSYLVANIA WATERSHED,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W85-04642

TILLAGE INFLUENCES ON EROSION DURING FURROW IRRIGATION,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
E. C. Dickey, D. E. Eisenhauer, and P. J. Jasa.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1468-1474, September-October, 1984. 4 Fig, 5 Tab, 13 Ref.

Descriptors: *Soil erosion, *Furrow irrigation, *Tillage, Runoff, Nutrients, Conservation tillage, Irrigation effects, Cultivation.

Erosion and runoff from furrow irrigation of corn was measured for three conventional and three reduced tillage systems in 1981 and 1982. The plots were located on a Hastings silt loam soil having a 0.5% slope and a 366 m furrow length. Erosion was the least for slot-planting and greatest for the chisel system, ranging from 20 to 340 kg/ha, respectively, for the first 45 min of runoff during the first irrigation. Erosion from the fourth irrigation was about 75% less than from the first irrigation. Cumulative runoff after 45 min of runoff was similar for all treatments. Nutrient losses were minimal for all irrigations monitored. For most tillage treatments, no differences were measured between nonwheel and wheel track furrows for cumulative soil loss, erosion rate, sediment concentration, runoff amount and runoff rate. (Author's abstract)
W85-04749

4D. Watershed Protection

WATERSHED REHABILITATION PROGRAM RELATED TO THE MANAGEMENT OF RIVER AND RESERVOIR SEDIMENTATION IN INDONESIA,
Ministry of Forestry, Djakarta (Indonesia).
E. Sutadipradja, and H. Hardjowitjitro.
Water International, Vol. 9, No. 4, p 146-149, December, 1984. 3 Tab, 4 Ref.

Descriptors: *Erosion, *Indonesia, *Sedimentation, *Reservoirs, *Public policy, Soil conservation, Conservation, Revegetation, Reforestation, Watershed management.

Problems of sedimentation in Indonesia are basically caused by population problems (i.e., high population density, high population growth and unequal distribution) and improper use of the land without appropriate soil conservation measures. The erosion rate on dry land reached nearly 4 cm a year and at present 8.5 million hectares are considered as critical lands. The government of Indonesia has made great efforts to control soil erosion and sedimentation through the watershed rehabilitation program in 36 groups of priority watersheds based on Presidental Instruction Projects. Regreening projects on private lands have involved more than 1.95 million hectares and reforestation projects on state forest areas have an annual target of about 300,000 hectares. These projects have increased land productivity, provided more permanent labor opportunities and have been investigated as economically feasible actions. The government has created, with ample funds, a large field organization as a culmination of all efforts in finding a solution for more effective erosion and sedimentation control. (Author's abstract)
W85-04438

CONTROLLING EROSION AND SEDIMENTATION IN THE PANAMA CANAL WATERSHED,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
C. L. Larson, and W. Albertin.
Water International, Vol. 9, No.4, p 161-164, December, 1984. 1 Fig, 4 Ref.

Descriptors: *Watershed management, *Alajuila Watershed, *Panama, *Canal, Watershed, Erosion control, Erosion, Landslides, Cultivated lands, Slopes, Erosion.

The Alajuila Watershed has a highly developed drainage pattern with narrow valleys and steep, irregular slopes. Unfortunately, 13,400 ha of land in the over 45% slope category have been cleared by colonists and almost half of this is now being cultivated or pastured. After about 2 yr of cultivation, the land is converted to pasture or abandoned due to loss of fertility. Gullies often appear after about 5 yr of pasturing. Landslides are a problem in the steeper portions of the watershed. In early 1978 a task force assembled to study the problem. Three watersheds were selected from a five year project. The major objectives of the project were to protect the watershed from further deterioration by erosion and, in the case of the Canal Watershed, to protect the Alajuela and Gatun reservoirs from accelerated sedimentation. Watershed management activities carried out under the project include plantation forestry, agroforestry, forest reserves, pasture management soil conservation, land-use zoning, community education and new land-use concepts. The ultimate success of a watershed program depends on a sound institutional framework as well as adequate funding. Typically, neither is assured in this case. (Baker-IVI)
W85-04442

ECONOMIC/INSTITUTIONAL ISSUES IN SEDIMENTATION MANAGEMENT IN DEVELOPING COUNTRIES,
Comision Economica para America Latina, Santiago (Chile). Div. of Natural Resources and the Environment.
M. Nelson.
Water International, Vol. 9, No. 4, p 165-168, December, 1984. 2 Fig, 3 Ref.

Descriptors: *Santiago, *Chile, *Developing countries, *Economic aspects, *Watershed management, *Sedimentation, Erosion control, Management.

Economic analysis as an aid to decision on management of sedimentation, rests on use of benefit-cost or cost-effectiveness techniques. The usefulness of such analysis depends on three fundamental conditions; identification of key physical relationships, subject to management intervention, which enable prediction of the cause-effect linkages in generation, transport and deposition of sediment; prediction of economic and financial costs and benefits associated with linkages in the physical system which influence sediment yields and their upstream and downstream effects; and evaluation of the viability and transaction costs of alternative institutional arrangements to undertake activities to change sediment supply and manage downstream consequences. The key economic principles which apply to sediment management are opportunity cost, tradeoffs and diminishing marginal returns, exponential decline in yields or exponential increase in unit costs of production or environmental protection. If resources are used in such a way as to reduce inputs or amenities provided through the water system downstream, as a result of sedimentation, then management requires that society divert investment from other activities to protect the resource base. As a first step it is essential to identify the critical physical cause-effect linkages in erosion and transport and deposition of sediments. The vast majority of sediment management situations in Latin America, Asia and much of Africa are characterized by over-use of the upstream catchments under the prevailing technology. One is faced in these situations with the problem of organizing, maintaining and operating sociosystems to respond to dynamic complex conditions which require changes in both upstream technology and downstream perception of values with respect to development of the floodplain, acceptable risk for investments in this development, and equity and income transfers between upstream and downstream residents. (Baker-IVI)
W85-04443

MANAGEMENT OF SEDIMENT IN NEW SOUTH WALES, AUSTRALIA,
Water Resources Commission of New South Wales, Sydney (Australia).
D. Outhet, and R. Morse.
Water International, Vol. 9, No. 4, p 169-171, December, 1984. 1 Fig, 8 Ref.

Descriptors: *Sedimentation, *Watershed management, *New South Wales, Erosion control, Management, Soil erosion, Land use, Sediment transport.

The amount of sediment in major New South Wales rivers and reservoirs is relatively low compared to world averages. This is a result of relatively low erosion rates, the sediment coarseness and numerous sediment sinks between the eroding parts of catchments and the rivers and reservoirs. In some locations several problems have required attention. These include: sediment blockage of roads and culverts; sedimentation of small reservoirs and recreational lakes; sedimentation on large alluvial fans; river channel damage caused by low sediment supply; and lack of effective government control over soil erosion and sedimentation in the past. Strategies to overcome these problems start with information collection to pinpoint major problems. This enables the preparation of total catchment management plans. These require proper land-use policies, legislation and education of the public for effective implementation. The catchment management plans face several implementation problems. First legislation must be updated to enable Government authorities to coordinate their activities and implement the plan. This avoids the problem of funds going to one organization or problem area at the expense of others that are essential parts of the plan. Another problem is that many landholders believe that their sediment sources are insignificant and also that they have a right to do as they please on their own land. The complexity of the interrelated processes of erosion, transportation and deposition means that any action must be taken in a carefully considered and coordinated manner. (Baker-IVI)
W85-04444

SEDIMENTATION IN NEW ZEALAND HYDROELECTRIC SCHEMES,
Ministry of Works and Development, Wellington (New Zealand).
For primary bibliographic entry see Field 2J.
W85-04445

SEDIMENTATION PROBLEM IN WATER CONSERVANCY IN CHINA,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
D. Wu.
Water International, Vol. 9, No. 4, p 177-180, December, 1984. 3 Fig, 2 Tab, 4 Ref.

Descriptors: *Erosion control, *Sedimentation, *China, Hydroelectric plants, Watershed management, Water conservation, Soil conservation, Sediment managment, Water resources development, Reservoir sedimentation.

The state-of-the-art of river sedimentation management in China is reviewed. Attention is focused on the sediment load carried by main rivers in China; the related sediment problems encountered in developing water resources; and the methods in dealing with those problems. There are 50 rivers with annual maximum sediment load exceeding 10 million tons in China. There are more than 400,000 sq km of loess plateaus and hills in the drainage basin of the Yellow River. Inadequate conservation of soil and water leads to erosion, transportation and deposition of sediment, giving rise to much trouble in water conservation works. These problems include flood control, navigational concerns, reservoir sedimentation, and sediment problems of low-head diversion dams or hydroeletric projects. Methods for dealing with sediment problems include water and soil conservation and use of turbid water with emphasis on terracing, strip cropping, forestation, grass and crop rotation. Several types of structures may be built along a gully such as small reservoirs, check dams, drop structures, drainage ditches, and irrigation canal systems for diverting hyperconcentrated flow into farmland or to warp land. Processes for diverting water while preventing sediment from entering water intakes at hydroelectric plants are becoming more advanced. (Baker-IVI)
W85-04446

PRIVATE AND SOCIAL COST - BENEFIT PERSPECTIVES AND A CASE APPLICATION ON RESERVOIR SEDIMENTATION MANAGEMENT,
Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
F. Hitzhusen, B. Macgregor, and D. Southgate.
Water International, Vol. 9, No. 4, p 181-184, December, 1984. 2 Tab, 14 Ref.

Descriptors: *Developing countries, *Reservoir sedimentation, Sediment transport, Erosion control, Reservoirs, Forest management, Clear-cutting, Costs, Watershed management, Slopes, Agriculture, Dominican Republic, Valdesia dam.

The development of a comparative private and social cost-benefit perspective for sedimentation management in developing countries is considered. The design of optimum policies with respect to sediment management requires a comprehensive conceptualization and estimation of the level and distribution of private and social costs and benefits of alternative strategies. A situation in the Dominican Republic is used as a case application of the method. Clear cutting of several forested areas in the Cordillera Central has brought about a high rate of soil loss. In order to diminish the dependence of that country on imported oil, the Valdesia dam was constructed. Sedimentation in the reservoir has been a matter of continuous concern. Even before a major hurricane swept over the island in 1979 annual sediment yield in the reservoir watershed was estimated at 1.4 million metric tons. The following management policies were developed: in areas with a slope of class A (3-20% slope), continue crop farming on existing cropland; encourage mulching and contour farming and renovate all rangeland with a slope of 13-20%; for areas with a slope of class B (21-35% slope), encourage mixed cropping/agroforestry enterprises on existing cropland and renovate all rangeland; in areas with a slope of class C (36-50% slope), convert all existing cropland to agroforestry and

renovate all rangeland; in areas with slope of class D (over 50% slope), reforest all existing cropland and rangeland. (Baker-IVI)
W85-04447

SYSTEM OF PRACTICES FOR PREVENTING WATER BY AGRICULTURAL CHEMICALS,
Ukrainian Research Inst. of Forestry and Agriculture, Ivanovo-Frankovsk (USSR).
For primary bibliographic entry see Field 5G.
W85-04619

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DETERMINING TRACE CONCENTRATIONS OF COPPER IN WATER BY CATHODIC FILM STRIPPING VOLTAMMETRY WITH ADSORPTIVE COLLECTION,
Liverpool Univ. (England). Dept. of Oceanography.
C. M. G. van den Berg.
Analytical Letters, Vol. 17, No. A19, p 2141-2157, 1984. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Cathodic stripping voltammetry, *Voltammetry, *Copper, *Hanging mercury drop electrodes, *Metals, *Water analysis, Catechol, Complexing agents.

Certain metals have been successfully analyzed by cathodic stripping voltammetry (CSV) with concentration of the metal ions onto the surface of solid electrodes by precipitation with complexing agents which form complex ions of low solubility. Trace concentrations of copper (II) in natural water samples were determined by CSV of a film of copper-catechol complex ions adsorbed on a hanging mercury drop electrode (HMDE). Complexation with copper(II) is not selective for copper, but complexes with copper (II) are rather strong; additionally, the reduction potentials of various competing heavy metal ions such as lead (II) and cadmium (II) are well separated from that of copper (II). Addition of a large surplus of catechol (0.0001 to 0.001 M) further ensures that effectively 100% of all copper (II) ions is present in the catechol-complex ion form. After collection the current is measured for the reduction of copper (II) to copper (0) by CVS of the collected film using differential pulse modulation. The peak height of the copper-catechol reduction peak is linearly dependent upon the copper (II) concentration between 10 to the minus 10th and 10 to the minus 7th power M. The detection limit of the technique is below 10 to the minus 10th power M copper (II) for a collection time of 3 minutes, but the sensitivity can be further increased four-fold by collecting for 15 minutes. The sensitivity is reduced by high concentrations of competing trace metals and of surfactants, which necessitate calibration by standard additions to the sample. (Collier-IVI)
W85-04410

EVALUATION TECHNIQUE FOR GROUND WATER QUALITY BENEATH URBAN RUNOFF RETENTION AND PERCOLATION BASINS,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
For primary bibliographic entry see Field 2G.
W85-04417

GAS CHROMATOGRAPHIC DETERMINATION OF PICLORAM IN FISH,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
A. W. Rieger, D. C. G. Muir, and M. R. Hendzel.
Journal of the Association of Official Analytical Chemists, Vol. 68, No. 1, p 59-61, January/February, 1985. 1 Fig, 3 Tab, 5 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Picloram, Organic compounds, Fish, Chromatography, Herbicides.

Picloram, a widely used herbicide, degrades slowly in soils and water and is mobile in the soil environment because of its high water solubility. Thus it has the potential to contaminate aquatic systems. A method is presented for determining picloram in fish using HCl-ethyl acetate extraction, diazomethane derivatization, Florisil mini-column cleanup, and gas chromatographic (GC) determination. Two different extraction methods are described, one involving acidification and the other without acidification. The detection limit for this method is 5 ng/g, using a 4 g sample. The analysis was quick, simple, and sensitive. A radiotracer study showed that the extraction step was efficient when dealing with fish actually exposed to picloram. (Baker-IVI)
W85-04433

MONITORING OF RIVER WATER QUALITY WITHIN THE GREAT OUSE BASIN USING THE CHIRONOMID EXUVIAL ANALYSIS TECHNIQUE,
Anglian Water Authority, Huntingdon (England).
L. P. Ruse, and R. S. Wilson.
Water Pollution Control, Vol. 83, No. 1, p 116-135, 1984. 16 Fig, 6 Tab, 20 Ref.

Descriptors: *Great Ouse Basin, *England, *Water analysis, *Monitoring, *Midges, Exuvial analysis, Water quality control, Rivers, Pollutant identification.

The ubiquitous nature of chironomids makes the exuvial sampling technique as presented unique in its ability to sample the whole course of a river, and also presents a valuable opportunity for comparing it with currently accepted techniques used by water authorities. The method is useful for deep sluggish stretches difficult to sample adequately by other biological methods. The study was performed where the Bedford Ouse and Ely Ouse rivers merge together to form the Great Ouse basin. The close agreement between observations from the exuvial analysis and expectations from other sources strongly suggests this new method is a reliable source of information, sensitive to short and long-term river quality trends. The analysis may highlight water quality problems not identified with other techniques. (Baker-IVI)
W85-04454

DETERMINATION OF COD BY A MERCURY-FREE OPEN-TUBE METHOD,
Yorkshire Water Authority (England).
K. E. de Casseres, D. G. Best, and B. D. May.
Water Pollution Control, Vol. 83, No. 3, p 416-419, 1984. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Water analysis, *Chemical oxygen demand, Open-tube method, Chlorides, Silver sulfate.

Alternative COD methods have been explored which eliminate the use of mercury salts as chloride suppressants. An open tube method is described which also eliminates mercury sulfate and uses additional silver sulfate to act both as catalyst and chloride suppressant. This modified semimicro method has been evaluated using standard solutions and real samples both with and without the addition of chloride, and the results are compared with those obtained by the standard SCA reflux method. The proposed method offers substantial savings in chemicals and about a 70% savings in bench space compared with the reflux method, while maintaining acceptable accuracy and precision. The study showed 8% silver sulfate is an effective chloride suppressant and is a suitable substitute for sulfuric acid in COD determinations where the chloride concentration does not exceed 2000 mg/l and the chloride:COD ratio is not greater than 5:1. The method has the added advantage of increased sample throughput and explosion risks are minimal. (Baker-IVI)
W85-04467

VOLATILE ORGANIC POLLUTANTS IN BIOTA AND SEDIMENTS OF LAKE PONTCHARTRAIN,
New Orleans Univ., LA. Center for Bio-Organic Studies.
J. B. Ferrario, G. C. Lawler, I. R. DeLeon, and J. L. Laseter.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 246-266, February, 1985. 4 Tab, 15 Ref. Army Corps of Engineers, Contract DACW29-82-M-0189.

Descriptors: *Lake Pontchartrain, *Louisiana, *Sediments, *Organic compounds, Estuarine biota, Volatile compounds, Halogenated hydrocarbons, Benzene, Toluene, Estuaries, Pollutant identification.

Lake Pontchartrain is a shallow, oligohaline, 1631 sq km estuary located in the deltaic plain of the Mississippi River. The lake serves an adjacent metropolitan area of over 1.5 million people as a major recreational area and as a source of substantial quantities of crabs, shrimps, and other aquatic foods. Samples of oysters, clams, and sediments were collected in May-June, 1980, from the mouths of the Inner Harbor Navigation Canal (IHNC), the Chef Menteur Pass, and The Rigolets, at Lake Pontchartrain. Oysters from the IHNC population contained thirteen specific EPA priority pollutants, of which ten were identified as halogenated with the remainder being benzene and two of its derivatives. The mean concentrations ranged from 0.04 ng/gram wet weight for chlorobenzene to 310 ng/g wet weight for 1,1,1-trichloroethane. The results of the analysis for volatile organic pollutants showed thirteen specific priority pollutants in the analyses with the IHNC samples showing the largest number. Most of the priority pollutants identified are halogenated, with the remaining compounds being benzene and toluene. While the volatile organic priority pollutants found in the biota and sediment samples are of obvious anthropogenic origin, the majority of the other compounds identified are probably biogenic. All the volatile EPA priority polutants identified have possible adverse human health effects including central nervous system depression, narcosis, and various renal and hepatotoxic effects. (Baker-IVI)
W85-04476

IMPORTANCE OF SPECIATION METHODS IN ANALYTICAL CONTROL OF WATER TREATMENT PROCESSES WITH APPLICATION TO FLUORIDE REMOVAL FROM WASTE WATERS,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
J. Buffle, N. Parthasarathy, and W. Haerdi.
Water Research, Vol. 19, No. 1, p 7-23, 1985. 12 Fig, 4 Tab, 52 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Chemical analysis, *Fluoride, *Speciation, Aluminum hydroxide, Coagulation, Ultrafiltration, Filtration, Chemical coagulation, Water anlysis, Spectroscopy.

In many treatment processes, coagulant control is limited just to determination of its optimum dose by the empirical jar-test method which gives no indication of the nature of reactivity of the active species and gives no determination of the forms of the pollutant. Simple methods were developed for control of coagulant reactivity, the products formed, and reactivity of the uneliminated pollutants in the removal of fluoride from aluminum industry wastewater by preciptation with hydrolyzed Al(III) polymer. Fluoride wastes originate from wet scrubbing of emissions from reduction furnaces in which aluminum is separated from bauxite in the presence of cryolite. The wastewater contains the following major constituents with varied concentration depending on the treatment used: F = 50-500 mg/l; SO4 = 0-500 mg/l; Ca = 0-40 mg/l; and 3 < pH < 8. A combination of ultrafiltration with spectroscopic methods and fluoride ion-selective electrode offers a powerful means for the control of both the precipitant and pollutant, e.g. fluoride. Al-27 n.m.r. was used for the identification of hydrolytic products of

aluminum(III) and the ultrafiltration technique was applied for the separation of the active polymer. The hydrolytic products were also characterized by timed spectrometric method. The interaction between aluminum hydroxide polymer and fluoride was studied by means of fluoride ion-selective electrode, ultrafiltration and atomic absorption spectrometry. Using these techniques for determination of optimum conditions for fluoride removal, it was found that the fluoride levels can be brought down to less than 10 mg/l, the limit set by Swiss regulatory body for discharge of waste water. (Collier-IVI)
W85-04485

MEASUREMENT OF PARTICULATE ASSOCIATION OF AMERICIUM IN FRESHWATER,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
N. S. Fisher.
Water Research, Vol. 19, No. 1, p 79-84, 1985. 2 Fig, 4 Tab, 22 Ref.

Descriptors: *Americium, *Particulates, *Complexation, *Radionuclides, Filtration, Metals, Water analysis.

A laboratory investigation tested various filtration methods to study the particulate-water fractionation of Am-241 added to filtered freshwater (Monaco tap water) adjusted to different pH's. By using a system of washed Nuclepore polycarbonate filters, the particulate association (> 0.2 or > 1 micro m) was found to increase hyperbolically with pH and with time, so that less than 1% of the Am was filterable (i.e. retained by a filter) at pH 4.2 and about 5% was filterable at pH 8.2 after 1 day; light had no apparent effect on the filterability of the Am. These values are somewhat greater than those for particle association of Am in seawater but substantially lower than previous estimates of Am particulate association in filtered freshwater. Filter adsorption problems are identified for other filtration systems commonly employed to assess metal particulate association. The results suggest that Am in freshwater is unlikely to form particles to an appreciable extent at pH's < or = 8. (Author's abstract)
W85-04491

COMPARISON OF CURRENT METHODS OF POLIOVIRUS CONCENTRATION FROM TAP WATER,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5F.
W85-04492

DETERMINATION OF TRIALKYL AND TRIARYL PHOSPHATES IN ENVIRONMENTAL SAMPLES,
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
For primary bibliographic entry see Field 5B.
W85-04497

DIFFERENT APPROACH TO WATER QUALITY SAMPLING,
Wessex Water Authority, Poole (England).
M. P. Brown, and D. P. Outtram.
Water Pollution Control, Vol. 82, No. 3, p 309-314, 1983. 2 Tab.

Descriptors: *Water quality control, *Sampling, Somerset River, England, Water quality, Computers, Monitoring.

A random sampling program project was undertaken to produce better information on the quality of river waters and discharges with the existing number of samples taken from the Somerset River. Composite river maps were prepared from samples taken and used to prepare graded river maps. With reference to the grade river maps the overall sampling requirement for the division was deduced by applying certain rules. A crossroad has now been reached in the development of the sampling program. The fully computerized scheme could be pursued, the existing program (suitably enhanced to take account of some of the shortfalls) could be continued or the whole scheme abandoned in favor or the original approach to sampling or another new approach. At present a regional sampling scheme is being developed, and the implications of this upon the agency sampling program have not yet been fully evaluated. (Baker-IVI)
W85-04524

EVALUATION OF ACIDIFICATION BASED ON FORMER COLORIMETRIC DETERMINATION OF PH: THE EFFECT OF INDICATORS ON PH IN POORLY BUFFERED WATER,
Oslo Univ. (Norway). Dept. of Limnology.
I. A. Blakar, and I. Digernes.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 679-685, October, 1984. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Colorimetry, *Acidification, *Indicators, *Hydrogen ion concentration, Buffering, Water analysis.

The effect of indicators on pH in unbuffered water are examined and the use of the former colorimetric pH-data to quantify changes in pH over time is discussed. Indicator solutions did not influence pH of strongly buffered solutions, but unbuffered water was affected to a varying degree. In parts of their working range the indicators had little effect on pH, but could show considerable deviation in others. An example is given of how pH in different unbuffered water samples measured to 5.3, 6.6, and 8.3 with pH-meter, could all be read to 6.6 colorimetrically depending on the indicator used. Correspondingly unbuffered water with pH 5.4 could be measured to pH 4.8, 5.4, 5.9, or 8.3 depending on which indicators were used. All the effects were within the standard working ranges of the indicators used. Methylred (4.4 to 6.0) and methylorange (2.8 to 4.4) were the only indicators giving relatively accurate pH-determinations. Other indicators evaluated included bromcresolgreen, bromcresolpurple, dibromred, bromophenolred, bromthymolblue, phenolred, and cresolred. Ideally, the indicator solution added should have the same pH as the sample, but this would make measurements very laborious and complicated. The pH-meter readings of unbuffered water changed less than 0.05 pH-units when any of the indicators tested were added in higher dilution (1:400). (Baker-IVI)
W85-04530

METALS AND SYNTHETIC ORGANIC COMPOUNDS IN PLANKTON FROM THE ESTUARY AND HARBOR AREA IN OSAKA CITY,
Osaka City Inst. of Public Health and Environmental Sciences (Japan).
S. Kawai, M. Fukushima, T. Tsuchinaga, and K. Oda.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 50, No. 10, p 1777-1783, October, 1984. 4 Fig, 5 Tab, 16 Ref.

Descriptors: *Plankton, *Monitoring, *Pollutant identification, *Heavy metals, *Organic compounds, Osaka, Japan, Chlorinated hydrocarbons, Organophosphorus compounds, Biological magnification, Estuaries, Harbors.

This study was made in order to evaluate the feasibility of net plankton analysis for monitoring pollution due to heavy metals and synthetic chemicals in seawater. Plankton was collected by using a phytoplankton net in the harbor area of Osaka City, Japan. Heavy metals, organochlorine and organophosphorus compounds in the net plankton and also in the corresponding seawater were determined. The heavy metal concentration in the seawater increased in the order of, HG < Cd < Pb < Cu, Cr < Ni < Zn < Mn < Fe. In the net plankton, the order was as follows; Hg < Cd < Ni, Cr, Pb < Cu, Mn < Zn < Fe. Except for Ni and Mn, the metal levels in the net plankton corresponded to those in the seawater, and their bioconcentration factors (BCF) were 10,000 to 50,000 but in Ni and Mn the factors were 4,000 to 5,000. Organochlorine compounds such a PCBs and HCH were clearly noticed in the net plankton and the levels ranged from 1 to 5 micro-g/g and from 0.1 to 0.2 micro-g/g in dry basis, respectively. These values were entirely dependent on the seawater levels and the BCF of PCBs was 11,000 and 4,000 in HCH. Organophosphorus pesticides including diazinon, IBP (s-benzyl diisopropyl phosphorothionate) and fenitrothion were almost always found in the seawater. These compounds, however, were never detected in the net plankton. These results indicate the feasibility of plankton analysis for monitoring approximate pollution in water, but some problems observed in certain metals and organophosphorus compounds still remain to be studied. (Author's abstract)
W85-04607

COMPARISON OF THE SELENASTRUM BOTTLE TEST AND THE NATURAL PHYTOPLANKTON ASSAY IN ALGAL TOXICITY TESTS,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
V. A. Eloranta, and L. Halttunen-Keyrilainen.
Archiv fur Hydrobiologie Supplement, Vol. 67, No. 4, p 447-459, December, 1984. 4 Fig, 4 Tab, 23 Ref.

Descriptors: *Pulp wastes, *Toxicity, *Phytoplankton, *Selenastrum bottle test, Kraft mills, Carbon radioisotopes, Effluents, Industrial wastes, Algae, Algal growth.

Acute toxicity of three effluents from a bleached kraft pulp mill was studied on algal growth and C-14 fixation with Selenastrum bottle test and natural phytoplankton assay. The effluents used were the C-stage and the E-stage effluents, and the whole effluent, BKME. The main purpose of this study was to compare the results between the single-species test (a screening test) and the natural phytoplankton community assay, and to evaluate the usefulness of these tests. Chemical properties of test solutions (e.g. pH, buffering capacity, nutrients) affected the acute toxicity of the effluents more than test algae. Algal responses measured by two different methods might remarkably differ because of dark color of the effluent. According to the standardized test, Selenastrum was most sensitive to the effluents. However, in lake water tests Selenastrum was less sensitive than natural phytoplankton after the EC50 (2 + 4 h) values. The phytoplankton assay might also show another kind of sensitivity, to show secondarily stimulative effects of the effluents. (Author's abstract)
W85-04615

PRECONCENTRATION OF SUBMICROGRAM AMOUNTS OF METALS FROM NATURAL WATERS FOR X-RAY ENERGY SPECTROMETRIC DETERMINATION USING PYRROLIDINECARBODITHIOIC ACID,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
T. Tisue, C. Seils, and R. T. Keel.
Analytical Chemistry, Vol. 57, No. 1, p 82-87, January, 1985. 5 Fig, 4 Tab, 24 Ref.

Descriptors: *Trace metals, *Spectrometry, Natural waters, X-ray energy spectrometry, Preconcentration, Water analysis, Metals.

A method was developed for the routine determination of several trace metals in natural waters by X-ray energy spectrometry following precipitation with pyrrolidinecarbodithioate. Preoxidation with persulfate eliminates interferences by organic matter. By optimizing carrier ion selection and measurement conditions, one may determine dithioate-reactive elements with Z < or = 50 by means of their K X-rays, and some with Z > or = 80 by means of their L X-rays. Determinations are feasible for several elements at concentrations down to 250 ng/L, or below. Recoveries are generally greater than 90%, although some exceptions are noted. Reproducibility with real samples averaged about 25% relative standard deviation for five representative elements at concentrations above 250 ng/L. (Author's abstract)
W85-04621

TRACE DETERMINATION OF ALDEHYDES IN WATER BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Osaka Prefecture Environmental Pollution Control Center (Japan).
K. Takami, K. Kuwata, A. Sugimae, and M. Nakamoto.
Analytical Chemistry, Vol. 57, No. 1, p 243-245, January, 1985. 4 Fig, 4 Tab, 8 Ref.

Descriptors: *Aldehydes, *High-performance liquid chromatography, Alphatic compounds, Aromatic compounds, Cation exchange, Sampling, Acetaldehyde, Propionaldehyde, Benzaldehyde.

A liquid chromatographic method is presented to determine trace amounts of aliphatic and aromatic aldehydes in water by using an innovative sampling cartridge. The PTFE cartridge used was packed with a moderately sulfonated cation exchange resin charged with 2,4-dinitrophenylhydrazine. A 20-500-mL volume of water sample was passed through the cartridge. The 2,4-dinitrophenylhydrazone derivatives of the aldehydes on the resin were selectively eluted with acetonitrile. The eluate was analyzed by high-performance liquid chromatography with a 3-micro-m ODS column. With a 500-mL water sample, the detection limits were 0.6 micro g/L for formaldehyde and 0.3 micro-g/L for acetaldehyde, propionaldehyde, and benzaldehyde. The aldehydes could be determined with 1.7-3.7% relative standard deviation in the range 1-10 micro-g/L. (Author's abstract)
W85-04622

SIMULTANEOUS DETERMINATION OF ZINC AND CHROMATE IN COOLING WATER BY DIFFERENTIAL PULSE POLAROGRAPHY,
Projects and Development India Ltd., Sindri (India). Chemical Research Wing.
V. K. Jindal, M. A. Kham, R. M. Bhatnagar, and S. Varma.
Analytical Chemistry, Vol. 57, No. 1, p 308-383, January, 1985. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Polarography, *Zinc, *Chromates, *Cooling water, Pollutant identification, Phosphates, Chromates, Differential pulse polarography, Water analysis.

The use of differential pulse polarography (DPP) for the simultaneous determination of zinc and chromate in cooling water is reported where zinc (5 ppm), chromate (20 ppm), and polyphosphate (50 ppm) formulation is used as a corrosion inhibitor. This will help in effective control of cooling tower performance. In addition to calcium ions, other ions that are likely to be present and interfere with the determination of zinc and chromate ions by DPP are sulfate, chloride, nitrite and nitrate, and these occur in significant amounts in the cooling and process water. The DPP method has been applied for the simultaneous determination of zinc and chromate ions in process and cooling water samples from fertilizer plants in India. The method is based on the reduction of Cr and Zn on SMDE in 1 M NH3-0.1 M NH4Cl and 0.005% gelatine supporting electrolyte. Due to interference it is essential to complex calcium ions by adding polyphosphate and to destroy NO2(-)/NO3(-) by adding sulfamic acid along with hydrochloric acid before the actual recording of DP polarograms. The present DP polarographic method for the simultaneous determination zinc and chromate is comparable in its utility and applicability with spectrophotometric methods. The method has a better accuracy and higher sensitivity and is quick, as both of the ions can be determined in a single scan. (Baker-IVI)
W85-04624

DETERMINATION OF MICROBIAL CELL NUMBERS IN SUBSURFACE SAMPLES,
Oklahoma State Univ., Stillwater. Dept. of Biochemistry.
J. J. Webster, G. J. Hampton, J. T. Wilson, W. C. Ghiorse, and F. R. Leach.
Ground Water, Vol. 23, No. 1, p 17-25, January-February, 1985. 2 Fig, 3 Tab, 34 Ref.

Descriptors: *Microorganisms, *Subsurface material, *Bacterial analysis, Metabolic activity, ATP, Microbiological studies.

Because the transport and fate of the organic pollutants may be influenced by microorganisms present in subsurface material, reliable measurements of the number of organisms in subsurface samples and their metabolic activity are needed. A special drilling rig and aseptic procedures were used to yield uncontaminated subsurface samples. The number of bacteria in subsurface samples was determined by microscopic counting after acridine orange staining; the proportion of cells capable of respiration was determined by INT reduction. An independent measure of metabolic activity was obtained by measuring ATP extracted from the samples. A procedure and extractant for the extraction of ATP from subsurface material were developed. The extractant contains reagents to reduce the loss of the extracted ATP. Subsurface samples from Oklahoma and Texas contain 10 to the 6th to 10 to the 7th cells per g of subsurface material (depths of 2-9 m). Between 1 and 10% of the cells were metabolically active. When the two methods are employed together, a more complete picture of the potential metabolic activity can be obtained. When coupled with existing microcosm data, these methods can reduce the expense and time for predicting the behavior of pollutants in subsurface environments. (Moore-IVI)
W85-04636

NITROGEN-ISOTOPE RATIOS OF NITRATE IN GROUND WATER UNDER FERTILIZED FIELDS, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W85-04641

DETERMINATION OF TRACE AMOUNTS OF HEAVY METALS IN WATERS BY A FLOW-INJECTION SYSTEM INCLUDING ION-EXCHANGE PRECONCENTRATION AND FLAME ATOMIC ABSORPTION SPECTROMETRIC DETECTION,
Academia Sinica, Shenyang (China). Inst. of Forestry and Soil Science.
Z. Fang, S. Xu, and S. Zhang.
Analytical Chimica Acta, Vol. 164, p 41-50, October, 1984. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Atomic absorption spectrometry, *Flow-injection analysis, *Ion exchange, *Heavy metals, Nickel, Copper, Lead, Cadmium, Metals, Pollutant identification,.

A flow-injection system with ion-exchange preconcentration and atomic absorption detection has been developed and applied to the determination of trace amounts of heavy metals in some natural waters. A multifunctional rotary valve, incorporating two parallel miniature ion exchange columns packed with a chelating resin with salicylic acid functional groups was used for sequential sampling, injection, ion exchange and elution. A 20-28 fold increase in sensitivity compared to direct aspiration of sample was obtained for nickel, copper, lead, and cadmium at a sampling rate of 40/hr and 40-50 fold enhancements were possible at samping rates of 20/hr. (Baker-IVI)
W85-04653

APPLICATION OF ION-EXCHANGE CHROMATOGRAPHY WITH AN ION-SELECTIVE ELECTRODE DETECTOR TO IODINE DETERMINATION IN NATURAL WATERS,
National Research Council of Canada, Halifax (Nova Scotia). Atlantic Research Lab.
E. C. V. Butler, and R. M. Gershey.
Analytica Chimica Acta, Vol. 164, p 153-161, October, 1984. 6 Fig, 24 Ref.

Descriptors: *Ion exchange chromatography, *Iodine, *Pollutant identification, *Ion selective electrode, Water analysis, Potentiometry, Natural waters, Seawater, Iodides.

The use of an iodide-ion selective electrode to measure iodide separated from other anions in fresh waters and sea water by ion exchange high pressure liquid chromatograpy is described. For efficient operation of the detector, a background level of iodide is diffused into the column effluent just upstream of the detector. This feature enables on-line preconcentration of iodide on an anion guard cartridge. For sea water, it is advantageous to determine iodide directly and to quantify iodate as the difference between total iodine and iodide. The direct determination of iodide in a coastal sea water and the quantitation of other iodine species after simple chemical pretreatment are described. (Baker-IVI)
W85-04654

SAMPLING TUBING EFFECTS ON GROUNDWATER SAMPLES,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
For primary bibliographic entry see Field 7B.
W85-04655

SCHEME FOR THE DIRECT ANALYSIS OF ORGANICS IN THE ENVIRONMENT BY TANDEM MASS SPECTROMETRY,
Virginia Univ., Charlottesville. Dept. of Chemistry.
D. F. Hunt, J. Shabanowitz, T. M. Harvey, and M. Coates.
Analytical Chemistry, Vol. 57, p 525-537, February, 1985. 1 Fig, 8 Tab, 15 Ref.

Descriptors: *Tandem mass spectrometry, *Pollutant identification, *Water analysis, Mass spectrometry, Organic compounds.

An alternative system for the direct analysis of organics in the environment is presented which is based on tandem mass spectrometry that overcomes many of the limitations inherent in the gas chromatography/mass spectrometry methodology. The method employs the technique of collision activated dissociation on a triple quadrupole mass spectrometer and facilitates direct, rapid qualitative semiquantitative analysis of organics in both liquid and solid environmental matrices at the 10-100 ppb level. Elimination of most, if not all, wet chemical and chromatographic separation steps, detection of both known and unknown by molecular weight and functional group, and a total analysis time per sample of under 30 min are additional features of the tandem mass spectrometry method. (Baker-IVI)
W85-04656

USE OF BACTERIOLOGICAL INDICATORS FOR SWIMMING WATER QUALITY,
Gore and Storrie Ltd., Toronto (Ontario).
M. D. Palmer, J. D. Lock, and T. P. H. Gowda.
Water and Pollution Cotrol, Vol. 122, No. 3, p 14-15, 17-18, 74, May/June, 1984. 1 Fig, 2 Tab.

Descriptors: *Water quality, *Bacteria analysis, *Indicator organisms, *Swimming, Recreation, Water management, Coliforms, Bacteria, Sampling, Beaches.

For an indicator bacteria to be a reliable measure of water quality they should be associated with the source of pathogens; be able to provide an accurate estimate of the number of pathogens present at the levels which pose a health risk; have the same environmental survival characteristics of the most resistant pathogen possibly present; and be measurable by simple methods with considerable accuracy. The use of fecal coliforms as an indicator requires a relationship between the coliforms and pathogens. Enterococci have proved to be extremely useful as they were found to be more consistently related to fecal wastes than the other indicators; their densities did not increase during treatment of the wastewaters; they do not multiply after leaving the intestinal tract; they survive better in the environment than coliforms and enteroviruses; and they seem to better simulate viral pathogens with regard to chlorine sensitivity. It is general practice that a geometric mean value of a number of samples should be used as a measure of the bacteria to reduce the impact of single abnor-

mally high values. How many samples are required for a representative geometric mean value is of major concern. The sampling program should be developed for a particular beach to reflect the characteristics and use of that beach. For some beaches other secondary indicators can be used to indicate elevated levels of bacteria. Health authorities will have to establish the level of acceptable risk for any particular beach. (Baker-IVI)
W85-04765

VOLTAMMETRIC METHODS FOR DISTINGUISHING BETWEEN DISSOLVED AND PARTICULATE METAL ION CONCENTRATIONS IN THE PRESENCE OF HYDROUS OXIDES. A CASE STUDY ON LEAD (II),
Technical Univ. of Lisbon (Portugal). Inst. Superior Tecnico.
M. de L. S. Goncalves, L. Sigg, and W. Stumm.
Environmental Science and Technology, Vol. 19, No. 2, p 141-146, 1985. 4 Fig, 2 Tab, 29 Ref.

Descriptors: *Lead, *Voltammetry, *Dissolved solids, *Particulate matter, Oxides, Colloids, Polarography, Pollutant identification, Iron oxide hydroxide, Manganese dioxide, Silicon dioxide, Metals.

Voltammetric techniques (differential pulse polarography, DPP, anodic stripping voltammetry, ASV, and differential pulse anodic stripping voltammetry, DPASV) were evaluated for their capability to distinguish between dissolved and particulate Pb(II) concentrations. Colloids of FeOOH, MnO2, and SiO2 were found to have no effect on the electrochemical reversibility (peak width, peak potential and pseudopolarographic half-wave potential) of the Pb(II) reduction system. Soluble Pb(II) concentrations measured in the presence of colloids were consistent and independent of the voltammetric method used and the different time scales employed in these techniques. Equilibrium constants for the specific adsorption of Pb(2+) on FeOOH, MnO2, and SiO2 surfaces were determined. Applicability of voltammetric techniques to other metals and in the presence of other colloids and in natural waters is discussed. (Author's abstract)
W85-04800

DETERMINATION OF SPREADING OF NUTRITIVE SALTS IN QUASI-STAGNANT WATERS BY USING LITHIUM (CHLORIDE) AS TRACER AND CONTINUOUS MEASUREMENT OF WATER-QUALITY PARAMETERS (DIE BESTIMMUNG VON AUSBREITUNGSVORGANGEN VON NAHRSALZEN IN QUASI STEHENDEN GEWASSERN UNTER VERWENDUNG DES TRACERS LITHIUM (CHLORID) UND DIE KONTINUIERLICHE MESSUNG VON WASSERGUTEPARAMETERN),
Neandestre. 23, 1000 Berlin 49.
H. Kaldenhoff.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 4, p 118-122, October, 1984. 8 Fig.

Descriptors: *Tracers, *Lithium chloride, *Water quality, *Nutrients, Sampling, Data analysis, Stagnant water, Solute transport, Diffusion.

A measuring system was developed to determine the spreading of nutritive salts in quasi-stagnant waters. Lithium chloride was used as a tracer. The system is installed on board a boat and consists of an injection appliance for producing the tracer cloud, a sampling system for taking water samples continuously from different depths, a flame spectrometer for in-situ sample analysis, a data logger and a software package for data analysis. The tracer concentration in each zone of measurement can be plotted in the form of an isogram or a three-dimensional graph to show the spreading and movement as a function of time and depth. the system is also suited, using analogous probes, to measure water quality parameters, such as oxygen concentration, pH, temperature, conductivity and metal ions. These data are then evaluated and plotted in the same way as the tracer concentration. (Moore-IVI)
W85-04810

SPECIFIC ULTRAVIOLET ABSORBANCE BAND OF MICROCYSTIS AERUGINOSA TOXINS,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
J. N. Eloff.
Journal of the Limnological Society of South Africa, Vol. 8, No. 1, p 5-7, 1982. 3 Fig, 11 Ref.

Descriptors: *Ultraviolet absorption, *Microcystis, *Toxins, Cyanophyta, Toxicity, Eutrophication.

Microcystis aeruginosa is a cosmopolitan cyanobacterium frequently responsible for freshwater algal blooms in eutrophied impoundments. The blooms result in serious water management problems. Toxic fractions of Microcystis aeruginosa extracts were always associated with a 240-nm absorbance band. The ratio of the absorbance at 240 nm to other wavelengths can provide a measure of toxin purity during isolation. Mouse toxicity assay which is a relatively tedious and time-consuming procedure if accurate toxicity estimates are required, have always been used to detect toxic fractions. The M. aeruginosa toxins were ninhydrin-negative before hydrolysis and lacked visible fluorescence. Their 240-nm absorbance is of value in the isolation of the toxin. Monitoring the eluates from column chromatographic separations at 240 and 210 nm identified toxic fractions in all of the M. aeruginosa extracts examined because only toxic fractions have higher absorbance at 240 than at 210 nm. (Baker-IVI)
W85-04816

SEWAGE-DERIVED BACTERIA MONITORED IN A MARINE WATER COLUMN BY MEANS OF CAPTIVE MUSSELS,
University Coll. of Swansea (Wales). Dept. of Botany and Microbiology.
D. R. Trollope, and S. B. S. Al-salihi.
Marine Environmental Research, Vol. 12, No. 4, p 311-322, 1984. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Bacteria, *Mussels, *Monitoring, *Wastewater pollution, Escherichia, Streptococcus, Fecal coliforms, Marine environment, Tidal effects, Bacterial analysis.

Batches of mussels, Mytilus edulis, obtained from a sewage-free shore were introduced into the water column at a sewage polluted site and the changed content (Escherichia coli, fecal streptococci) was assessed after immersion periods of 2 to 40 h. Rapid bacterial uptake was demonstrated; changes were analyzed with respect to immersion period, revealing that 2 h was satisfactory. The numbers of bacteria varied with height in the water column; mussels for the sea bed contained higher numbers of E. coli than mussels immersed just below the surface except for mussels withdrawn at, and for about 3 h after, low water (LW). These observations were shown to be related to the characteristics of the effluent and tidal systems operative at the site. (Moore-IVI)
W85-04868

EMBRYO ABNORMALITIES IN THE PERIWINKLE, LITTORINA 'SAXATILIS', AS INDICATORS OF STRESS IN POLLUTED MARINE ENVIRONMENTS,
Institute for Marine Environmental Research, Plymouth (England).
D. R. Dixon, and D. Pollard.
Marine Pollution Bulletin, Vol. 16, No. 1, p 29-33, January, 1985. 3 Fig, 30 Ref.

Descriptors: *Periwinkles, *Bioindicators, *Marine environment, *Wales, Embryonic growth stage, Water pollution effects, Water quality, Pathology, Gastropods.

Brood pouches of periwinkles belonging to the Littorina 'saxatilis' species complex usually contain, in addition to the five normal stages in development, a proportion of embryos that are morphologically abnormal. The frequency of adults with a high percentage of abnormals in their brood pouches reflects to a great extent the degree of environmental stress, natural and anthropogenic, to which the adult population has been exposed. Collections of this gastropod from coastal populations along the Gower coast, in South Wales, disclosed higher frequencies of abnormal embryos from sites exposed to pollutant-laden, residual water currents in Swansea Bay, than was recorded from a clean, coastal population at Rhossili, 26 km west of Swansea, where frequencies were similar to those recorded from other unpolluted, coastal populations elsewhere in the British Isles. While environmental water quality is probably a dominating factor in determining this effect, the presence of a low frequency of high scoring individuals in clean environments points to this phenomenon having a complex etiology. It is suggested that the underlying causal factor may be one of disease, which is present in all L. 'saxatilis' populations, and which is triggered by factors related to reduced environmental water quality. (Author's abstract)
W85-04893

RETRIEVAL OF MATERIAL FROM THE SURFACE MICROLAYER WITH SCREEN AND PLATE SAMPLERS AND ITS IMPLICATIONS FOR PARTITIONING OF MATERIAL WITHIN THE MICROLAYER,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
K. W. Estep, J. S. Maki, S. C. Danos, and C. C. Remsen.
Freshwater Biology, Vol. 15, No. 1, p 15-19, February, 1985. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Air-water interfaces, *Surface microlayers, *Sampling, Particulate matter, Dissolved solids, Algae, Surface tension.

Unique physical, chemical and biological conditions exist at the air-water interface. Visible slicks often form a surface film. In addition to this surface monolayer there is an associated layer of undetermined thickness in which dissolved material and organisms are often concentrated. Surface microlayer samples were collected from two small experimental ponds in Wisconsin from June 1978 to November 1980, using screen and plate samplers. These devices performed identically for dissolved substances but for particulate material the glass plate sampler produced values 4 times those obtained with the screen. Differences in sampling efficiency are probably the result of the failure of the screen sampler to release all of the particulate material it has collected. Macroscopic algal filaments are often trapped on the screen during draining. Particulates are most likely to be concentrated at the surface monolayer by virtue of adherence to the surface tension and would be more efficiently sampled by the plate which picks up less subsurface water. There may be a four-fold dilution with subsurface water in the screen samples when compared to the plate samples. Dissolved material is concentrated in a thicker layer below the surface monolayer, resulting in equal sampling efficiency with the plate and screen samplers. The surface microlayer of nutrient-rich waters should not be thought of as only a surface monolayer of hydrophobic material but as a complex of a surface active monolayer with associated particulates and a thicker layer of dissolved material. (Moore-IVI)
W85-04895

EFFECTS OF PHOSPHORUS AND NITROGEN ENRICHMENT ON THE YIELD OF SOME STRAINS OF STIGEOCLONIUM, KUTZ. (CHLOROPHYCEAE),
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
P. J. R. de Vries, S. J. M. de Smet, and J. van der Heide.
Freshwater Biology, Vol. 15, No. 1, p 95-103, February, 1985. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Phosphorus, *Nitrogen, *Algal growth, *Eutrophication, *Bioassay, Limiting nutrients, Mathematical models, Water pollution effects.

In the Netherlands, in most agricultural areas extensive growth of macrophytes and algae in polder ditches is caused by high nutrient loads of both nitrogen and phosphorus. Algal bioassays are a

suitable tool for monitoring eutrophication. A bioassay procedure was applied to demonstrate the interaction between phosphorus and nitrogen in determining the yield of selected strains of Stigeoclonium in a synthetic medium as well as in natural waters. Increase of yield after addition of one nutrient depends on the concentration of the other. A graphic growth model based on the experiments in synthetic medium allows prediction of yields at different combinations of nitrate and phosphorus concentrations. In general, yields in natural waters before and after addition of nitrate and/or phosphate agree with the model. In some cases, other limiting factors appear to be involved. Apparently, prediction cannot be based on a simple determination of only a few nutrient concentrations at the sampling site. Bioassays should also be made to detect the possible interaction of other factors. Neither an exponential model (Baule-Mitscherlich) nor a hyperbolic model adequately describe the interaction demonstrated between nitrogen and phosphorus limitation. (Moore-IVI)
W85-04898

CAPILLARY GAS CHROMATOGRAPHY DETERMINATION OF VOLATILE ORGANIC ACIDS IN RAIN AND FOG SAMPLES,
California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
K. Kawamura, and I. R. Kaplan.
Analytical Chemistry, Vol. 56, No. 9, p 1616-1620, August, 1984. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Gas chromatography, *Organic compounds, *Volatile acids, *Pollutant identification, Rain, Fog, Water analysis.

A sensitive method for measuring volatile acid (C1-C7) in rain and fog samples as their p-bromophenacyl esters, using a high-resolution capillary gas chromatograph employing fused silca columns is presented. The purification of the esters was performed on silica gel columns prior to GC analysis. The authenticity of the esters was verified by GC/MS. Due to its high sensitivity, the capillary GC/FD method has great advantages for measuring face amounts of volatile acids in environmental samples. Although simpler to perform, ion chromatography is less sensitive and in practical terms is limited to detection of formic and acetic monocarboxylic acids only. Phenacyl esters of the volatile acids can be easily identified by their characteristic fragmentation patterns using GC/MS. (Baker-IVI)
W85-04959

USE OF A PERMEATION SAMPLER FOR DETERMINATION OF VOLATILE PRIORITY POLLUTANTS,
Akron Univ., OH. Dept. of Chemistry.
R. D. Blanchard, and J. K. Hardy.
Analytical Chemistry, Vol. 56, No. 9, p 1621-1624, August, 1985. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Sampling, *Permeation samplers, *Volatile compounds, *Priority Pollutants, Water analysis, Gas chromatography, Pollutant identification, Organic compounds.

A method for the sampling and subsequent analysis of six volatile organic Priority Pollutants is described. Samples are collected by permeation through a silicone polycarbonate membrane and adsorbed onto activated charcoal. Analysis consists of sample desorption and quantitative measurement by gas chromatography. Linearity is obtained between the mass of analyte collected and the product of the external concentration of analyte and the time of exposure, with linearity observed from low parts per billion to mid parts per million. This method has the advantages of providing time-weighted-average concentration values, stabilizing the collected sample, requiring no power, and being simple and inexpensive to use. The device response time is less than 5 min for each compound. No significant interferences are observed but response is temperature dependent. Precision and accuracy are comparable to presently accepted methods of collection and analysis. (Author's abstract)
W85-04960

DITHIOCARBAMATE EXTRACTION OF GALLIUM FROM NATURAL WATERS AND FROM BIOLOGICAL SAMPLES FOR NEUTRON ACTIVATION ANALYSIS,
Idaho Univ., Moscow. Dept. of Chemistry.
J. C. Yu, and C. M. Wai.
Analytical Chemistry, Vol. 56, No. 9, p 1689-1691, August, 1985. 1 Fig, 21 Ref.

Descriptors: *Gallium, *Neutron activation analysis, *Extraction, Natural waters, Water analysis, Pollutant identification, Metals.

Traces of gallium in aqueous solution can be extracted with a mixture of pyrrolidinecarbodithioate and diethyldithiocarbamate in the pH range 4-6 into chloroform. Gallium in the organic phase can be back-extracted into the aqueous phase with a lead nitrate solution for neutron activation analysis (NAA). This two-step extraction process provides a large preconcentration factor for gallium and eliminates potential interferences from the matrix species and other metals present in natural water and biological samples. Because lead is insensitive to NAA, its presence in the final solution does not cause any interferences for gallium determination. By use of this extraction method and NAA, a detection limit of 10-3 micro-g/L gallium in water can be achieved. (Author's abstract)
W85-04961

5B. Sources Of Pollution

TRACE METAL RESIDUES IN SHELLFISH FROM MARYLAND WATERS, 1976-1980,
Maryland Dept. of Health and Mental Hygiene, Baltimore.
M. Eisenberg, and J. J. Topping.
Journal of Environmental Science and Health, Vol. B19, No. 7, p 649-671, October, 1984. 1 Fig, 3 Tab, 22 Ref.

Descriptors: *Trace metals, *Shellfish, *Maryland, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Zinc, Oysters, Clams, Crabs, Heavy metals.

Levels of seven heavy metal residues, arsenic, cadmium, chromium, copper, lead, mercury and zinc were monitored in samples of the American oyster (Crassostrea virginica), the soft shell clam (Mya arenaria), the hard shell clam (Mercenaria mercenaria) and the blue crab (Callinectes sapidus). The study was conducted from 1976 through 1980. In cases where the Food and Drug Administration has established action levels, mean and median yearly values were significantly below these levels. In cases where no action level exists, heavy metal residues in the shellfish samples were well below levels which are generally regarded as safe. No significant yearly trends in heavy metal residues were discovered. Apparent increases in arsenic levels merit further study. (Baker-IVI)
W85-04436

ORGANOCHLORINE RESIDUES IN SHELLFISH FROM MARYLAND WATERS, 1976-1980,
Maryland Dept. of Health and Mental Hygiene, Baltimore.
M. Eisenberg, and J. J. Topping.
Journal of Environmental Science and Health, Vol. B19, No. 7, p 673-688, October, 1984. 3 Tab, 12 Ref.

Descriptors: *Shellfish, *Chlorinated hydrocarbons, *Fate of pollutants, *Maryland, Organic compounds, Oysters, Clams, Crabs, Chesapeake Bay, Polychlorinated biphenyls, Monitoring.

Samples of the American oyster (Crassostrea virginica), the hard shelled clam (Mercenaria mercenaria), the soft shelled clam (Mya arenaria) and the blue crab (Callinectes sapicus) were sampled from the Maryland waters of the Chespeake Bay and its tributaries. These samples were analyzed for as many as 18 organochlorine compounds considered to be toxic substances. This study encompassed the period from 1976 to 1980. In cases where action levels have been established by the Food and Drug Administration, mean and median yearly values fall considerably below these levels. In cases where no action level exists, organochlorine residues in the shellfish samples were well below levels which are generally regarded as safe. (Baker-IVI)
W85-04437

ORGANOCHLORINE INSECTICIDES AND PCBS IN WATER, SEDIMENT, AND FISH FROM THE MEDITERRANEAN SEA,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
M. A. El-Dib, and M. I. Badawy.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 216-227, February, 1985. 1 Fig, 5 Tab, 12 Ref.

Descriptors: *Mediterranean Sea, *Insecticides, *Polychlorinated biphenyls, Organic compounds, Fish, Sediments, Water analysis, Seawater, Aldrin, Endrin, DDT, Lindane, HCB, Chlordane, Pesticide residues.

In Egypt and some other Mediterranean countries, wastewaters are discharged into the sea directly, or via agricultural drains. The prevailing levels of organochlorine insecticides and PCBs are assessed in the sea water, sediments and some fish species collected at Port-Said. Aldrin, endrin, dieldrin and o,p-DDT were not detected in any of the water samples investigated. HCB and lindane residues were always very low compared with the other isolated organochlorine insecticides. Chlordane was identified in most water samples and its concentration ranged between 0.1 and 92.9 ng/L. PCBs were identified in all water samples investigated but its concentration was subject to material changes. The mean of residue levels of PCBs in water during September 1982, April, June, and September 1983 were 94, 41, 105, and 19 ng/L, respectively. The concentration of total p,p'-DDT tends to equal or exceed that of PCBs during September 1982 and April 1983. PCBs were always present in sediment samples as was the case with water samples. The distribution and concentration levels of organochlorine insecticides and PCBs in fish species investigated are listed. p,p'-DDT and its metabolites were the most frequently distributed insecticides in the fish studied and presented the highest residues compared to other insecticides. (Baker-IVI)
W85-04473

DETERMINATION OF POLYAROMATIC HYDROCARBONS IN SCALLOPS (PECTEN MAXIMUS) BY UV FLUORESCENCE AND HPLC COMBINED WITH UV AND FLUORESCENCE DETECTORS,
Centre National de la Recherche Scientifique, Brest (France). Lab. de Chromatographie.
M. P. Friocourt, G. Bodennec, and F. Berthou.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 228-238, February, 1985. 5 Fig, 4 Tab, 17 Ref.

Descriptors: *Bioindicators, *Monitoring, *Scallops, *Polyaromatic hydrocarbons, Fluorescence, Chromatography, Aliphatic compounds, Aromatic hydrocarbons, Water pollution sources, Oil spills.

Information is provided on the level of hydrocarbon pollution in scallop breeding areas in an attempt to use these organisms as biomonitors. In a first approximation the levels of polyaromatic hydrcarbons (PAH) in gonads were nearly twofold that observed in muscles: 8.6 vs 4.0. This result was expected as the lipid content is higher in gonads than in muscles. Both aliphatic and aromatic hydrocarbons were higher in somatic tissues than in gonads. Lipids appears to be not the only factor involved in the accumulation of hydrocarbons. All the liquid chromatographic profiles from the different scallop samples were similar. They mainly consisted of numerous two and three ring compounds. Temporal fluctuations were noted in PAH concentrations over several months of study. These were due in part to changes in biological and biochemical activities, and changes in the sea water temperature. In order to estimate the degree of coastal pollution in four commercial sites, the PAH burden of eight samples collected at nearly

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the same period of the year were compared. The samples taken from Baie de St Brieuc were the least polluted. Baie de Brieuc is widely open on the Cyanne while Carantec, another sample site, is polluted by the neighboring towns and the remains of Amoco Cadiz and Tanio oil spills. The Brest area is located on a semienclosed bay polluted by chronic industrial ouputs and agricultural discharges. (Baker-IVI)
W85-04474

SIMULTANEOUS ACCUMULATIONS OF NAPHTHALENE, A PCB MIXTURE, AND BENZO(A)PYRENE, BY THE OYSTER, CRASSOSTREA VIRGINICA,
National Marine Fisheries Service, Charleston, SC. Southeast Fisheries Center.
A. R. Fortner, and L. V. Sick.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 256-264, February, 1985. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Naphthalene, *Polychlorinated biphenyls, *Benzo(a)pyrene, *Oysters, *Bioaccumulation, Fate of pollutants, Organic compounds, Diet, Detritus.

Accumulations of C-14 labeled naphthalene by oysters fed detritus-like particulate matter, manufactured from ground Spartina alterniflora leaves, or from contaminants dissolved in ambient water, were antagonistically affected by the simultaneous exposure to multiple contaminants and were tissue specific. Unlike observed accumulations of naphthalene, accumulations of a C-14 labeled polychlorinated biphenyls (PCB) mixture by selected oyster tissues were not always antagonistically affected by simultaneous exposures to three organic contaminants. Tissue accumulations of radiolabeled benzo(a)pyrene were not significantly affected by the simultaneous presence of other organic contaminants. Among oysters fed detrital material, gill tissue accumulated significantly more benzo(a)pyrene than mantle, labial palps, or digestive diverticular tissues. When oysters ingested particulate matter sorbed with the mixed organic contaminants, benzo(a)pyrene concentrations in all tissues monitored were not significantly different than when oysters were exposed only to benzo(a)pyrene. Similarly, when oysters were exposed to dissolved organics, simultaneous exposure to naphthalene and PCB's did not result in significant changes in tissue concentrations of benzo(a)pyrene. (Baker-IVI)
W85-04477

BIRD USE AND HEAVY METAL ACCUMULATION IN WATERBIRDS AT DREDGE DISPOSAL IMPOUNDMENTS, CORPUS CHRISTI, TEXAS,
Patuxent Wildlife Research Center, Laurel, MD.
D. H. White, and E. Cromartie.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 295-300, February, 1985. 2 Tab. 10 Ref.

Descriptors: *Water birds, *Heavy metals, *Spoil banks, *Corpus Christi, *Texas, Lead, Zinc, Cadmium, Mercury, Selenium, Birds, Fate of pollutants.

Biweekly mid-morning waterbird censuses were taken at three dredge-pits on the industrialized south shore of Nueces Bay, Corpus Christi, Texas during May 1981 - July 1982. Fifty-six species of birds were observed feeding in one or more of the dredge-pits. Nine species were present more than 20% of the total census periods. The censuses were begun about a year after the impoundments were filled with dredge material. In three sediment samples analyzed, element concentrations were quite variable. Geometric means were lead, 49.2 ppm; zinc, 847.6 ppm; cadmium, 7.5 ppm; mercury, 0.5 ppm; and selenium, 2.3 ppm. Lead, zinc, cadmium, and mercury did not accumulate to elevated levels in aquatic birds using the dredge-pits when compared to birds from undeveloped areas. Selenium in some birds from dredge-pits was within the range known to cause reproductive impairment in chickens. It is unknown whether these elevated selenium levels adversely affect wild aquatic birds. (Baker-IVI)
W85-04480

REGIONAL RIVER SULFUR RUNOFF,
Washington Univ., St. Louis, MO. Center for Air Pollution Impact and Trend Analysis.
R. B. Husar, and J. D. Husar.
Journal of Geophysical Research, Vol. 90, No. C1, p 1115-1125, January, 1985. 5 Fig, 3 Tab, 39 Ref.

Descriptors: *Sulfur, *Runoff, *Water pollution sources, Spatial distribution, Path of pollutants, Niger River, Volta River, Colorado River.

The water and sulfur runoff data for 54 large river basins were assembled, covering 65% of the nondesert land area of the world. The sulfur concentration ranges from 0.5 mg S/L for the West African rivers Niger and Volta to 100 mg S/L in the Colorado River; the world average is 3.2 mg S/L. The concentrations in central and eastern Europe as well as central and eastern North America exceed 8 mg S/L. The sulfur runoff density is also highest in the river basins over these industrialized regions, exceeding 2 g S/m2/yr. However, high sulfur runoff density in excess of 3 g S/m2/yr is also measured over the Pacific islands New Zealand and New Guinea and the archipelagos of Indonesia and the Philippines. The natural background sulfur runoff was estimated by assuming that South America, Africa, Australia, and the Pacific Islands are unperturbed by man and that the average river sulfur concentration is in the range 1-3 mg S/L. Taking these background concentration values, the man-induced sulfur runoff for Europe ranges between 2 and 8 times the natural flow, and over North America, man's contribution ranges between 1 and 5 times the natural runoff. The global sulfur flow from nondesert land to the oceans and the Caspian Sea is estimated as 131 Tg S/yr, of which 46-85 Tg S/yr is attributed to natural causes. The regional river sulfur runoff pattern discussed in this paper does not have enough spatial resolution to be directly applicable to studies of the environmental effects of man-induced sulfur flows. However, it points to the continental-size regions where those perturbations are most evident and to the magnitude of the perturbations as expressed in units of the natural flows. (Author's abstract)
W85-04481

GEOCHEMISTRY OF INORGANIC GERMANIUM IN NATURAL WATERS,
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 2K.
W85-04482

MIGRATION AND SPECIATION OF LEAD IN A RIVER SYSTEM HEAVILY POLLUTED FROM A SMELTER,
Ceske Vysoke Uceni Technicke v Praze. Dept. of Nuclear Chemistry.
P. Benes, M. Cejchanova, and B. Havlik.
Water Research, Vol. 19, No. 1, p 1-6, 1985. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Lead, *Source of pollutants, *Fate of pollutants, *Smelters, Heavy metals, Anodic stripping voltammetry, Urban runoff, Particulates.

Anodic stripping voltammetry was used for the study of the migration and speciation of lead in surface water affected by atmospheric deposits around a smelter, by ore mining and urban runoff. Three physiocochemical forms of lead were distinguished: dissolved-labile (Pb(2+), PbOH(+) and PbCO3), dissolved-bound (colloids or strong complexes) and particulate (retained by 0.40 micro m membrane filter). Labile forms represented a very significant part of lead input from the washout of the atmospheric deposits, whereas most of lead from urban runoff and ore mining was in particulate or bound forms. Rather large stability of high concentrations of the labile forms of lead in the waters was found. It has been concluded that the precipitation of sparingly soluble lead compounds is not a primary factor controlling the concentration of dissolved lead in stream waters. The migration and speciation of lead was strongly affected by water flow rate. With increasing water flow rate, the concentration of particulate and labile lead increased whereas the concentration of bound forms decreased. Most of the lead was carried downstream in a small river during high water flow rate, but sedimented in a larger river. Rapid removal of lead by sedimentation occurred during low streamflow conditions. (Author's abstract)
W85-04484

MEASUREMENT OF PARTICULATE ASSOCIATION OF AMERICIUM IN FRESHWATER,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 5A.
W85-04491

DETERMINATION OF TRIALKYL AND TRIARYL PHOSPHATES IN ENVIRONMENTAL SAMPLES,
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
S. Ishikawa, M. Taketomi, and R. Shinohara.
Water Research, Vol. 19, No. 1, p 119-125, 1985. 4 Fig, 6 Tab, 9 Ref.

Descriptors: *Trialkyl phosphates, *Triaryl phosphates, *Plasticizers, *Chemical analysis, *Water pollution sources, *Kitakyushu City, *Japan, Gas chromatography, Mass spectrometry, Water analysis, Phosphate esters.

Trialkyl and triaryl phosphates are widely used as plasticizers, industrial hydraulic fluids and lubricant additives. Analytical methods for determination of trialkyl and triaryl phosphate esters in water and sediment were developed. A survey of their presence in sediments, seawater, and river water was performed in the area of Kitakyushu City, Japan. Products of extraction with dichloromethane (water sample) or acetone (sediment sample) were analyzed with a gas chromatograph equipped with a flame photometric detector and a gas chromatograph/mass spectrometer after cleanup through a Florisil column. The separation of gas chromatography was good with 2% OV-17 +2% PZ-179 on Uniport HPS. Recoveries fortified with 0.3-3 micro g were 71-98% for water sample and 78-95% for sediment sample. In the environmental survey, tributyl phosphate (5-36 ng/l), Tris (3-chloropropyl) phosphate (16-176 ng/l, Tris (2-chloroethyl) phosphate (TCEP) (14-347 ng/l), Tris (2,3-dichloropropyl) phosphate (CRP) (23-136 ng/l), triphenyl phosphate (13-31 ng/l), and tricresyl phosphate (67-259 ng/l) were detected in river water and seawater, and TCEP (13-28 ng/g) and CRP (9-17 ng/g) were detected in sediment. The pollution by phosphate esters is assumed to be affected by domestic wastewater because TBP, TCEP, CRP and TCP were observed in domestic wastewater and TBP, TCEP and CRP appeared in samples where little industrial wastewater was present and tidal action had no effect. (Collier-IVI)
W85-04497

ORGANIC ACIDITY IN PRECIPITATION OF NORTH AMERICA,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
W. C. Keene, and J. N. Galloway.
Atmospheric Environment, Vol. 18, No. 11, p 2491-2497, 1984. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Acid rain, *Organic compounds, *Precipitation chemistry, *Virginia, Formic acid, Acetic acid, Microorganisms, Fate of pollutants, Water pollution sources.

Organic anions were measured in 16 precipitation events sampled in central Virginia between 25 April and 1 October 1983. Formic and acetic acids contributed 16% of volume weighted free acidity. The decrease in free acidity in stored aliquots was directly proportional to the disappearance of dissociated HCOO- and CH3COO-. The loss of free acidity between pH measured at field sites and at central laboratories was used to estimate dissociated organic acidity in samples collected by the

National Atmospheric Deposition Program (NADP) and the MAP3S Precipitation Chemistry Project. Based on the arithmetic means of the volume weighted averages for each site, we estimate that organic acids contributed 18-35% of free acidity in NADP samples and 16% of free acidity in MAP3S samples. The loss of free acidity in MAP3S samples was three times greater during the growing season than it was during the rest of the year. Because they are rapidly assimilated by microbes, organic acids are unimportant in the long-term acidification of the environment. (Author's abstract)
W85-04499

RAINBORNE SO2, PRECIPITATION PH AND AIRBORNE SO2 OVER SHORT SAMPLING TIMES THROUGHOUT INDIVIDUAL EVENTS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
T. D. Davies.
Atmospheric Environment, Vol. 18, No. 11, p 2499-2502, 1984. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Precipitation chemistry, *Hydrogen ion concentration, *Sulfur dioxide, *Norfolk, *England, Acid rain, Air pollution, Sample preservation, Water pollution sources.

Rainborn SO2 and precipitation pH were determined in samples collected sequentially in Norfolk, England (over periods varying from a few minutes to hours, depending on precipitation intensity) throughout a number of events. Rainfall was collected in amber-glass bottles containing tetrachloromercurate solution and in bottles without the TCM solution. During the sampled rain events airborn SO2 was measured on a 15-min basis by bubbling air through TCM at around 30 l/min; these data were utilized to compare observed rainborn SO2 levels with levels predicted from equilibrium theory. Much better agreement was found between observed SO2 washout ratios and those predicted from equilibrium theory than in previous studies when the sampling was over longer timebases. The pH of the precipitation samples lay in the range 3.3-6.0. The rainborne SO2 concentrations and pH values exhibit considerable variation, on a time-scale of a few minutes, throughout individual events. SO2 concentrations declined overall throughout the events although the decline was not uniform; this illustrates the concentration shifts in gas-phase SO2, aqueous-phase SO2 and H(+) concentrations. (Collier-IVI)
W85-04500

ATMOSPHERIC HEAVY METALS IN HIGH ALTITUDE SURFACE SNOWS FROM MONT BLANC, FRENCH ALPS,
Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).
F. M. Batifol, and C. F. Boutron.
Atmospheric Environment, Vol. 18, No. 11, p 2507-2515, 1984. 2 Fig, 5 Tab, 50 Ref.

Descriptors: *Snow, *Mont Blanc, *French Alps, *France, *Heavy metals, *Precipitation chemistry, Atomic absorption, Lead, Cadmium, Copper, Zinc, Silver, Sodium, Manganese, Potassium, Calcium, Iron, Aluminum, Metals, Metalloids, Water pollution sources.

Heavy metals and metalloids in snow and ice layers in high altitude cold alpine glaciers in Europe and other mid-latitude areas have not been extensively investigated. Surface snow samples were collected in June 1973 in the massif of Mont Blanc, French Alps, at three separate sites whose altitude ranges from 3560 to 4785 m a.s.l. These samples were collected using ultra-clean techniques and analyzed for Pb, Cd, Cu, Zn, Ag, Na, Mg, K, Ca, Fe, Al and Mn by Graphite Furnace Atomic Absorption in clean room conditions. Measured concentrations are very low, indicating the extreme purity of high altitude snow in the Alps. Principal components factor analysis of the data suggest a crustal source for Na, Mg, K, Ca, Fe, Mn and Al. Heavy metals Pb, Cd, Cu, Zn and Ag are found on the other hand to be derived from one or several sources independent of the crustal source. Concentrations of the investigated heavy metals ranged from 1 to 15 times 10 to the -9 power g/g for Pb and Zn, from 0.1 to 1 times 10 to the -9 power g/g for Cu, from 20 to 500 times 10 to the -12 power g/g for Cd, and from 10 to 40 times 10 to the -12 power g/g for Ag. Concentrations of the other elements ranged from 10 to the -8 power to 10 to the -7 power for for Na, Mg, K, Ca, Fe, and Al, and from 1 to 10 times 10 to the -9 g/g for Mn. Measured concentrations in snow appear to be closely related to those previously published by other authors for local aerosols. (Collier-IVI)
W85-04501

LONG-TERM TRENDS IN PRECIPITATION CHEMISTRY AT HUBBARD BROOK, NEW HAMPSHIRE,
New York Botanical Garden, Bronx, NY.
G. E. Likens, F. H. Bormann, R. S. Pierce, J. S. Eaton, and R. E. Munn.
Atmospheric Environment, Vol. 18, No. 12, p 2641-2647, 1984. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Precipitation chemistry, *Hubbard Brook, *West Thornton, *New Hampshire, *Acid rain, Sulfates, Nitrates, Ammonium, Chlorides, Magnesium, Calcium, Hydrogen ion concentration, Temporal distribution, Trends.

A continuous, 19-year record (1963-1982) of weekly, bulk precipitation chemistry at the Hubbard Brook Experimental Forest in West Thornton, New Hampshire shows no statistically significant trend in annual volume-weighted concentrations of hydrogen ion and nitrate, but a 34% decrease in sulfate, a 34% decrease in ammonium, a 63% decrease in chloride, a 79% decrease in magnesium and an 86% decrease in calcium during the period. Nitrate concentrations increased from 1964 to 1971 and H-ion concentrations decreased after 1970. Frequency distributions of the concentrations of the chemical components of precipitation are skewed. The range of H-ion concentrations in weekly samples has narrowed, and the frequency distribution has shifted toward higher concentrations (lower pH) during the last 19 years. Highest concentrations generally occur with lowest amounts of precipitation for most ions, but low concentrations can occur with either low or high amounts of precipitation. Time trends in deposition generally parallel trends in concentration over the 19-year period. Chemical deposition generally increases with increasing amount of precipitation in weekly samples. (Author's abstract)
W85-04502

COMPOSITION OF PRECIPITATION ON AMSTERDAM ISLAND, INDIAN OCEAN,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. N. Galloway, and A. Gaudry.
Atmospheric Environment, Vol. 18, No. 12, p 2649-2656, 1984. 6 Fig, 4 Tab, 13 Ref.

Descriptors: *Amsterdam Island, *Indian Ocean, *Precipitation chemistry, *Acid rain, Hydrogen ion concentration, Sulfate, Nitrate, Chlorides, Sodium, Magnesium, Potassium, Calcium, Organic acids, Isotopic tracers.

The composition of precipitation on Amsterdam Island, in the central Indian Ocean was investigated, as were the processes controlling the precipitation composition and the acids responsible for the observed acidity. The data set comprises 66 rain events collected over a 30 month period and analyzed for SO4(-2), NO3(-), Cl(-), CH3COO(-), HCOO(-), Na(+), Mg(2+), K(+), Ca(2+), H(+), strong acidity and total acidity. Supporting data used in data analysis include Rn-222 and meteorological parameters. Precipitation on Amsterdam Island has two components, seawater and acid. Using Mg(2+) as the seawater tracer, there is no significant difference between the K(+)/Mg(2+), Cl(-)/Mg(2+), Na(+)/Mg(2+) and Ca(2+)/Mg(2+) ratios of the rain and those of seawater. The SO4(-2)/Mg(2+) ratio is significantly larger than the seawater ratio. The acid component is substantially smaller than the seasalt component. The volume weighted pH of the precipitation samples is 5.06 with primary proton donors being H2SO4, organic acids (HCOOH and CH3COOH) and HNO3. The maximum contributions of these acids to precipitation acidity are 30, 25 and 15%, respectively. There is an interaction between the alkaline seawater component and the acidic component. Specifically, using Mg(2+) as a tracer of seawater alkalinity, there is, on the average, a loss of 10% of the original free acidity due to neutralization. Specific samples ranged from < 10 to 50% neutralization, depending on the relative magnitude of the acid and seawater components. Rn-222 was used as a tracer to estimate the influence of the long range transport of marine and continental material on the composition of Amsterdam Island precipitation. A comparison of the SO4(-2*), NO3(-), H(+) and CH3COO(-) and HCOO(-) concentrations between events with a continental source area and those with a marine source area revealed a possible continental influence on NO3(-) only. (Author's abstract)
W85-04503

WET DEPOSITION OF TRACE METALS TO THE WESTERN ATLANTIC OCEAN AT THE MID-ATLANTIC COAST AND ON BERMUDA,
Delaware Univ., Newark. Coll. of Marine Studies.
T. M. Church, J. M. Tramontano, J. R. Scudlark, T. D. Jickells, and J. J. Tokos, Jr.
Atmospheric Environment, Vol. 18, No. 12, p 2657-2664, 1984. 1 Fig, 5 Tab, 31 Ref.

Descriptors: *Trace metals, *Lewes, *Delaware, *Bermuda, *Precipitation chemistry, Cadmium, Copper, Iron, Manganese, Nickel, Lead, Vanadium, Zinc, Metals.

The concentration of the trace metals Cd, Cu, Fe, Mn, Ni, Pb, V and Zn has been measured in atmospheric precipitation events at the middle Atlantic coast (Lewes, DE) and on the western Atlantic island of Bermuda. The purpose is to assess the sources, transport, and wet deposition of trace metals to the western Atlantic during non-summer months when trace metals are likely to be transported by westerly air mass flow from N America to the open Atlantic. The concentrations, and wet deposition of trace metals are greater at the coast than on Bermuda, and the other at both sites (Fe > Zn > Pb > Cu, Mn, Ni > V > Cd) is similar. The trace metal enrichment factors for all metals but Mn, based on crustal Fe, are significantly greater than unity, and the order (Cd > Pb > Zn > Cu > Ni > V) is also the same at the coast as on Bermuda. This evidence suggests common sources from North America for trace metals in western Atlantic precipitation and important atmospheric transport of trace metals to the Atlantic Ocean. Calculations using enrichment factors from sea salt aerosol (Na based) indicate recycling of trace metals from the sea surface, while generally considered not to be important, could be a potentially significant process contributing to Mn and V enrichments in open western Atlantic precipitation. (Author's abstract)
W85-04504

ANALYSIS OF PRECIPITATION COLLECTED ON A SEQUENTIAL BASIS,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
R. G. De Pena, T. N. Carlson, J. F. Takacs, and J. O. Holian.
Atmospheric Environment, Vol. 18, No. 12, p 2665-2670, 1984. 7 Fig, 5 Tab, 6 Ref. NOAA contract NA82RAC0157 and NOAA-DOE contract NA82RAC00032.

Descriptors: *Precipitation chemistry, *Acid rain, *Path of pollutants, Hydrogen ion concentration, Conductivity, Sulfates, Nitrates, Ammonium, Water pollution sources.

With the aim of establishing a source receptor relationship, precipitation was collected on a sequential basis at the Penn State MAP3S site from December 1979 to April 1980 and from September 1982 until the present; each sample was analyzed for pH, conductivity, sulfate, nitrate, ammonium and other ions. For each sample, air trajectories were determined according to the relative-wind

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method on isentropic surfaces. A good correlation was obtained when the concentrations were related to the precipitation rate or intensity. The relationship can be expressed by a power law of the type C = a(I to the -b power) where C is the ion concentration, a and b are constants and I is the precipitation rate. The precipitation concentrations were also correlated with the source-strength, a number proportional to the emissions of SO2 or NOx along the path of the trajectories. The two values correlated in most of the events. If future work confirms these preliminary results, a method will be available on which pollution regulation can be based. (Collier-IVI)
W85-04505

COMPARATIVE STUDIES OF NO3- CONCENTRATIONS IN SOME TROPICAL RAINS,
Ibadan Univ. (Nigeria). Dept. of Physics.
A. I. I. Ette, and A. B. Udoimuk.
Atmospheric Environment, Vol. 18, No. 12, p 2781-2786, 1984. 5 Fig, 1 Tab, 37 Ref.

Descriptors: *Nitrates, *Precipitation chemistry, *Tropical regions, *Nigeria, Ibadan, Calabar, Atmospheric physics, Electric field intensity, Electrical studies.

Apart from electrical discharges in the atmosphere other sources of NOx production include photolytic action in the stratosphere, biological action in soils and anthropogenic activity. Values of nitrate ion concentration, electric field intensity Eo, field reversal frequency and rainfall intensity R were measured on an event basis for rain events monitored at Ibadan and Calabar located in the rain belt of Nigeria. Strong dependence of nitrate ion concentration on Eo demonstrates that NOx production by sources of a nonelectrical nature are unimportant, at least as far as the two stations investigated are concerned, and that electrical discharges are the major sources of NO3(-) in tropical rains. The nitrate-nitrogen deposition rate at Calabar correlates well with the total rainfall, each having a pronounced peak in August; while the nitrate concentration exhibits no significant or systematic monthly variation. The significantly high concentration in January is likely to be due to bush burning which normally precedes planting in most parts of the country. Mean nitrate concentrations compare well with those reported in the literature for other tropical locations. (Collier-IVI)
W85-04506

FRACTIONATION OF TRACE METALS IN ACIDIFIED FRESH WATERS BY IN SITU DIALYSIS,
National Swedish Environment Protection Board, Solna.
H. Borg, and P. Andersson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 725-729, October, 1984. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Acidification, *Fractionation, *Dialysis, *Sulfur, *Nitrogen, *Sweden, Aluminum, Zinc, Manganese, Cadmium, Lead, Organic matter, Complexation, Fate of pollutants, Lakes.

The increased deposition of acid sulfur and nitrogen compounds over Sweden has caused an extensive acidification of lakes and streams during the last decades with severe damage to aquatic life as a consequence. Separation of metal fractions in lakewaters by in situ dialysis showed that the dialysable part was highest for Cd, followed by Cu, Al and Pb. The dialysable portion of Cd and Al increased with decreasing pH which was also the case for Pb in waters with low concentration of humic substances. In the more humic waters, the dialysable Pb-fraction was small, most likely because Pb is bound to colloidal organic matter, probably associated to hydrous ferric oxides. The influence of organic matter is further demonstrated by the negative correlation found between total organic carbon content and the dialysable fractions of Pb, Cu, and Al. (Baker-IVI)
W85-04535

IMPACT OF SEDIMENTATION ON THE PHOSPHORUS CONTENT OF THE EUPHOTIC ZONE OF LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2H.
W85-04555

EXTERNAL AND INTERNAL LOADING AND RETENTION OF PHOSPHORUS IN THE R. JORKA LAKES (MASURIAN LAKELAND, POLAND) VS THEIR TROPHIC STATUS,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W85-04556

ROLE OF BIVALVES IN THE PHOSPHORUS AND NITROGEN BUDGET IN LAKES,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W85-04558

STREAM PHOSPHORUS EXPORTS FROM PREALPINE WATERSHEDS WITH RESPECT TO GEOLOGY AND LAND USE,
Osterreichisches Eutrophieprogramm, Projekt Salzkammergutseen, A-4852 Weyregg, Austria.
O. Moog.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1071-1076, October, 1984. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Attersee watershed, *Salzkammergut, *Austria, *Phosphorus, *Land use, *Nutrients, Agricultural watersheds, Agricultural runoff, Erosion, Landslides, Water pollution sources.

Thirteen drainage basins, forming the major part of the direct catchment area of Attersee in the Salzkammergut lake district of Austria, were studied to test P export coefficients and to identify major diffuse sources of phosphorus as a basis for application of pollution control measures. Stream P exports from the 13 prealpine drainage basins varied between 7-245 kg TP per sq km and year. A range of 7-120 kg was usual. The lowest phosphorus exports were found in forested-rocky catchments of the calcite-dolomite region. The P losses from the flysh and morainic region were generally higher. The influence of agricultural land use on the P export could be studied due to a sewage collection system diverting the domestic and industrial wastewaters of the villages around Attersee to a central treatment plant which has been in operation since 1976. In a catchment area where the domestic and industrial sewage is served by purification systems, the percentage of agricultural land use can be used to estimate the range of the P export; a positive linear correlation between mean stream P concentration and percentage of land use was observed. No correlation was detected between discharge and TP concentrations. Active landslips within single drainage basins caused seriously high P exports (230 and 245 kg/sq km/yr); in these cases the high amount of suspended solids which contains P adsorbed at the soil particles is responsible for the high P load of these creeks. (Collier-IVI)
W85-04560

PCBS AND ORGANOCHLORINE PESTICIDES IN THE ST. LAWRENCE SYSTEM (BPC ET PESTICIDES ORGANOCHLORES DANS LE SYSTEME SAINT-LAURENT),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Canadian Water Resources Journal, Vol. 8, No. 2, p 32-63, 1983. 8 Fig, 8 Tab, 45 Ref.

Descriptors: *St. Lawrence River, *Polychlorinated biphenyls, *Chlorinated organic pesticides, Fish, Pesticides, Distribution, Estuaries.

Organochloro pesticides and polychlorobiphenyls (PCB) are among the most toxic anthropogenic compounds presently found in the environment. In the case of the St. Lawrence river in Eastern Canada, the concentrations of both these pollutants has been shown to be higher in water, sediments and fish from the stretch of the river upstream from the island of Orleans than those from samples taken downstream in the St. Lawrence estuary. In certain hot spots such as the run of the river at Montreal and the St. Louis and St. Francois lakes, the measured PCB concentrations in fish (11 species) were as high as 15 ppm; present Canadian legislation sets the maximum permissible level for fish destined for human consumption at 2 ppm. In both the estuary and the gulf of the St. Lawrence organochloro pesticide and PCB concentrations are lower and more uniformily distributed than those found upstream; one consequently finds relatively low levels of these compounds in the fish populations sampled downstream from the island of Orleans (9 species) although some cases are recorded where the concentrations of PCB are higher than 2 ppm. (Author's abstract)
W85-04581

FACTORS INFLUENCING THE BEHAVIOUR OF DE-ICING SALTS IN AN URBAN FLOOD CONTROL RESERVOIR,
Ontario Hydro, Toronto.
W. S. Scott.
Canadian Water Resources Journal, Vol. 8, No. 2, p 104-120, 1983. 3 Fig, 5 Tab, 9 Ref.

Descriptors: *Deicers, *Salts, *Flood control reservoirs, Reservoirs, Chlorides, Sodium, Thaw, Rainfall, Urban runoff, Path of pollutants, Saline water, Roads, Air temperature.

Water samples collected from a newly constructed reservoir and its watershed during a complete salting season indicated the presence of high concentrations of chloride and sodium in the bottom waters of the reservoir at the beginning of thaw periods. This effect occurred despite the fact that water flowing out of the reservoir is normally drawn from very near the bottom. The salt-laden bottom waters were eventually drained from the reservoir as the thaw periods continued, or after freezing temperatures returned. Elevated salt levels returned, however, at the beginning of each successive thaw period. The number and duration of thaw periods and associated rainfall were found to be major influences on the accumulation and behavior of the salt-laden waters. Factors influencing salt levels in the source streams were analyzed. Salt inputs were shown to be significantly correlated with: the amount of salt applied to streets prior to thaw periods, the degree of urbanization of the watershed, length and type of roads drained, the duration of thaw periods, precipitation, and the rate of rise in temperature at the start of thaw periods. (Author's abstract)
W85-04584

SMALL FORMAT, HAND HELD HELICOPTER BASED PHOTOGRAPHY FOR MONITORING INDUSTRIAL WATER EFFLUENT PLUMES,
Waterloo Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W85-04586

ATTENUATION OF CHEMICAL ELEMENTS IN ACIDIC LEACHATES FROM COAL MINERAL WASTES BY SOILS,
Los Alamos National Lab., NM.
L. E. Wangen, and M. M. Jones.
Environmental Geology and Water Sciences, Vol. 6, No. 3, p 161-170, 1984. 5 Fig, 6 Tab, 18 Ref.

Descriptors: *Mine wastes, *Leachates, *Coal mines, *Soil chemistry, Fate of pollutants, Percolation, Aluminum, Arsenic, Cadmium, Cobalt, Chromium, Copper, Fluorine, Iron, Manganese, Nickel, Zinc, Alkalinity.

The chemical attenuation of acidity and selected elements (aluminum, arsenic, cadmium, cobalt, chromium, copper, fluorine, iron, manganese, nickel, and zinc) in acidic leachates from coal mineral wastes by four natural subsurface soils has

been investigated using laboratory column methods. Leachate solutions were allowed to percolate through the soils under simulated natural flow conditions, and the elemental concentrations in the influents and effluents were measured periodically. Elemental retentions were substantial for all species except manganese, which was eluted in excess from all soils except the most calcareous. Two processes appeared to operate in decreasing influent concentrations: (1) precipitation of solid phases caused by increased pH of the leachate as it percolated through the soil, and (2) adsorption of elements onto exchange and sorption sites naturally present in the soil and on iron and aluminum oxide precipitates formed in situ from leachate components because of the increased pH. The soil property most important in retention was its alkalinty. Thus, carbonaceous soils provide the best control material for acidic leachates from coal mineral wastes. Results show that natural soils can substantially reduce pollutant fluxes to the environment from acidic coal waste dumps and should be considered when selecting waste disposal sites. (Author's abstract)
W85-04600

INVENTORIES AND SORPTION-DESORPTION TRENDS OF RADIOCESIUM AND RADIOCOBALT IN JAMES RIVER ESTUARY SEDIMENTS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
C. L. Zucker, C. R. Olsen, I. L. Larsen, and N. H. Cutshall.
Environmental Geology and Water Sciences, Vol. 6, No. 3, p 171-182, 1984. 1 Fig, 4 Tab, 26 Ref.

Descriptors: *Cesium radioisotopes, *Cobalt radioisotopes, *Sorption, *Desorption, *James River, *Virginia, Estuaries, Estuarine sediments, Fallout, Radioactive wastes, Fate of pollutants.

Anthropogenic radionuclides (Cs-137, Cs-134, Co-60) have been introduced to the James River estuary as a result of low-level releases from the Surry Reactor site since 1973 and worldwide atmospheric fallout from nuclear weapons tests since the early 1950s. The total radionuclide burden in the estuary sediments has been estimated by integrating radionuclide activities in 29 box cores and extrapolating these integrated values over surface areas subdivided on the basis of sediment type, rate of accumulation, and proximity to the reactor release site. The results indicate that 30% of the Co-60, but only 15% of the Cs-134 released from the reactor site, has been retained in the estuary sediments, and about 40% of the Cs-134 and Co-60 sediment inventory is in areas that represent less than 5% of the total estuarine surface area. Depletion of the Cs-134 in downstream sediments forms a noticeable trend in the James River estuary, and it is postulated that seawater cation competition and exchange is primarily responsible. (Author's abstract)
W85-04601

ASSESSMENT OF HISTORICAL CHANGE IN TWO NORTHERN MINNESOTA LAKES,
Minnesota Univ.-Duluth. Dept. of Biology.
J. R. Hargis, and L. J. Shannon.
Environmental Management, Vol. 8, No. 6, p 481-488, November, 1984. 7 Fig, 26 Ref.

Descriptors: *Ecosystems, *Water pollution effects, *Minnesota, *Hare Lake, *Echo Lake, Powerplants, Acid precipitation, Sulfates, Transparency, Zooplankton, Lakes, Variability.

Two northern Minnesota lakes (Hare and Echo Lakes) that had been studied in detail 22 years earlier (1958) were restudied to determine the extent of alteration in ecological conditions. Approximately one year after the original investigation, a coal-fired power plant, which incremented sulfate loading by about 6 kg/ha-yr, began operation nine miles away. These lakes lie within a region judged susceptible to acidic precipitation, though each lake, based on its buffering capacity, would be judged only moderately sensitive. In spite of the influence of this plant and other anthropogenic inputs, the change in lake ecology was apparently minimal. Water clarity decreased in both lakes and some alteration in zooplankton community structure was observed. The long-term utility of lake surveys depends upon how carefully and completely conditions can be reconstructed from records and reports. Past surveys generally omit measures of variability for the data, allowing only qualitative comparisons to be drawn. In order to judge the graded responses of aquatic ecosystems, necessary to sound management, quantitative measures are needed. (Author's abstract)
W85-04602

SNOW POLLUTION AND ITS EFFECT ON HEAVY METALS LOAD OF THE KOZLOWA GORA RESERVOIR AS COMPARED TO RAIN AND RIVER WATER,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Reczynska-Dutka.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 3, p 163-173, 1984. 1 Fig, 11 Tab, 32 Ref.

Descriptors: *Snow, *Rain, *Heavy metals, *Kozlowa Gora Reservoir, *Poland, Path of pollutants, Lead, Zinc, Cadmium, Cobalt, Nickel, Manganese, Iron, River water.

Studies were carried out during the winter of 1978-79 to determine the levels of Pb, Ni, Cd, Co, Zn, Mn and Fe in snow falling on the surface of the Kozlowa Gora drinking water reservoir, located along the northern limit of the Upper Silesia Industrial Region (Poland). The levels of the metals in snow are compared with those in rainfall and river water supplying the reservoir. Snow falling on the reservoir showed increased amounts of Zn, Pb, Cd, Mn and Fe. Snow transported at most one half of the load brought by rain, due to lower concentrations of heavy metals in snow and the lower amounts of precipitation in winter. In comparison to the river, rain carried three times more Zn, comparable amounts of Pb and Cd, and 40% or less of the other heavy metals. The load of Zn, Pb and Cd deposited by snow constituted about 30% of the influx with the river, and the other metals constituted less than 20%. Rain appears to be the most important source of Zn pollution of the ecosystem under study. (Moore-IVI)
W85-04611

GROUNDWATER SOURCE OF NITRATE IN NEARSHORE MARINE SEDIMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
D. G. Capone, and M. F. Bautista.
Nature, Vol. 313, No. 5999, p 214-216, 17 January 1985. 4 Fig, 34 Ref.

Descriptors: *Groundwater pollution, *Nitrates, *Marine sediments, Water pollution sources, Path of pollutants, Groundwater discharge, Hydraulic gradient, Salinity.

Subsurface discharge accounts for about 10-20% of the freshwater input to Great South Bay, New York. The upper aquifer is the presumed source of this discharge and, because it is heavily contaminated with nitrate, the groundwater may be an important source of nitrate to the bay. Determinations of the interstitial nutrient chemistry of freshly collected cores from nearshore sediments support this hypothesis. Pore-water nutrient profiles were determined in Great South Bay, New York, at a site near Patchogue. High rates of submarine groundwater discharge, typically 10-50 l/sq m/day were recorded. Core samples showed slight decreases in salinity and concomitant increases in nitrate below 20 cm. An anoxic zone with sulfate reduction between 5 and 10 cm was always noted in the core samples and active nitrification above it, possibly accounting for some of the anomalies in the profiles of nitrate and ammonium above 5 cm. The rate of submarine groundwater discharge is a function of the hydraulic gradient maintained by rainfall and heavy rain causes rapid rate increases. Although highly variable in time, cores taken after substantial rainfall showed increasing nitrate concentrations and decreasing salinities with depth. Submarine groundwater discharge is a source of nitrate which should be considered in estimates of nitrogen influx to coastal marine ecosystems. (Baker-IVI)
W85-04616

MIGRATION AND ATTENUATION OF SELECTED ORGANICS IN A SANDY AQUIFER - A NATURAL GRADIENT EXPERIMENT,
36635 Fairfield Road, Ingleside, IL 60041.
P. A. Sutton, and J. F. Barker.
Ground Water, Vol. 23, No. 1, p 10-16, January-February, 1985. 3 Fig, 18 Ref.

Descriptors: *Organic compounds, *Attenuation, *Solute transport, *Groundwater pollution, Tracers, Chlorides, Butyric acid, Phenol, Chlorophenol, Dimethyl phthalate, Path of pollutants, Fate of pollutants.

A natural gradient tracer test was conducted in an unconfined sandy aquifer at Borden, Ontario. N-butyric acid, phenol, p-chlorophenol, and dimethyl phthalate (DMP) were used as organic tracers at concentrations ranging from 70 to 100 ppm and chloride was used as a nonreactive tracer at a concentration of 243 ppm. Approximately 2,100 l were injected below the water table and were monitored with a three-dimensional network of bundle-type, multilevel piezometers over a period of 60 days and once again after 204 days. The plume gradually split into two zones due to local heterogeneity. The centers of mass for the organic compounds migrated at essentially the same rate as chloride, but attenuated at different rates. Butyric acid and phenol attenuated the most rapidly. Chlorophenol attenuated only slightly faster than chloride and DMP attenuated at roughly the same rate as chloride. Sorption does not appear to be important in the system studied. Dispersion and biodegradation probably produced the observed attenuation of organics. (Author's abstract)
W85-04635

GROUND-WATER CONTAMINATION AND WELL CONSTRUCTION IN SOUTHEAST NEBRASKA,
Nebraska Univ., Lincoln. Conservation and Survey Div.
M. E. Exner, and R. F. Spalding.
Ground Water, Vol. 23, No. 1, p 26-34, January-February, 1985. 7 Fig, 23 Ref.

Descriptors: *Wells, *Groundwater pollution, *Nebraska, Water pollution sources, Nitrates, Fecal coliforms, Animal wastes, Farm wastes, Atrizine, Alachlor, Well water.

The study area comprises 1100 sq mi of agricultural land in the lower Big Nemaha drainage basin in southeast Nebraska. Most of the farms are cash grain-livestock operations. Nitrogen fertilizer use is low. Nitrate-nitrogen (NO3-N) concentrations and total (TC) and fecal coliform (FC) densities were determined in ground water from 268 household and stock wells. Seventy-one percent of the samples had NO3-N concentrations above 10 mg/l and/or TC densities > or = 1/100 ml. Most of the NO3-N contamination is from the dissolution of manure in barnyards and corrals. The average delta N-15 value was + 11.9 0/00 for the 115 samples with NO3-N levels in excess of 8.5 mg/l. Only 10% of the wells met Nebraska's criteria for private well construction. NO3-N levels exceeded 10 mg/l in 4% of these wells while 30% contained one or more TC/100 ml. The highest incidence of NO3-N and coliform contamination occurred in dug (47%) or augered (80%) wells with open-jointed casing. Poorly constructed wells contained low levels of atrazine. One well contained alachlor. The limited availability of ground water supplies and still more limited supplies of good quality ground water have led to the formation of rural water districts, and the abandonment of many wells. These wells should be plugged to prevent direct contamination of the aquifer and the use of wells for waste disposal. (Moore-IVI)
W85-04637

NITROGEN-ISOTOPE RATIOS OF NITRATE IN GROUND WATER UNDER FERTILIZED FIELDS, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
W. J. Flipse Jr., and F. T. Bonner.
Ground Water, Vol. 23, No. 1, p 59-67, January-February 1985. 3 Fig, 3 Tab, 32 Ref. NSF grant CHE 78-24176.

Descriptors: *Nitrates, *Nitrogen isotopes, *Groundwater pollution, *Long Island, *New York, Fertilizers, Water pollution sources, Pollutant identification.

Ground-water samples from two heavily fertilized sites in Suffolk County, New York, were collected through the 1978 growing season and analyzed for nitrate-N concentrations and nitrogen-isotope ratios. Six wells were at a potato farm; six were on a golf course. The purpose of this study was to determine whether the N-15/N-14 ratios (delta N values) of fertilizer are increased during transit from land surface to ground water to an extent which would preclude use of this ratio to distinquish agricultural from animal sources of nitrate in ground water. Ground water at both sites contained a greater proportion of N-15 than the fertilizers being applied. At the potato farm, the average delta N-15 value of the fertilizers was 0.2%; the average delta N-15 value of the ground-water nitrate was 6.2%. At the golf course, the average delta N-15 value of the fertilizers was - 5.9%, and that of ground-water nitrate was 6.5%. The higher delta N-15 values of ground-water nitrate are probably caused by isotopic fractionation during the volatile loss of ammonia from nitrogen applied in reduced forms (NH(+4) and organic-N). The delta N-15 values of most ground-water samples from both areas were less than 10%, the upper limit of the range characteristic of agricultural sources of nitrate; these sources include both fertilizer nitrate and nitrate derived from increased mineralization of soil nitrogen through cultivation. Previous studies have shown that the delta N-15 values of nitrate derived from human or animal waste generally exceed 10%. The nitrogen-isotope ratios of fertilizer-derived nitrate were not altered to an extent that would make them indistinguishable from animal-waste-derived nitrates in ground water. (Author's abstract)
W85-04641

EFFECT OF AGRICULTURAL LAND USE ON GROUND-WATER QUALITY IN A SMALL PENNSYLVANIA WATERSHED,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
H. B. Pionke, and J. B. Urban.
Ground Water, Vol. 23, No. 1, p 98-80, January-February, 1985. 5 Fig, 3 Tab, 32 Ref.

Descriptors: *Groundwater, *Water quality, *Land use, *Pennsylvania, Geology, Forests, Cropland, Nitrates, Chlorides, Phosphates, Shales, Sandstone, Siltstone, Path of pollutants.

Groundwater analyses from 14 wells, taken over a 10-year period, were used to examine the impact of land use and geology on groundwater quality. The 7.4 sq km watershed, located in central Pennsylvania, contains two main land uses and three geologic zones. The uppermost zone is 95% forestland underlain by sandstone. The middle zone is siltstone and 72.5% cropland, while the lower zone is shale and 67% cropland. The groundwater quality of the forested sandstone was highly variable and often impacted by rainfall quality. Nitrates, chloride and phosphate concentrations were much higher in ground waters underlying cropland. The mean concentrations ranged from five to seven times those observed in ground water underlying forests. The contamination pattern is consistent with that computed from a nutrient balance, based on known fertilizer and manure use on local croplands. Potentially useful as chemical tracers, NO3-N and Cl appear most related to cropland impact, and Na appears to be related to the geological distribution. The greatest impact on groundwater quality was associated with the intensively cropped shales. This zone is located on the groundwater pathway from the agriculturally-impacted zone to the stream; the nitrate, chloride, and phosphate concentrations are greatly decreased due to mixing and dilution. The chemical nature of these ground waters reflects more the geochemistry of local geologic deposits than the impact of cropland use. (Moore-IVI)
W85-04642

DISPERSION MODELING OF MULTIPLE SOURCES USING THE HP-41CV,
New Hampshire Water Supply and Pollution Control Commission, Concord.
D. H. Allen.
Ground Water, Vol. 23, No. 1, p 85-89, January-February, 1985. 3 Ref.

Descriptors: *Dispersion, *Model studies, Plumes, Injection wells, Wells, Computer models.

WMPLUME is an analytic dispersion model based on the Wilson and Miller equation presented in a program for the HP-41CV handheld, programmable calculator, the HP-41CX, or the HP-41C with four memory modules. The user specifies the spacing and extent of the field of observation points. The calculator can handle up to 36 fully penetrating, continuous injection well sources or a lesser number of discontinuous wells. The time of observation can be changed easily and sources can be added or deleted readily. The code is prepared for use with or without a printer attached to the calculator. (Author's abstract)
W85-04644

SPATIAL DISTRIBUTIONS OF PRECIPITATION ACIDITY AND MAJOR ION WET DEPOSITION IN NORTH AMERICA DURING 1980,
Atmospheric Environment Service, Downsview (Ontario).
L. A. Barrie, and J. H. Hales.
Tellus, Vol. 36B, p 333-355, 1984. 15 Fig, 2 Tab, 35 Ref.

Descriptors: *Spatial distribution, *Acid precipitation, *Ions, *North American, Ammonium, Nitrates, Sulfates, Hydrogen ions, Sulfuric acid, Air pollution, Precipitation chemistry, *Acid rain, Water pollution sources.

Observations are presented of the mean annual concentration and deposition of H(+), SO4(-2), NO3(-), and NH4(+) ions in precipitation in North America during 1980. The concentration and deposition of hydrogen, sulfate and nitrate ions in precipitation was highest in eastern North American, where the majority of anthropogenic sulfur and nitrogen oxide emissions occur. A definite southward shift in sulfate and nitrate maxima occurrs in 1980, compared to merged-network data from previous years. This apparent shift is caused primarily by sampling artifacts in the older CANSAP data. Precipitation is most acidic in the region covering New York, Pennsylvania, Ohio, Indiana, Illinois, Kentucky, West Virginia, and the southern half of the province of Ontario. This same region receives the highest wet deposition of hydrogen, sulfate and nitrate ions and is the source of sulfur and nitrogen. Of the anthropogenic sulfur and nitrogen oxides released in the eastern North American budget area, 24 and 25% are removed by precipitation in the same area, respectively. The rest are dry deposited or discharged from the area. There is evidence that nitrogen oxides are wet removed somewhat more effectively than sulfur oxides within selected subregions of the eastern North American budget area. The concentration and deposition patterns of sulfate, nitrate and hydrogen ions are similar to each other but differ from those of NH4(+). The former are influenced by emissions of anthropogenic oxides of sulfur and nitrogen while the latter originates mainly from natural sources with a maximum source strength in the center of the continent. Precipitation acidity has increased in the southeastern US since the 1950s. In the region of maximum deposition, 1980 observations of annual wet deposition of hydrogen sulfate and nitrate ions are within 25% of the 5-year mean. (Baker-IVI)
W85-04647

TRENDS IN LAKE ROTORUA WATER QUALITY,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
For primary bibliographic entry see Field 2H.
W85-04669

GROUNDWATER QUALITY PROTECTION: THE ISSUE IN PERSPECTIVE,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5G.
W85-04683

EFFECT OF POLLUTION ON THE COASTAL WATERS OF THE RED SEA IN FRONT OF JEDDAH, SAUDI ARABIA; 2. NUTRIENT SALTS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Marine Science.
For primary bibliographic entry see Field 5C.
W85-04711

RADIUM VARIABILITY PRODUCED BY SHELF-WATER TRANSPORT AND MIXING IN THE WESTERN GULF OF MEXICO,
Oregon State Univ., Corvallis. School of Oceanography.
For primary bibliographic entry see Field 2K.
W85-04712

TRACKING RIVER PLUMES WITH VOLATILE HALOCARBON CONTAMINANTS: THE NIAGARA RIVER-LAKE ONTARIO EXAMPLE,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
M. E. Comba, and K. L. E. Kaiser.
Journal of Great Lakes Research, Vol. 10, No. 4, p 375-382, 1984. 15 Fig, 9 Ref.

Descriptors: *Plumes, *Halocarbons, *Niagara River, *Lake Ontario, *Halogenated hydrocarbons, *Fate of pollutants, Chlorinated hydrocarbons, Brominated hydrocarbons, Hypolimnion, Lakes.

The concentrations of six predominant volatile halocarbon contaminants CCl4, total and industrial CHCl3, CHBrCl2, CH2Cl2, CFCl3, and C2Cl4 in epi- and hypolimnetic lake waters are used to demonstrate tributary plumes and nearshore currents on the Lake Ontario/Niagara River example. The relative speed and sensitivity of the analysis for volatile halocarbons provides for a synoptic view of the major currents at the time of sampling. For example, the individual distributions of several contaminants indicate the existence of a Niagara River surface water plume in northerly direction for approximately 8 km into the lake. In contrast, the predominantly east-west isostats of the contaminant concentrations in the hypolimnetic water indicate little direct influences by the Niagara River and show the existence of other contaminant sources in these areas. (Author's abstract)
W85-04715

ENVIRONMENTAL IMPACT OF TWO, ADJACENT, HAZARDOUS WASTE DISPOSAL SITES IN THE NIAGARA RIVER WATERSHED,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 5C.
W85-04718

SHORT-TERM UPTAKE OF HEAVY METALS BY PERIPHYTON ALGAE,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Vymazal.
Hydrobiologia, Vol. 119, No. 3, p 171-179, December, 1984. 5 Fig, 8 Tab, 40 Ref.

Descriptors: *Heavy metals, *Periphyton, *Algae, *Bioaccumulation, Metals, Water pollution effects, Lead, Cadmium, Copper, Cobalt, Chromium, Nickel, Zinc, Iron, Manganese, Humic acids, Cladophora, Oedogonium, Chlorophyta.

The utilization of periphyton activity for the removal of heavy metals from enriched small streams has been examined. By means of short-term batch laboratory experiments the courses of metal uptake have been studied. Naturally growing periphyton community filamentous algae Cladophora glomerata and Oedogonium rivulare were used for uptake study; uptake of nine heavy metals - Pb, Cd, Cu, Co, Cr, Ni, Zn, Fe and Mn - was determined during four hours of exposure. In addition the influence of humic substances on heavy metal uptake has been determined. Uptake of all metals increased during four hours of exposure but not in the same way. Some metals were removed continuously (Ni, Cr, Fe and Mn), other metals were removed more rapidly during the first hour or first two hours of exposure and then only slight removal continued (Cu, Pb, Cd, Co). Uptake of Zn was rather unambiguous. Results of these experiments suggest that the course of uptake for individual metals could be similar for most periphyton algae. It was established that humic substances significantly reduce heavy metal uptake. The highest decrease of uptake was observed in Cu, Cr, Co and Cd. The results of model experiments are being tested in a pilot scale with respect to the demands of engineering practice. (Author's abstract)
W85-04721

INTERNAL P LOADING IN LAKES: A DIFFERENT APPROACH TO ITS EVALUATION,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 2H.
W85-04723

TRACE METALS IN OXIC LAKE SEDIMENTS: POSSIBLE ADSORPTION ONTO IRON OXYHYDROXIDES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
A. Tessier, F. Rapin, and R. Carignan.
Geochimica et Cosmochimica Acta, Vol. 49, No. 1, p 183-194, January, 1985. 5 Fig, 5 Tab, 54 Ref.

Descriptors: *Lake sediments, *Trace metals, *Adsorption, *Iron oxyhydroxides, *Ontario, Fate of pollutants, Cadmium, Copper, Nickel, Lead, Zinc, Hydrogen ion concentration.

Apparent overall equilibrium constants for the adsorption of Cd, Cu, Ni, Pb and Zn onto natural iron oxyhydroxides have been calculated from the partitioning of these trace metals in oxic lake sediments and the in situ measurement of trace metal concentrations in the associated pore waters. Such values obtained from three lakes of various pH located on the Precambrian Shield, in the area of Sudbury, Ontario, are compared with equilibrium constants obtained for the adsorption of the trace metals onto iron oxyhydroxides in well-defined media. Despite the complexity of natural waters and the great number of parameters that can influence adsorption, the agreement of the field data with the laboratory experiments and with theory is relatively good. In two of the lakes, the partitioning of Cd, Ni and Zn between the pore waters and the iron oxyhydroxides would be adequately predicted by a model describing the adsorption of these trace metals at low surface coverage onto amorphous iron oxyhydroxides in a NaNO3 solution. The results suggest that adsorption of Cd, Cu, Ni, Pb and Zn onto iron oxyhydroxides is involved in the lowering of trace metal concentrations in the oxic pore waters of the studied lakes below the concentrations prescribed by equilibrium solubility models. (Baker-IVI)
W85-04757

FLUID TRANSPORT PROCESSES IN UPPER SPENCER GULF,
Adelaide Univ. (Australia). Dept. of Mathematical Physics.
For primary bibliographic entry see Field 2L.
W85-04762

PHYSICAL PROCESSES AND POLLUTION IN THE WATERS OF SPENCER GULF,
Adelaide Univ. (Australia). Dept. of Applied Mathematics.
For primary bibliographic entry see Field 2L.
W85-04763

REGIONAL VARIATION IN THE DISTRIBUTION OF TRACE METALS IN MODERN INTERTIDAL SEDIMENTS OF NORTHERN SPENCER GULF, SOUTH AUSTRALIA,
Adelaide Univ. (Australia). Dept. of Geology and Mineralogy.
P. Harbison.
Marine Geology, Vol. 61, No. 2/4, p 221-247, November, 1984. 5 Fig, 10 Tab, 56 Ref.

Descriptors: *Spencer Gulf, *South Australia, *Trace metals, *Path of pollutants, Sediment transport, Spatial distribution, Estuaries, Heavy metals, Industrial wastewater, Intertidal sediments, Industrial wastes, Nitric acid, Littoral environment.

Northern Spencer Gulf, a marine inlet extending 170 km inland from the open sea, is a narrow, almost landlocked, water body seltered by the Cultana Hills to the west and the Flinders ranges to the east. Intertidal sediments near metal industries in northern Spencer Gulf have surface enrichments of nitric acid soluble Cd, Cr, Fe, Mn, Pb and Zn up to two orders of magnitude greater than sediments from non-industrial areas. Controlling influences on the distribution of these metals appear to be proximity to the source, the direction of littoral transport, and the environment of deposition. Changes in sedimentation resulting directly from a shoreline construction at Whyalla are predictable, and suggest the use of such structures to direct the transport of contaminated particulates to desired locations. (Baker-IVI)
W85-04764

WATER UTILITY IN THE NUCLEAR AGE,
A. F. Wigglesworth.
Water and Pollution Control, Vol. 122, No. 6, p 20, 22, 24, 27 and 75-78, December, 1984.

Descriptors: *Nuclear explosions, *Fallout, *Utilities, *Water supply, *Canada, Water pollution sources, Drinking water, Water conveyance, Planning, Decision making, Radioactive wastes, Water treatment facilities.

Water facilities in Canada are highly vulnerable to nuclear attack. Fallout settling on the surface of the earth will contaminate any water with which it comes in contact in one of three ways: immediate fallout, delayed fallout (deposited on watersheds and washed into supply tributaries or reaching other surface water supplies), or deferred fallout (deposited on snow or ice on watersheds and frozen rivers, lakes or reservoirs). A large proportion of the post attack population will have ground source water available which is free of radioactivity. Communities that must rely on surface sources would be subject to far greater dangers than drinking contaminated water. Water softening and purification plants would provide sufficient decontamination of water to significantly reduce the absorbed doses to body organs. Water source contamination by fallout would be a secondary problem in any post attack environment. Water distribution would be the major problem. Various design considerations to make the problem less acute are considered. Steps to be taken in resuming operations after an attack include: assessment of physical damage, the use of mobile treatment facilities, quality control, and supplying public information. (Baker-IVI)
W85-04773

TOXICOLOGIC STUDIES ASSOCIATED WITH THE AGRICULTURAL USE OF MUNICIPAL SEWAGE SLUDGE AND HEALTH EFFECTS AMONG SEWAGE TREATMENT PLANT WORKERS,
New York State Coll. of Veterinary Medicine, Ithaca.
For primary bibliographic entry see Field 5E.
W85-04776

MULTIPHASE APPROACH TO THE MODELING OF POROUS MEDIA CONTAMINATION BY ORGANIC COMPOUNDS; I. EQUATION DEVELOPMENT,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
L. M. Abriola, and G. F. Pinder.
Water Resources Research, Vol. 21, No. 1, p 11-18, January, 1985. 2 Fig, 34 Ref. DOE contract DE-AC02-79EV10257.

Descriptors: *Mathematical equations, *Organic compounds, *Porous media, Capillary water, Path of pollutants, Model studies, Solute transport, Gas phase.

The infiltration and migration of a chemical contaminant in the subsurface is a complex process. A multiphase approach to the modeling of organic compound migration in the subsurface is presented. This comprehensive approach makes it possible to describe the simultaneous transport of a chemical contaminant in three physical forms: as a nonaqueous phase, as a soluble component of a water phase, and as a mobile fraction of a gas phase. Using volume-averaging theory, equations governing such migration were developed from basic conservation of mass principles for a two-component contaminating phase. Incorporated within these equations are the effects of matix and fluid compressibility, gravity phase composition, interphase mass exchange, capillarity, diffusion, and dispersion. The resulting equations form a system of three nonlinear partial differential equations in five unknowns, two capillary pressures and three mass fractions. On the basis of the concept of local equilibrium between the phases, two constraints relating mass fractions were formulated to close this mathematical system. (Baker-IVI)
W85-04787

MULTIPHASE APPROACH TO THE MODELING OF POROUS MEDIA CONTAMINATION BY ORGANIC COMPOUNDS; 2. NUMERICAL SIMULATION,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
L. M. Abriola, and G. F. Pinder.
Water Resources Research, Vol. 21, No. 1, p 19-26, January, 1985. 11 Fig, 1 Tab, 13 Ref. DOE contract DE-AC02-79EV10257.

Descriptors: *Organic compounds, *Model studies, *Simulation, *Porous media, Gravity, Finite different methods, Plumes, Infiltration, Path of pollutants, Hydrocarbons.

A multiphase approach to the modeling of organic compound migration in the subsurface has been presented. The equations developed to govern such migration arose from the basic principles incorporating the effects of matrix and fluid compressibility, gravity, phase composition, interphase mass exchange, capillarity, and diffusion/dispersion. To demonstrate the applicability of the approach, a one dimensional implicit, finite difference model was developed and used to simulate the infiltration of a hydrocarbon mixture in a soil column. Migration of the organic phase along with the migration of the contaminant plume in the gas and water phases was simulated. Convergence of the model's iteration scheme was demonstrated heuristically for this problem, along with the convergence of the difference scheme in space and time. A mass balance performed on the heavy organic fraction component indicated that mass was being conserved in the system. Thus a workable model has been developed which can describe much of the complexity of subsurface contaminant migration heretofore unexamined. (Baker-IVI)
W85-04788

BIODEGRADATION OF ORGANIC CHEMICALS,
New York State Coll. of Agriculture and Life

Sciences, Ithaca.
M. Alexander.
Environmental Science and Technology, Vol. 19, No. 2, p 106-111, 1985. 3 Fig, 38 Ref.

Descriptors: *Fate of pollutants, *Organic compounds, *Biodegradation, Kinetics, Microorganisms, Mineralization, Cometabolism.

The rates of mineralization of some organic compounds are directly proportional to their concentration, so predictions of biodegradation rates can be made using laboratory tests of high levels of chemicals. With these compounds, however, the kinetics of the process and therefore the shapes of the curves of chemical disappearance will be a function of concentration. Other chemicals are mineralized at trace levels but may be cometabolized only at higher concentrations. There is a threshold below which certain, usually mineralizable molecules are not converted to carbon dioxide. Microorganisms may not assimilate carbon from chemicals present in trace amounts in natural environments; they will not grow or produce the large, acclimated populations needed for enhanced biodegradation. It is possible to predict the minimum concentration of a chemical necessary to support microbial growth. Based on these findings, tests of biodegradation, mineralization, or cometabolism that are performed using chemical concentrations greater than those that prevail in nature may lead to erroneous conclusions about the occurrence, rates, and products of microbial transformation in nature. (Baker-IVI)
W85-04797

EFFECTS OF DISSOLVED ORGANIC CARBON ON THE ADSORPTION PROPERTIES OF PLUTONIUM IN NATURAL WATERS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
D. M. Nelson, W. R. Penrose, J. O. Karttunen, and P. Mehlhaff.
Environmental Science and Technology, Vol. 19, No. 2, p 127-131, 1985. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Dissolved solids, *Organic carbon, *Adsorption, *Plutonium, Natural waters, Fate of pollutants, Colloids, Particulate matter, Organic matter, Sediments.

The hazard associated with the entry of plutonium into aquatic systems is largely determined by the extent to which it remains in solution. Its movement from areas of confinement or known contamination into uncontaminated areas is controlled by the proportion existing in the dissolved phase. The colloidal organic carbon (COC) found in natural aquatic systems is a major factor controlling the distribution of reduced plutonium between solid and dissolved phases. COC inhibits the adsorption of reduced plutonium (oxidation states III or IV) to suspended sediment particles. This effect can be described by a system of equilibria in which COC competes with the solid particles for Pu (III, IV). Pu (III, IV) forms both 1:1 and 1:2 complexes with COC. Low pH conditions suppress the formation of 1:2 complexes but not 1:1 complexes. When corrected for the influence of COC, the intrinsic adsorption coefficient for plutonium (III, IV) falls in the range (500,000 to 3,000,000) for all the surface waters examined. On a weight basis, the COC and natural sediments have approximately equal affinities for plutonium, except in Lake Michigan waters where the COC had substantially less affinity for plutonium. This may be related to the very long residence time of water in Lake Michigan, which may result in more highly degraded organic matter with fewer functional groups juxtposed to chelate metals. (Moore-IVI)
W85-04799

INFLUENCE OF PH AND IONIC STRENGTH ON THE AQUEOUS-NONAQUEOUS DISTRIBUTION OF CHLORINATED PHENOLS,
Oregon State Univ., Corvallis. Dept. of Chemistry.
J. C. Westall, C. Leuenberger, and R. P. Schwarzenbach.
Environmental Science and Technology, Vol. 19, No. 2, p 193-198, 1985. 4 Fig, 4 Tab, 18 Ref.

Descriptors: *Chlorinated phenols, *Hydrogen ion concentration, *Ionic strength, Phenols, Chlorinated hydrocarbons, Aqueous phase, Nonaqueous phase, Counterions, Tetrachlorophenol, Pentachlorophenol, Octanol.

The distribution ratio of hydrophobic ionizable organic compounds (HIOC's) between aqueous and nonaqueous phases is shown to depend on the pH and ionic strength of the aqueous phase. Four models are presented to describe the association of the HIOC with the nonaqueous phase: (i) transfer of the neutral organic species from the bulk of the aqueous phase to the bulk of the nonaqueous phase: (ii) transfer of the ionic organic species with inorganic counterions to the bulk of the nonaqueous phase; (iii) transfer of the ionic organic species to the aqueous-non-aqueous interface with inorganic counterions in the aqueous phase; (iv) association of the organic species with specific functional groups of the nonaqueous phase. The distribution of 2,3,4,5-tetrachlorophenol and pentachlorophenol in the two-phase system composed of KOH, KCl, H2O, octanol, and the chlorophenol was determined as a function of ionic strength and interpreted quantitatively in terms of models i and ii. For aqueous phases with high pH values and ionic strengths, the dominant species of the chlorophenols in the octanol phase were the chlorophenolate ions in association with K(+) counterions. (Author's abstract)
W85-04803

BEHAVIOUR OF ORGANIC MICROPOLLUTANTS (PAH, PCB, AND BHC) AND OF A FECAL STEROL IN THE HUSUM ESTUARY AND IN THE ADJACENT NORTH FRISIAN WADDEN SEA (VERHALTEN ORGANISCHER UMWELTCHEMIKALIEN (PCA, PCB UND HCH) UND EINES FAKALEN STEROLS IN DER HUSUMER AUE UND AUF DEN ANGRENZENDEN WATTERN - NORDFRIESLAND),
Bayreuth Univ. (Germany, F.R.).
R. Herrmann, W. Thomas, and D. Hubner.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 4, p 101-107, October, 1984. 10 Fig, 3 Tab, 26 Ref.

Descriptors: *Coprostanol, *Polychlorinated biphenyls, *Polynuclear aromatic hydrocarbons, *BHC, *Husum Estuary, *Germany (Federal Republic), North Sea, Spatial distribution, Hydrocarbons, Pesticides, Algae, Sediments, Fate of pollutants, Tidal effects.

The unequal spatial distributions in the three groups of organic micropollutants (PCB, PAH, and BHC) and the fecal sterol coprostanol within the sediments of the Husumer Aue and the adjacent Wadden Sea were interpreted by cluster analysis and principal component analysis. The regional patterns of PAH and PCB concentrations in sediments, algae and water are characterized by a decrease in concentrations from the zone of maximum turbidity to the sea. Further, the concentrations decrease from the tidal gully towards the tidal flats. The chlorinated pesticides alpha-BHC and gamma-BHC show an irregular distribution pattern which is dominated by a multiple input from intensively used agricultural land. The concentrations of coprostanol in sediments and algae indicate clearly the spatial distribution of fecal pollution. The spatial-temporal behavior of PCB and PAH, which are predominantly adsorbed on suspended sediments, results from the settling, resuspension and transport with the tidal currents of such sediments. This may be inferred from the temporal concentration profiles of water samples taken during a complete tidal cycle. (Author's abstract)
W85-04808

NUTRIENT BUDGETS FOR AGRICULTURAL WATERSHEDS IN THE SOUTHEASTERN COASTAL PLAIN,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 6G.
W85-04826

ACCUMULATION OF COPPER AND ZINC IN THE YELLOW WATER LILY, NUPHAR VARIEGATUM: RELATIONSHIPS TO METAL PARTITIONING IN THE ADJACENT LAKE SEDIMENTS,
Quebec Univ., Sainte-Foy.
P. G. C. Campbell, A. Tessier, M. Bisson, and R. Bougie.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 11, p 23-32, January, 1985. 5 Fig, 7 Tab, 35 Ref.

Descriptors: *Copper, *Zinc, *Water lily, *Bioaccumulation, *Lake sediments, Quebec, Macrophytes, Aquatic plants, Fate of pollutants, Heavy metals, Iron, Bioavailability.

Relationships between the partitioning of Cu and Zn in lake sediments and their availability to the yellow water lily, Nuphar variegatum, were examined downstream from a major Cu/Zn mining and smelting complex in Northwestern Quebec, Canada. At each of 13 sampling sites five N. variegatum individuals were collected, separated into stem and rhizome portions, and analyzed for total Cu and Zn. At the same sites, sediment cores were collected at the base of each plant; the 0- to 2-cm stratum was extruded, wet sieved (850 micro-m), and subjected to a sequential leaching procedure to determine the partitioning of Cu and Zn among various operationally defined geochemical fractions. Statistical analysis suggested that a significant portion of the Cu burden in N. variegatum was probably derived from the sediments, whereas the Zn content of the plant originated largely in the water column. The concentrations of Cu in the fractions most readily extracted from the sediment were the best indicators of Cu bioavailability in the sediment; normalization of these concentrations with respect to the Fe content of the sediment improved the relationship with rhizome Cu content suggestions that Fe play a protective role in regulating Cu bioavailability. (Author's abstract)
W85-04837

DISSIPATION OF PERMETHRIN IN LIMNOCORRALS,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
K. R. Solomon, J. Y. Yoo, D. Lean, N. K. Kaushik, and K. E. Day.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 1, p 70-76, January, 1985. 3 Fig, 5 Tab, 31 Ref.

Descriptors: *Limnocorrals, *Permethrin, *Fate of pollutants, Pesticides, Absorption, Lake sediments, Water chemistry, Lake St. George, Ontario.

A need for replicate and more realistic methods to evaluate the effects of pesticides in the aquatic ecosystem, has led to the investigation of the use of enclosures or limnocorrals. In order to develop a methodology for studying the effects of pesticides in enclosures and to determine the impact of the pesticide permethrin on the aquatic ecosystem, permethrin was applied to approximately 100-cu m limnocorrals in Lake St. George, a small mesotrophic lake in Ontario at concentrations of 500, 50, 5, and 0.5 micro-g/L. Permethrin dissipated from the water rapidly and approximated first-order kinetics in the first 8-12 d. Time taken for 50 and 90% dissipation ranged from 1.65 and 3.65 d, respectively, at 0.5 micro-g/L to 3.5 and 6.75 d, respectively, at 50 micro-g/L. Inter- and intra-seasonal replication of dissipation patterns was good. Rate of dissipation varied slightly with depth, normally being slower at greater depth. Absorption of permethrin to sediments was rapid, penetration was shallow, and disappearance was slow. There was an increase in the Secchi disk depth in the treated limnocorrals. Dissolved inorganic carbon decreased in all limnocorrals, including controls after treatment, suggesting precipitation of calcium carbonate which may act as a scavenging agent for permethrin in the water. The limnocorral offers more replicatability, repeatability, and realism than other systems and will become a useful tool for studying the effects of pesticides in aquatic systems. (Moore-IVI)
W85-04838

CHEMICAL SURVEY OF THE VOLTA ESTUARY,
Institute of Aquatic Biology, Achimota (Ghana).
For primary bibliographic entry see Field 2L.
W85-04854

ORGANOCHLORINE RESIDUES IN COMMON TERNS AND ASSOCIATED ESTUARINE ORGANISMS, MASSACHUSETTS, USA, 1971-81,
Massachusetts Audubon Society, Lincoln.
I. C. T. Nisbet, and L. M. Reynolds.
Marine Environmental Research, Vol. 11, No. 1, p 33-66, 1984. 1 Fig, 11 Tab, 93 Ref, 1 Append.

Descriptors: *Organochlorine pesticides, *Pesticide residues, *Terns, *Massachusetts, Fish, Mussels, Polychlorinated biphenyls, DDT, TDE, DDE, Dieldrin, Heptachlor epoxide, Chlordane, Urban areas, Land use, Industrial wastes, Distribution.

Organochlorine residues were measured in eggs of common terns Sterna hirundo at nine stations and in Atlantic silversides Menidia menidia at 11 stations in coastal Massachusetts, 1973-74. Tern eggs were sampled at one station from 1971 to 1981 and at another from 1973 to 1978. Mussels Mytilus edulis and various fish were sampled in 1975-76. PCBs were the predominant residues in all samples. DDE, TDE, DDT and HEOD (dieldrin) were detected in most samples of fish. HE (heptachlor epoxide), Alpha-chlordane, oxychlordane and HCB were also detected in most samples of tern eggs. Concentrations of DDE, TDE and PCBs in tern eggs were highly correlated with those in fish at the same stations. Concentrations of PCBs in tern lipids were about 10 times those in the lipids of their prey. Except for HCB, concentrations of organochlorines were highest in urban areas (Boston Harbor and Buzzards Bay) and lowest in remote areas (outer Cape Cod). In Buzzards Bay, levels of DDE, HEOD, HCB and PCBs declined significantly between 1971 and 1981. However, on outer Cape Cod, only PCBs clearly declined after 1973, and by 1976 most of the urban-rural differences in levels of other organochlorines had disappeared. The geographical patterns in pesticide residue levels were associated both with urban uses and with specific agricultural uses. The highest levels of PCBs were associated with industrial effluents at New Bedford and Boston. Hatching failure in common terns was associated with elevated residues of DDE in one sample, but population effects of DDE were only marginal after 1971. (Author's abstract)
W85-04861

MERCURY POLLUTION IN SEDIMENTS, BENTHIC ORGANISMS AND INSHORE FISHES OF HAIFA BAY, ISRAEL,
Israel Oceanographic and Limnological Research Ltd., Haifa.
H. Hornung, B. S. Krumgalz, and Y. Cohen.
Marine Environmental Research, Vol. 12, No. 3, p 191-208, 1984. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Mercury, *Sediments, *Benthos, *Fish, *Haifa Bay, *Israel, Heavy metals, Water pollution sources, Bays, Gastropods.

Total mercury concentrations were determined in surficial sediments, eleven species of benthic organisms and six species of fish from Haifa Bay, Israel. The results show that essentially all of the shallow water zone of the Bay receives anthropogenic mercury. A mercury-cell chlor-alkali plant was identified as the source of pollution. Surficial sediments in vicinity of the plant, containing up to 0.99 micro-g Hg/g dry weight, were up to 157 times enriched in mercury relative to an unpolluted area. Mercury levels in the benthic organisms reflected the levels in the sediments. Maximal concentrations reaching 38.7 and 18.2 micro-g Hg/g dry weight were found in the carnivorous gastropod mollusks Arcularia circumcinta and Arcularia gibbosula, respectively. In all fish species, specimens caught in Haifa Bay had higher mercury concentrations in the muscle tissue than specimens caught south of the Bay. A maximal value of 1.66 micro-g Hg/g wet weight was recorded in Diplodus sargus. (Author's abstract)
W85-04863

RADIOECOLOGICAL STUDIES OF ACTIVATION PRODUCTS RELEASED FROM A NUCLEAR POWER PLANT INTO THE MARINE ENVIRONMENT,
Lund Univ. (Sweden). Dept. of Radiation Physics.
M. Nilsson, S. Mattsson, and E. Holm.
Marine Environmental Research, Vol. 12, No. 3, p 225-242, 1984. 12 Fig, 2 Tab, 9 Ref.

Descriptors: *Radioactive wastes, *Nuclear powerplants, *Bioindicators, *Marine environment, Oresund, Seaweeds, Crustaceans, Fate of pollutants, Distribution, Cobalt radioisotopes.

The Barseback nuclear power plant, located on the Oresund sound between Denmark and Sweden, consists of two boiling water reactors. The release of radionuclides, mainly activation products, is quite low during normal operation. During the summer, when annual overhaul and partial refuelling take place, the discharge is much higher. Samples of seaweeds and crustaceans collected along the coast were analyzed for radionuclides. Seaweeds (Fucus vesiculosus, F. serratus, Ascophyllum nodosum and Cladophora glomerata) and crustaceans (Idothea and Gammarus) proven to be excellent bioindicators for radioactive corrosion products released from the nuclear power plant into the marine environment. These bioindicators have been used to map the spatial and temporal distribution of the released radioactivity. The activity has been followed up to 150 km from the power plant, and the decrease in activity concentration in the bioindicators with distance can be expressed by a power function. The variation with time of activity concentration reflects the amount of activity discharged from the power plant, with good resolution in time. The bioindicators exhibit different uptake patterns of the radionuclides detected. The crustacean Idothea showed variations in the Co-60 activity concentration between winter and summer. (Moore-IVI)
W85-04865

PHOSPHORUS, NITROGEN, AND CARBON CYCLING BY FISH POPULATIONS IN TWO SMALL LOWLAND RIVERS IN POLAND,
Lodz Univ. (Poland). Inst. of Environmental Biology.
T. Penczak.
Hydrobiologia, Vol. 120, No. 2, p 159-165, 1985. 6 Tab, 24 Ref.

Descriptors: *Fish, *Utrata River, *Ner River, *Poland, *Cycling nutrients, Carbon, Phosphorus, Nitrogen, Population density, Growth, Metabolism.

Fish were caught at 6 sites in the Utrata River, a tributary of the Bzura River in the Vistula drainage basin, and 3 sites in the Zalewka Brook, a tributary of the Ner River in the Warta drainage basin. Amounts of C, P and N consumed by fish populations at these sites were estimated. Phosphorus was assimilated two times more efficiently than carbon and nitrogen. No significant differences in the levels of C, P, and N were noted with relation to body length, sex, and season. The amount of C, P, and N consumed by fish populations at the sites depended mainly on fish density and fish diet. The results imply that fish populations are important in the cycling of these elements. On average, fish consumed 7.9 kg of carbon, 3.1 kg of phosphorus, and 6.6 kg of nitrogen to assimilate 1 kg of each of these elements into their body. Phosphorus was the most effectively used element for growth; the efficiency for nitrogen and carbon is two times lower. All elements are absorbed most efficiently by young fish. (Baker-IVI)
W85-04888

BIOLOGICAL AVAILABILITY OF METALS TO MARINE ORGANISMS,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
M. Waldichuk.
Marine Pollution Bulletin, Vol. 16, No. 1, p 7-11, January, 1985. 7 Ref.

Descriptors: *Metals, *Marine organisms, *Fate of pollutants, Fish, Aquatic life, Sediments, Minerals.

To have an impact on aquatic organisms, metals must be in a form that is biologically available to them. Metals in particulate form, both suspended in the water and in the sediments, are seldom available directly to aquatic organisms. The only exception to their biological unavailability is when the particulate metals are ingested by marine organisms and become solubilized in the acidic juices of the gut. Natural processes releasing metals from minerals are considered. Attention is also given to the physical characteristics of sediments and the distribution of metals biogeochemical processes in the sediments, mine tailings, sewages sludge and dredge spoils, effects of water characteristics, mode of uptake by marine organisms, and measurement of bioavailability of metals. (Baker-IVI)
W85-04891

PCBS, DDTS AND OTHER CHLORINATED HYDROCARBONS IN MARINE ORGANISMS FROM THE MEDITERRANEAN COAST OF ISRAEL,
Bioresearch Labs. Inc., Haifa (Israel).
R. Ravid, J. Ben-Yosef, and H. Hornung.
Marine Pollution Bulletin, Vol. 16, No. 1, p 35-38, January, 1985. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Fate of pollutants, *Mediterranean Sea, *Fish, *Shellfish, *Chlorinated hydrocarbons, Pesticides, Polychlorinated biphenyls, Coastal waters, DDT, Organic compounds, BHC, Aldrin, Israel.

Commercially exploited species of fish and shellfish taken along the coast of Israel were examined for organochlorine residues to evaluate in the present state of concentration and to serve as a baseline for monitoring in the future. Organochlorines analyzed were DDT and metabolites, PCBs (Aroclor 1242, 1254, and 1260), BHC (alpha and gamma) and aldrin. For Mullus barbatus no differences in the pesticide concentrations in this species were found among the sampling stations. The correlation coefficient shows a positive relation in the concentration of DDTS with increasing length of fish. Upeneus moluccensis showed a higher concentration of pesticides in the Tel-Aviv area than at the other three stations. An inverse relation was noted between DDTs, PCBs and the total length of the fish. Saurida undosquamis showed a positive relationship between the concentrations of DDTs, PCBs and the total length of the fish. In about 25% of the Parapeneus longirostris specimens no pesticides were detected. There was no correlation between the concentrations of DDT and body length of Parapenaeus longirostris, but there was a significant negative correlation between the concentrations of PCBs and the body length. DDTs were found in all samples investigated and, except for one sample of Mullus barbutus, all samples included PCBs as well. BHC was found in 75% of the samples and aldrin only in 40%. (Baker-IVI)
W85-04894

RETRIEVAL OF MATERIAL FROM THE SURFACE MICROLAYER WITH SCREEN AND PLATE SAMPLERS AND ITS IMPLICATIONS FOR PARTITIONING OF MATERIAL WITHIN THE MICROLAYER,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 5A.
W85-04895

TRACE METAL AND PCB CONTENT OF MUSSELS (MYTILUS EDULIS) FROM THE SOUTHWESTERN BALTIC SEA,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
H. Moller, R. Schneider, and C. Schnier.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 5, p 633-647, 1983. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Mussels, *Polychlorinated biphenyls, *Trace metals, *Baltic Sea, Water pollution

sources, Heavy metals, Wastewater pollution, Marine environment, Fjords, Thorium, Uranium, Scandium, Iron.

Hydrographic pecularities, including slow water exchange with the North Atlantic and stable water stratification, amplify ecological problems in the Baltic Sea. The introduction of human wastes into such an ecologically unstable area is a far greater danger than waste disposal in other marine environments. The concentrations of polychlorinated biphenyls and 28 metals were determined in mussels from 32 stations in the southwestern Baltic Sea. Elevated levels of PCBs (up to 28 mg/kg lipids) were found in harbor areas, but the high percentage of lipid in the dry weight of soft parts of the mussels partly explain this. There were three areas in which several elements occurred at levels clearly above the average for the whole region. One was near the Kiel sewage outlet, where chromium, nickel, silver, cadmium, gold, and mercury were found at high concentrations. Increased levels of heavy metals in the outer Flensburg Fjord and in the vicinity of Fehmarn Sound seem to be due to natural geological formations. This is indicated by the presence of high concentrations of thorium, uranium, scandium, and some rare earth elements, which are not commonly found in anthropogenic wastewaters. Elevated levels of heavy metals were usually not present in mussels from fjord stations. Two exceptions involving iron may be due to rust leached from a lock gate of the Kiel Canal and to the addition of FeSO4 to the cooling water of the Kiel power plant. (Moore-IVI)
W85-04902

DECOMISSIONING OF MERCURY CELL CHLOR-ALKALI PLANTS IN CANADA,
Environmental Protection Service, Ottawa (Ontario).
I. McBeath.
Available from Environmental Protection Service, Ottawa K1A 1C8, Canada. Economic and Technical Review Report EPS 3-EP-83-5, November 1983. 57 p, 5 Fig, 1 Tab, 6 Append.

Descriptors: *Industrial wastes, *Chemicals wastes, *Mercury pollution, *Mercury, *Effluents, *Runoff, *Seepage, *Restoration, Chemical industry, Decontamination, Detoxification, Cleanup, Contamination, Dismantling, Canada.

This report reviews in detail the procedures followed by six companies in dismantling, decontaminating and restoring, or converting their mercury cell chlor-alkali plants. Methods used to confine mercury-contaminated wastes from these plants in secure burial sites are described. This report deals only with closure procedures, although the safety and health of the workers was also emphasized during discussions with plant personnel. At each plant the activities were planned to minimize the possible exposure to mercury and frequent regular personnel monitoring was undertaken even though the wearing of face masks was mandatory if the mercury concentration in the air was greater than 0.05 mg/cu cm. The monitoring also included urine testing. Emphasis was placed on spill prevention and prompt clean-up. Cell rooms were well ventilated and atmospheric monitoring for mercury was carried out. All of the closed and converted plants monitor for mercury in the effluents, runoff and seepages from the original plant sites and burial areas. If any increase in mercury releases and migration are noted, corrective action will be taken immediately. All mercury removed from the closed and converted plants was sold. The dismantling, decontaminating and restoring of plant sites varied from plant to plant depending upon the extent of mercury contamination, the topographical location and type of soil at the plant, and the availability of a salt cavern to the plant.
W85-04939

CHLOROPHENOLS AND THEIR IMPURITIES IN THE CANADIAN ENVIRONMENT: 1983 SUPPLEMENT,
Environmental Protection Service, Ottawa (Ontario).
P. A. Jones.
Available from Environmental Protection Service, Ottawa, Ontario K1A 1C8. Economic and Technical Review Report EPS 3-EP-84-3, March 1984. 93 p, 1 Fig, 7 Tab, 142 Ref, 4 Append.

Descriptors: *Canada, *Chlorophenols, *Industrial wastes, Industrial production, *Environmental effects, *Ecotoxicology, Environmental policy, Literature, Pest Control Products Act.

Since the publication of the Environment Canada report 'Clorophenols and Their Impurities in the Canadian Environment' many changes have occurred in the use patterns of chlorophenols, and many research studies have been undertaken. The current Canadian use patterns for chlorophenols and the associated regulations under the Pest Control Products Act, administered by Agriculture Canada, as well as results of relevant research on the chlorophenols as reported in the literature since 1980, have been documented in this supplement. An annotated historical review of chlorophenols in Canada has also been included. The earlier Environment Canada review on chlorophenols contained considerable information on polychlorinated dibenzo-p-dioxins and other impurities usually present in chlorophenols. The information presented in this supplement has been restricted to that on chlorophenols since recent reviews have dealt specifically with the polychlorinated dibenzo-p-dioxins and other related impurities. Major subject areas addressed in the chlorophenol supplements include those on; quantities in commerce, sources to the environment, levels and stability in the environment, ecotoxicology, and fate and mobility in the environment.
W85-04941

5C. Effects Of Pollution

IN VIVO EFFECTS OF CADMIUM ON SOME ENZYME ACTIVITIES IN TISSUES OF THE FRESHWATER CATFISH, HETEROPNEUSTES FOSSILIS,
D.A.V. Coll., Muzaffarnager (India). Dept. of Zoology.
K. V. Sastry, and Km. Subhadra.
Environmental Research, Vol. 36, No. 1, p 32-45, February, 1985. 7 Tab, 33 Ref.

Descriptors: *Cadmium, *Enzymes, *Toxicity, *Catfish, Fish tissues, Animal tissues, Fish physiology, Metals, Heavy metals, Water pollution effects.

Alterations in the activities of some enzymes in a freshwater catfish, Heteropneustes fossilis, have been examined in liver, kidney, intestine, ovary, gills, and muscles after exposure to 0.26 mg/liter of cadmium for 15, 30, and 60 days. The fish were hyperglycemic and hyperlactemic after 15 and 30 days of exposure. The liver and muscle glycogen content was depleted in the first two periods of exposure. In contrast, 60 days of cadmium treatment increased the glycogen content of the two tissues. Liver lactic acid level was elevated after 15 days. Muscle lactic acid content fell significantly after 15 and 60 days of exposure, but it was elevated after 30 days. Acid phosphatase activity was inhibited in liver, ovary, and gills but the enzyme activity increased in kidney and intestine. The activity of alkaline phosphatase decreased in liver, kidney, and intestine but elevation was recorded in ovary and muscles. In all three exposure periods, hexokinase activity of kidney and ovary was inhibited but the enzyme activity increased in intestine. Hexokinase showed elevation in liver, gills, and muscle after 15 and 30 days of exposure and inhibition after 60 days of exposure. The activity of xanthine oxidase decreased in liver and muscles and elevated in the rest of the tissues. Glutamate dehydrogenase fell significantly in intestive, ovary, and gills. The liver, kidney, and muscles the enzyme activity was elevated. Liver, intestine, gills, and muscles showed elevation in aminoacid oxidase activity. However, the enzyme activity was inhibited in kidney and in ovary. (Author's abstract)
W85-04434

HEAVY METAL TOXICITY TO MICROBE-MEDIATED ECOLOGIC PROCESSES: A REVIEW AND POTENTIAL APPLICATION TO REGULATORY POLICIES,
New York Univ., NY. Dept. of Biology.
H. Babich, and G. Stotzky.
Environmental Research, Vol. 36, No. 1, p 111-137, February 1985. 1 Tab, 162 Ref. EPA grant R808329.

Descriptors: *Heavy metals, *Toxicity, *Microorganisms, *Water pollution effects, *Regulations, Ecological effects, Policy making.

Microorganisms are sensitive to heavy metal pollution as are other components of the biota. However, most studies on the interactions between microbes and heavy metals have been conducted in synthetic media or in altered (e.g., sterilized) environmental samples and usually have used only single species. Few studies have evaluated the effects of heavy metals on the activities of natural heterogeneous microbial populations, both autotrophic and heterotrophic, in terrestrial and aquatic environments. These latter studies have shown that heavy metals inhibit primary productivity, nitrogen fixation, the mineralization of carbon, nitrogen, sulfur, and phosphorus, litter decomposition, and enzyme synthesis and activity in soils, sediments, and surface waters. The potential adverse effects of heavy metals on such microbe-mediated ecologic processes need to be incorporated into the methodologies used by regulatory agencies, such as the U.S. Environmental Protection Agency, to prepare environmental risk assessments which, in turn, are used to formulate environmental criteria, such as the Water Quality Criteria, and to evaluate the safety to the environment of exposure to 'new chemical substances,' as mandated by the U.S. Toxic Substances Control Act of 1976. To provide appropriate data that can be assimilated into regulatory policy, it is essential that microbial ecotoxicity tests be standardized, are neither costly nor difficult to train personnel to conduct, and produce data that can be quantitated. (Author's abstract)
W85-04435

PHYSICAL AND ECONOMIC IMPACTS OF SEDIMENTATION ON FISHING ACTIVITIES; NAM PONG BASIN, NORTHEAST THAILAND,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
S. H. Johnson, III, and S. Kolavalli.
Water International, Vol. 9, No. 4, p 185-188, 1984. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Reservoirs, *Sedimentation, *Watershed management, *Thailand, *Fishing, Economic aspects, Nonpoint pollution sources, Erosion control, Soil erosion, Forest management, Clear-cutting, Environmental effects.

Rapid economic development in Southeast Asia has led to the destruction of large areas of natural forests. Without proper land management and protection, intensification of economic activities has resulted in increased soil erosion. Physical and economic impacts of nonpoint pollution from erosion on the larger off-farm environment are considered. The focus is on the flow of suspended sediment into water channels and the resulting increased turbidity and sediment deposits within downstream reservoirs. Using dynamic models of the Nam Pong watershed in Northeast Thailand, the reservoir formed by the Ubolratana Dam, and the community of fishing families, the magnitude of actual economic losses resulting from forest clearing is determined. Long term environmental and economic implications and alternative management strategies are presented. (Baker-IVI)
W85-04448

EVALUATION OF EUTROPHICATION IMPACT IN PUBLIC WATER SUPPLY RESERVOIRS IN EAST ANGLIA,
C. R. Hayes, and L. A. Greene.
Water Pollution Control, Vol. 83, No. 1, p 42-51, 1984. 4 Tab, 1 Ref.

Descriptors: *Eutrophication, *Reservoirs, *Water quality control, *East Anglia, *England, Water

quality, Drinking water, Water supply, Economic aspects.

Problems, causes and effects of eutrophication along with possible control options are considered for 12 reservoirs in the Anglian Water Authority region. Sewage treatment, river management, reservoir management, water treatment and distribution are interlinked with eutrophication. To resolve the complex interdependent water quality issues requires sophisticated data handling techniques and the cooperation of both scientific and engineering disciplines. The long term influence of eutrophication on the wholesomeness of public supplies from Anglian lowland reservoirs is of concern. The cost penalities likely to be incurred by Anglian Water Authority as a consequence of lack of recognition or the blind eye approach are very considerable as evidenced by preliminary estimates of long-term capital expenditure on treatment works and their distribution systems to ameliorate discoloration problems. (Baker-IVI)
W85-04451

EFFECTS OF THE RECHARGE ON SEWAGE EFFLUENTS UPON THE QUALITY OF CHALK GROUNDWATER,
H. A. C. Montgomery, M. J. Beard, and K. M. Baxter.
Water Pollution Control, Vol. 83, No. 3, p 349-366, 1984. 6 Fig, 11 Tab, 14 Ref.

Descriptors: *Groundwater recharge, *Effluents, *Wastewater disposal, *Chalk aquifers, *England, Groundwater quality, Water quality control, Storativity, Transmissivity, Nitrogen removal, Organic matter.

In Southern England the chalk is well-fractured, fine-grained, soft limestone in which intergranular flow predominates. Values for unconfined chalk storativity are commonly in the range of 0.5-2% and of transmissivity 500-3000 sq m/day. Rates of movement in the unsaturated and saturated zones were studied to ascertain whether the removal processes observed in the USA for organic matter, nitrogen, and microbiological contaminants would also occur in the chalk. Special emphasis was laid on the detection of organic micropollutants. Results show that, with a slight reservation about trace organics, effluent recharge to the chalk is not only an acceptable method of disposal on water quality grounds but could perhaps be adopted more widely as a resource conservation measure. Provision of sewage treatment appears to be immaterial as regards the groundwater quality some hundreds of meters from the recharge site except in so far as nitrogen removal is prevented if conventional biological treatment is provided. Obviously effluent recharge could not be used in areas of major fissuring of the chalk. In the Southern Water Authority such areas are thought to be confined to parts of north-west Kent and the areas adjacent to and beneath the tertiary outcrop in Southern Hampshire and Sussex. (Baker-IVI)
W85-04462

EFFECTS OF MOTORWAY RUN-OFF ON THE ECOLOGY OF STREAM ALGAE,
North West Water Authority, Warrington (England). Rivers Div.
G. B. J. Dussart.
Water Pollution Control, Vol. 83, No. 3, p 409-415, 1984. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Algae, *Highways, *Runoff, Water pollution effects, Streams, Salt, Species diversity, Abundance.

The impact of motorway drainage on the algae of upland streams in northwest England is described. Seven small streams were investigated, together with an intensive survey of one of the streams. The study took place at the end of the winter so that the maximum possible impact of events such as road salting would be identifiable. The purpose was initially to identify impacts and not to investigate chemical or biological mechanisms. Analyses of variance showed that downstream of the motorway there were significant increases in number of algal species, algal abundance, species diversity and the relative abundance of filamentous organisms. The relative abundance of filamentous organisms was the only aspect to show a positive but tenuous correlation with road-catchment length. (Baker-IVI)
W85-04466

EFFECT OF METHYLENE CHLORIDE ON RESPIRATION AND ELECTRON TRANSPORT SYSTEM (ETS) ACTIVITY IN FRESHWATER SEDIMENT,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
J. T. Trevors.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 239-245, February, 1985. 4 Tab, 9 Ref.

Descriptors: *Methylene chloride, *Respiration, *Sediment, *Water pollution effects, Oxygen, Carbon dioxide, Electron transport system, Microorganisms.

Methylene chloride caused very different effects in the sediment samples depending upon the method used to measure activity. Methylene chloride had no significant toxic effect during a 1 hour enzymatic assay of electron transport system (ETS) activity. Methylene chloride caused a stimulation of ETS activity at day 1 and 4 when compared with untreated controls. After 6 and 8 days, no significant inhibition or stimulation of activity was noted, whereas at day 11, a stimulation of activity was again noted. Methylene chloride significantly inhibited carbon dioxide evolution in the sediment. The effective concentration inhibiting carbon dioxide evolution by 50% after 7 days was estimated to be 11.7 micro-l/g. Oxygen uptake measured in the same sediment samples treated with methylene chloride indicated that it was being used as a substrate, and stimulated ETS activity and therefore oxygen uptake. Oxygen uptake was stimulated by similar concentrations ranging from 1.0 to 20 micro-l/g. Any investigation of non-toxic or toxic effects of pollutants on environmental processes should not rely on any single measurement of microbial activity. (Baker-IVI)
W85-04475

EFFECTS OF TRICHLOROACETIC ACID, A NEW CONTAMINANT FOUND FROM CHLORINATING WATER WITH ORGANIC MATERIAL, ON DRAGONFLY NYMPHS,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
M. Correa, E. J. Calabrese, and R. A. Coler.
Bulletin of Environmental Contamination and Toxicology, Vol. 43, No. 2, p 271-274, February, 1985. 1 Tab, 7 Ref.

Descriptors: *Water pollution effects, *Trichloroacetic acid, *Dragonflies, Chlorination, Ammonia, Respiration, Aquatic insects, Larval growth stage, Toxicity.

Trichloroacetic acid (TCA) has been found after chlorination of water rich in organic matter. A study was undertaken to assess the effects of TCA on respiration and ammonia excretion rates of nymphs of the dragonfly Somatochlora cingulata, a widely used indicator organism. Oxygen consumption was markedly and progressively enhanced in Somatochlora cingulata as a result of the TCA treatment. Highly significant differences were found between controls and experimental animals exposed to TCA with the respiration rate at 1 mg/L being nearly double that of the controls. Ammonia excretion levels increased significantly in a dose-dependent manner as a result of TCA exposure. As with oxygen consumption, the average ammonia excretion rate at 1 mg/l was twice that of controls. While the mechanisms by which the TCA treatment caused significant increases in oxygen consumption and ammonia excretion remains to be elucidated, it is of interest that the physiological changes observed occurred at levels of environmental relevance (10-100 ppb) for only a single four hour exposure. (Baker-IVI)
W85-04478

SUBCHRONIC EFFECTS OF A MIXTURE OF 'PERSISTENT' CHEMICALS FOUND IN THE GREAT LAKES,
Montreal Univ. (Quebec). Dept. de Pharmacologie.
M. G. Cote, G. L. Plaa, V. E. Valli, and D. C. Villeneuve.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 285-290, February, 1985. 2 Fig, 4 Ref.

Descriptors: *Great Lakes, *Organic compounds, *Toxicity, *Standards, Aldrin, Dieldrin, DDT, DDE, Endrin, Heptachlor, Lindane, Methoxychlor, Mirex, Toxaphene, Arochlor, DEHP, MEHP, Dibutylphthalate, Chlordane, Sublethal effects.

The 1978 Great Lakes Water Quality Agreement establishes guidelines or objectives for a series of 'persistent' toxic substances that had been identified as contaminants in the Great Lakes ecosystem. The combined effects of these chemicals was studied in order to determine if the established guidelines permit some measrue of safety in a toxicological sense. The 15 chemicals studied were blended into a ground cube diet, at four different concentration levels. Chemicals used included aldrin, dieldrin, DDT, DDE, endrin, heptachlor, lindane, methoxychlor, mirex, toxaphene, arochlor 1254, DEHP, MEHP, dibutylphthalate, and chlordane. The mixtures were well tolerated by both male and female rats when consumed for 91 days. No dose-related toxicological changes were noted. Although food consumption was significantly lower for the females during week 12, body weight was not significantly affected. Males exhibited no such change. The levels of compounds fed in the study were 1 to 1000-fold multiples of the water quality objectives proposed for control of persistent chemicals found in the Great Lakes. (Baker-IVI)
W85-04479

BIODEGRADABILITY OF TWO PRIMARY ALCOHOL ETHOXYLATE NONIONIC SURFACTANTS UNDER PRACTICAL CONDITIONS, AND THE TOXICITY OF THE BIODEGRADATION PRODUCTS TO RAINBOW TROUT,
Shell Chemicals U.K. Ltd., London (England).
For primary bibliographic entry see Field 5D.
W85-04487

PHYTOPLANKTON IN A POLLUTED SUBARCTIC LAKE BEFORE AND AFTER NUTRIENT REDUCTION,
Laensstyrelsen, Ostersund (Sweden).
S. Holmgren.
Water Research, Vol. 19, No. 1, p 63-71, 1985. 2 Fig, 6 Tab, 44 Ref.

Descriptors: *Phytoplankton, *Lakes, *Subarctic zone, *Sweden, *Nutrients, Phosphorus, Biomass, Water chemistry, Eutrophic lakes, Species composition, Ecological effects, Chlamydomonas, Chlorophyta, Dictyosphaerium, Chromulina, Cryptomonas, Mallomonas.

Phytoplankton and water chemistry were studied in a eutrophic subarctic Swedish lake before and after nutrient reduction. Pollution started in 1964 and the lake had received about 4.5 tons of phosphorus by the time the treatment plant was built in 1974. After that only 18-20 kg P/yr entered the lake. Before nutrient reduction the phytoplankton consisted principally of three species, Dictyosphaerium pulchellum var. minutum, Chromulina cv. darlecarlica and Cryptomonas cv. ovata. Two years after the P-load was reduced Chlamydomonas spp and Mallomonas akrokomos predominated in the plankton and their dominance has been maintained during the period of study. Seasonal average phytoplankton biomass decreased from 11.2 g/cu m in 1973 to 2.9 g/cu m in 1980. Average seasonal total phosphorus concentrations decreased from 168 micro g/l in 1980. Average Secchi depth readings increased from 1.3 m in 1973 to 2.1 m in 1980. Blue-green algae never had any quantitative importance in the lake and no blooms were observed. (Author's abstract)
W85-04490

ORGANIC SULFUR COMPOUNDS AND POLYCYCLIC HYDROCARBONS TRANSFERRED TO OYSTER AND MUSSEL FROM PETROLEUM SUSPENSION; IDENTIFICATION BY GAS CHROMATOGRAPHY AND CAPILLARY MASS CHROMATOGRAPHY,

Okayama Univ. (Japan). Dept. of Public Health.
M. Ogata, and K. Fujisawa.

Water Research, Vol. 19, No. 1, p 107-118, 1985. 4 Fig, 2 Tab, 13 Ref. Ministry of Education Agency (Japan) grant 57035029.

Descriptors: *Mussels, *Oysters, *Mollusks, *Sulfur compounds, *Polycyclic hydrocarbons, *Hydrocarbons, *Chromatography, Mytilus, Water pollution effects, Seawater, Gas chromatography, Mass spectrometry, Benzothiophenes.

Organic sulfur compounds in oyster (Crassostrea gigas) and mussel (Mytilus edulis) maintained in a crude oil suspension in seawater were analyzed by a gas chromatography-mass spectrometry system. Crude oil used in this experiment was a mixture of light crude oil and zubea crude oil (4:1) with a specific gravity of 0.857. The oil was poured into a separation funnel with sea water and then shaken vigorously; after standing, the lower seawater layer was separated and added to the exposure tank. Capillary column gas chromatography-mass chromatography of extracts of the oyster and mussel showed the presence of organic sulfur compounds of alkyl benzothiophene (C2-C4), dibenzothiophene and alkyl dibenzothiophene (C1-C4). Coexistence of polycyclic aromatic hydrocarbons with organic sulfur compounds was found in oyster and mussel. Accumulation ratios were calculated from concentrations of organic sulfur compounds in the biota samples to those in the water samples. The concentrations in water were calculated from the height ratio in gas chromatogram and average concentrations before and after the change of oil suspension were used for calculation of the concentration factors. The time courses of concentration ratios of organic sulfur compounds in the oyster and the mussel were determined by gas chromatography connected with flame photometric detector. Generally, the ratios in oyster and mussel increased as the exposure time increased and complete tissue saturation was not achieved within the present exposure periods used. Mussels discharged organosulfur compounds quickly, while the oysters tended to retain them relatively longer. Half lives of the compounds were calculated to be 12.1 + or - 2.9 days in oyster and 4.1 + or - 1.6 days in mussel. The organic sulfur compounds identified in this experiment are recommended as markers of oil pollution in shellfish. (Collier-IVI)
W85-04496

EFFECTS OF POWER STATION COOLING WATER DISCHARGES ON AQUATIC ECOLOGY,

Central Electricity Generating Board, Leatherhead (England). Biology Dept.
G. D. Howells.

Water Pollution Control, Vol. 32, No. 1, p 10-17, 1983. 7 Fig, 2 Tab, 32 Ref.

Descriptors: *Water pollution effects, *Hydroelectric plants, *Thermal pollution, Cooling water, Temperature effects, Fish, Crustaceans, Insects, Annelids, Additives, Chlorine.

The major effects of biological/ecological significance which seem likely to arise at inland power station cooling water discharges are those relating to increased temperatures, chemical additives and chemical quality changes. In general lethal temperatures are significantly greater than those in receiving waters, and also in the discharge, so that the more subtle or long-term effects of sub-lethal temperatures have to be distinguished from other environmental influences. The toxicity of chlorine to different organisms reported shows wide variations, attributable to different species' sensitivity, and different experimental exposures. The maximum exposure period below which no mortality occurs for any concentration of chlorine is about one third of the period for 50% of the population to be killed. Experimental studies showed that Limnodrilus increased egg production as temperature was increased to 25 C, while Tubifex egg production was steady over the range 10-25 C. The greater abundance of sexually mature Limnodrilus is attributable to increased temperature. Population abundance and the size of animals for crustaceans were largest at locations most subject to organic pollution, with a larger proportion of animals completing their life cycle in less than a year at warmer locations. Consistent differences in fish catch were found between rivers, but not upstream and downstream of the discharges in any one year. A significant difference in size of fry at downstream sites was observed and attributed to a winter attraction to, and a summer movement away from heated reaches. (Baker-IVI)
W85-04507

CONCEPTUAL MODEL OF LAKE ACIDIFICATION,

Norges Landbrukshoegskole, Aas. Dept. of Agricultural Hydrotechnics.
O. Groterud.

Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 686-691, October, 1984. 3 Fig, 14 Ref.

Descriptors: *Lakes, *Acidification, *Finnemarka, *Norway, Model studies, Limnology, Water pollution effects, Air pollution, Water pollution sources, Aluminum, Leaching, Vegetation, Fish, Invertebrates.

A model is used to describe the acidification dynamics of lakes in Finnemarka, southern Norway with reference to atmospheric, terrestrial and limnic factors involved in the acidification process. The lakes examined were soft water lakes in an area underlain by granitic rocks with very shallow overburden. The oligotrophication of the lakes and chemical changes have been examined by means of sediment analyses. Sedimentary chlorophyll determinations were studied down to a depth of about 15 cm. Some other parameters also determined in the sediment layers in question include ignition loss, pH, Eh, phosphorus, iron, manganese, aluminium, and alkaline soluble silicon. Biological changes like fish extinction and invertebrate community structure in the lake may both affect the metabolism rate and possibly the lake acidity directly. These changes are induced by the increased leaching of aluminum from the catchment and the increased acidity of the lake water. Increased growth of mosses, fungi and periphytic algae are involved in a feed-back process with the acid lake water. This increased growth may also be a result of increased transparency in the lakes. Changes in the decomposition of organic acids will possibly affect lake acidity. In general, the limnic acidification with many feed-back mechanisms is liable to be less stable than the two other main acidification processes. For instance, a change in the vegetation cover of the catchment may induce a feed back mechanism in the limnic part, thus giving rise to a stronger acidification than its contribution should merit alone. (Baker-IVI)
W85-04531

CHANGES IN BASE CATION CONCENTRATIONS DUE TO FRESHWATER ACIDIFICATION,

Norsk Inst. for Vannforskning, Oslo.
A. Henriksen.

Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 692-698, October, 1984. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Acid lakes, *Acid deposition, *Base cations, *Cations, *Norway, Magnesium, Calcium, Lakes, Water pollution effects.

Under natural conditions, lithological components within a watershed are subject to weathering processes that consume hydrogen ions and release other cations. If the hydrogen ion input increases the weathering rate should increase, releasing more cations (such as calcium, magnesium, and aluminum) and giving higher concentrations of cations in the runoff water. In developing empirical models of lake response to atmospheric acidic inputs it is necessary to know how the concentration of non-marine Ca plus Mg (CM*) changes in lakewater as acid inputs are changed. Two approaches have been used, based on chemical data from 719 lakes in southern Norway with similar bedrock lithology, across a gradient in acid loading, as reflected by the non-marine sulfate concentration (SO4*) in the lake. (1) Increases in CM* from increased weathering caused by increased SO4* should be nearly equal in lakes and drainage basins, grouped by similar elevation. Lakes with the lowest CM* at elevated SO4* in each group can have increased CM* by a maximum amount corresponding to the present concentration. A maximum increase factor of about 0.4 micro eq CM*/micro eq SO4* is derived. (2), A similar value is obtained from 486 lakes with pH < 5.0, assuming that H(+) and Al concentrations are negligible if HCO3(-) is present, and that an increase in SO4* is compensated by H(+), aluminum, and possibly increased CM*. This neglects SO4* used to compensate for lost HCO3(-). Both estimates of increased CM* caused by increased SO4* give maximum values. Effects of changed SO4* on pH may be calculated for a maximum or minimum pH change. Evaluation of available data do not clearly lead to the conclusion that the base cation concentrations really have increased in areas subjected to acid inputs. These trends will only be precisely determined with more extensive studies. (Collier-IVI)
W85-04532

DISSOLVED ORGANIC CARBON IN DANISH LAKES: CONCENTRATION, COMPOSITION, AND LABILITY,

Aarhus Univ. (Denmark). Botanical Inst.
M. Sondergaard.

Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 780-784, October, 1984. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Dissolved solids, *Organic carbon, *Denmark, *Lakes, Bacteria, Trophic level, Decomposition, Diel variation.

Dissolved organic carbon (DOC) is a major constituent of the carbon pool in aquatic environments. By bacterial activity the DOC is partly converted to particulate organic carbon and made available to higher trophic levels. An investigation of dissolved organic carbon was carried out in 14 lakes in Denmark. The lability of the DOC to bacterial decomposition was measured in four lakes as the decrease in concentration with time. Intensive, diel studies in five lakes were undertaken at different dates. Instantaneous concentrations of DOC are tabulated and plotted against the yearly pelagic primary production. A positive and significant correlation was noted. The lakes represent both drainage and seepage lakes, therefore one interpretation of the relationship is that the DOC is mainly of autochthonous origin and that an almost constant part of the production becomes refractory. A short water retention time and a high productivity would thus obscure the results. Lake Orn is the lake with the shortest retention time (19 days). The low concentration of DOC in Lake Orn thus can be explained by the lack of old and refractory DOC in the pool. Significant diel changes were only found at one occasion in Lake Mosso and in Lake Orn. Molecular weight separations indicate that only a minor part of the DOC was high molecular weight compounds. The major part was less than 700 Daltons and probably less than 300 Daltons. The most striking feature was the similarity of the elution patterns in 14 very different lakes and in samples collected at different seasons. (Baker-IVI)
W85-04540

DECLINE OF ZOOBENTHOS THROUGH FIVE DECADES OF EUTROPHICATION IN LAKE ESROM,

Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
P. M. Jonasson.

Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 800-804, October, 1984. 2 Fig, 2 Tab, 3 Ref.

Descriptors: *Benthic fauna, *Lake Esrom, *Denmark, *Eutrophication, Water pollution effects,

Wastewater pollution, Population dynamics, Mussels, Midges, Tubificids.

The oxygen uptake of zoobenthos, lethal effects of oxygen lack on respiration and growth retardation are examined. Changes in life histories and population dynamics are also recorded. Draining of tributaries through pipes resulted in increased eutrophication of the lake from 1956 onward. A total loading of 9,000 person equivalents (p.e.) polluted the lake. Untreated sewage, corresponding to 4,500 p.e. polluted the lake from 1961 to 1971. In 1968, 28,000 cu m of lumber also polluted the lake. Up to 1961 the zoobenthos community of the lake remained unaffected. During the period 1961-71, the midge Chironomus anthracius and the mussel Pisidium sp. were much reduced in numbers, while the turbificid Potamothrix hammoniensis remained unaffected. The total fauna 600 m from the sewage inlet was reduced in one year by 63% in numbers/sq m, but 3.5 km away the reduction was only 40% over a 10 year period. In 1982 the zoobenthos was greatly reduced: Potamothrix hammoniensis was reduced to 30.8%, C. anthracinus to 8.7% and Pisidium sp. to 0.06% of the average numbers before 1961, after another 10-year period with treated sewage (3,500 p.e.) and 10,000 cu m lumber in 1982. (Baker-IVI)
W85-04541

MACROPHYTES IN THE LOOSDRECHT LAKES: A STORY OF THEIR DECLINE IN THE COURSE OF EUTROPHICATION,
Limnologisch Inst., Nieuwersluis (Netherlands).
E. P. H. Best, D. de Vries, and A. Reins.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 868-875, October, 1984. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Macrophytes, *Lakes, *Eutrophication, *Loosdrecht Lakes, *Netherlands, Lake restoration, Water pollution effects, Aquatic plants.

The distribution of aquatic macrophytes in the Loosdrecht Lakes was studied as part of a base-line study before the lake restoration process. The present data are compared with older data and speculations on the future distribution are made. A rich macrophytic flora used to be present in the Loosdrecht area. Descriptions dating to 1941 mention local predominance of characeans, the distribution of Potamogetonaceae over large areas, and the presence of a diverse emergent flora. The survey for 1980-1982 indicated a significant decline, particularly in the submerged plants, which is attributed mainly to polluted inlet water. A recovery of the macrophytic flora is expected as a consequence of the better quality of inlet water in the near future. (Baker-IVI)
W85-04549

MODELLING EUTROPHICATION IN SHALLOW DUTCH LAKES,
Waterloopkundig Lab. te Delft (Netherlands).
F. J. Los, N. M. De Rooij, and J. G. C. Smits.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 917-923, October, 1984. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Eutrophication, *Netherlands, *Lakes, *Model studies, Phytoplankton, Oxygen, Nitrates, Phosphates, Mathematical models, Nutrients, Orthophosphates.

Eutrophication is an extremely complicated problem in the Netherlands, involving nutrient transports in rivers and nutrient transports to and from a lake's bottom in addition to biological and chemical processes in the lake. Mathematical models offer a possibility for an integrated approach. Two models are used: the BLOOM II, a phytoplankton model, and a biochemistry model, CHARON. Using the coupled model showed that the magnitude of the computed blooms expressed in chlorophyll units agrees well with the measurements, although the yearly averaged phytoplankton levels in the four lakes studied differ by a factor of ten. With some exceptions, the coupled model gives an accurate representation of the highly diversified annual patterns in the four cases. Computed values for the chemical species nitrate and oxygen in a lake agree very well with the measurements. Orthophosphate, however, tends to be underpredicted in 1980 and is strongly underpredicted in 1979. Computation of limiting factors and dominant phytoplankton species agree rather well with the measurements. (Baker-IVI)
W85-04551

OUTDOOR RECREATION - A NEW FACTOR DISTURBING LAKE ECOSYSTEMS, AS EXEMPLIFIED BY LAKE GIM, MAZURIAN LAKE DISTRICT,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
M. Bninska.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 978-981, October, 1984. 3 Tab, 10 Ref.

Descriptors: *Recreation, *Environmental effects, *Lake Gim, *Poland, Fish, Ecosystems, Camping, Eutrophication.

Lake Gim is located 25 km from the town of Olsztyn. The area of the lake is 175 ha and average depth is 7.6 m. The lake is intensively used for recreation. Fifty percent of the shore line (8600 m long) is occupied by various recreation sites and facilities. In 1979 they embraced 7 recreation centers belonging to various factories, 6 marked out tent camping sites, one scout camp and 112 private summer houses. In 1982 the number of the latter increased to 128. In 1979 there were on the average 26 tents daily at the marked out tent sites, while in 1982 this number increased to 72 tents daily throughout the season. In the period 1979 through 1982 loading of Lake Gimn with P originating from the recreational use amounted in successive years to: 0.2098 g/sq m /year in 1979, 0.2023 in 1981 and 0.2791 in 1982. Direct effect of the recreation upon lake loading with nutrients is confirmed by the results of chemical analyses of water. Near the recreation sites content of basic nutrients in water was much higher than at longer distances from the shore. These high loadings of lakes with nutrients, especially with P must affect fish stocks. Commercial fish catches in Lake Gim were examined from 1957 through 1981. The results show that Lake Gim is already in a state of advanced eutrophication, with initial symptoms of the ecosystem degradation. A clear succession in breaking down of particular groups of species is noted. Maximum catches were noted at the turn of 1960 to 1970, after which a constant decrease has been noted. The only direct impact on this lake has been recreational usage. (Baker-IVI)
W85-04557

EUTROPHICATION OF LAKE BALATON: MEASUREMENTS, MODELING AND MANAGEMENT,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
S. Herodek.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1087-1091, October, 1984. 4 Fig, 11 Ref.

Descriptors: *Lake Balaton, *Hungary, *Eutrophication, Model studies, Water pollution control, Phosphorus removal, Lake management, Nutrients, Water quality, Tributaries, Wastewater pollution.

Lake Balaton has a surface area of 594 sq km but the mean depth is only 3.2 m. Its long shape can be divided into four successive basins. The Zala River flows into the first one, while the Sio Canal drains water from the last basin into the Danube River. It is important to maintain a high water quality in this lake as it is visited by two million tourists each summer. Productivity increased in all 18 sampling sets very regularly in a south-westward direction. The discharge of the sewage treatment plants were measured. The main sources of P in the western part of the lake are the tributaries, while in the eastern part they are the direct municipal sewage discharges. The transport between the basins is significant. The BAP (biologically available P) retention in the four basins is similar, ranging from 67 to 73% of the BAP loads, despite the increasing water residence times. In the more eutrophic parts of the lake the sedimentation rate must be much higher than in the less eutrophic ones. In Basin II the BAP load should be reduced to one third of the present level. P removal from the wastewater of the towns on the watershed of the basin started in 1983. Pollution due to liquid manure produced by large animal farms must be stopped by the end of the next year. Most of the sewage water from the recreational area of Basin III will be diverted outside the watershed within the next two years. In the case of Basin IV, the P removal at the two largest sewage treatment plants started in spring 1983, and all the other sewage will be diverted into the Sio Canal within the next two years. (Baker-IVI)
W85-04562

IMPACT OF NUTRIENT LOAD ON TOTAL BIOMASS AND SPECIES SUCCESSION IN LAKE SUWA, JAPAN,
MAXIMUS, Inc., McLean, VA.
K. L. Seip, and T. Satoh.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1142-1149, October, 1984. 7 Fig, 1 Tab, 32 Ref.

Descriptors: *Lake Suwa, *Japan, *Nutrient load, *Biomass, *Succession, Model studies, Wastewater treatment facilities, Nitrogen, Phosphorus, Species diversity, Algae, Eutrophic lakes.

Lake Suwa is a relatively small and shallow eutrophic lake situated in the Nagano prefecture of Japan. A sewage plant is under construction in the area and is partly in use. When completed it is estimated that 50% of the N and 70% of the P load to the lake will be eliminated. The sharp changes in the curves representing simulation results are probably more characteristic for bioassay experiments than for whole lake observations. For 1977 data an average chlorophyll a (chl-a) concentration of 85 mg chl-a/cu m was obtained with a peak value of about 204 mg chl-a/cu m. The temperature variations used in the simulations were extreme. Changes in biomass values corresponding to 10-20% reductions in nutrient inputs may easily be caused by temperature variations and thus mask effects of reductions in nutrients. Nutrient load to the lake has decreased since 1977, but the exact amount of the decrease is unknown. In 1981 and 1982 the maximum chl-a was down from 200 mg/cu m to about 90 mg/cu m. The dominant species of algae was unchanged. On the basis of chl-a measurements it is probable that a 30-40% reduction in nutrient loads has been obtained. If P is reduced more than N, the absence of significant stocks of green algae may be consistent with simulation results, but it would be anticipated that green algae would be more abundant as the sewage plant comes to completion in 1985. According to the simulation results, Lake Suwa was a threshold response type lake in 1977. Linear or global models are probably not sufficient for the description of such lakes. Even in the present model the description of the release of nutrients from the sediments must be improved. (Baker-IVI)
W85-04565

SUBSAMPLING PROGRAM FOR THE ESTIMATION OF FISH IMPINGEMENT,
Union Carbide Corp., Oak Ridge, TN. Computer Sciences Div.
J. J. Beauchamp, and K. D. Kumar.
Environmental Management, Vol. 8, No. 6, p 539-542, 1984. 3 Fig, 3 Ref.

Descriptors: *Impingement, *Fish, *Sampling, Powerplants, Intakes, Environmental effects.

Federal regulations require operators of nuclear and coal-fired power-generating stations to estimate the number of fish impinged on intake screens. During winter months, impingement may range into the hundreds of thousands for certain species, making it impossible to count all intake screens completely. Graphs are presented for determining the approprite 'optimal' subsample that must be obtained to estimate the total number impinged. Since the number of fish impinged tends

to change drastically within a short time period, the subsample size is determined based on the most recent data. This allows for the changing nature of the species-age composition of the impinged fish. These graphs can also be used for subsampling fish catches in an aquatic system when the size of the catch is too large to sample completely. (Author's abstract)
W85-04604

PREDICTION OF RED TIDE OCCURRENCE BY MEANS OF DISCRIMINANT ANALYSIS (IN JAPANESE),
Hiroshima Prefecture Fisheries Experiment Station, Ondo (Japan).
A. Ouchi.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 50, No. 10, p 1647-1651, October, 1984. 4 Fig, 3 Tab, 4 Ref.

Descriptors: *Red tide, *Discriminant analysis, *Prediction, *Hiroshima Bay, *Japan, Eutrophication, Dinoflagellates, Water quality, Nitrogen, Phosphorus, Salinity.

This study was made to explore the possibility of predicting the red tide by the discriminant analysis based on quality data of surface water in the northern part of Hiroshima Bay. All the data (N=526) obtained from 1976 to 1982 were divided into two groups, non-red tide group and red tide group, according to a critical value 250 micro-g/l for the PON concentration. Then, the discriminant analysis was performed using six variables (WT, SAL, TDP, DIN, DON, PON). The results obtained are as follows. 1) Mahalanobis' distance was 8.85 and the probability of misclassification was evaluated to be 6.8%. The rate of misclassification was actually 4.2% for 526 data. 2) When a station is classified into the non-red tide group and its misclassification probability becomes more than 25%, or less than 5%, there is a great tendency for red tide to occur around the station. In the latter case, salinity ranged from 5.1 to 15.1% or TDP was 45-141 micro-g/l, DIN was 439-618 micro-g/l respectively, and the red tide actually occurred at a rate of 52%. 3) When a station belonging to the red tide group has the misclassification probability more than 17%, there is a great tendency for red tide to disappear. 4) This method has a great advantage in judging a red tide occurrence, because only one misclassification probability is used instead of six variables. (Author's abstract)
W85-04605

SOME REMARKS ON THE ECOLOGY OF ALGAE IN HEATED WATERS (UWAGI O EKOLOGII GLONOW W WODACH PODGRZANYCH),
Instytut Rybactwa Srodladowego, Piaseczno (Poland). Zaklad Rybactwa Stawowego.
J. Sosnowska.
Wiadomosci Ekologiczne, Vol. 30, No. 2, p 131-142, 1984. 1 Fig, 36 Ref.

Descriptors: *Heated water, *Algae, *Thermal pollution, *Water pollution effects, Cooling water, Thermal powerplants, Water temperature, Chlorination, Turbines, Phytoplankton, Aquatic plants, Periphyton.

The effect of water temperature and mechanical factors accompanying the discharge of heated water on the algae in various water bodies are reviewed. Discharge, especially in cold months, may cause changes in life cycles of aquatic organisms. A temperature increase, up to 25-30 C, usually stimulates the intensity of phytoplankton and periphyton growth. The maximal temperatures, above which the species composition of algae is usually reduced, are from 32-36 C, except for blue-green algae. Water temperatures exceeding 30 C usually inhibit the growth of phytoplankton. Rapid changes in water temperature in algal cultures results in the appearance of abnormally large or deformed individuals. Changes in phytoplankton composition due to an increase in water temperature are as follows: at 20-30 C Bacillariophyceae dominate (in number of species), at 30-35 C Chlorophyta dominate, and over 35 C Cyanophyta dominate. With a temperature drop from 40 to 18 C Chlorophyta appear first, then Bacillariophyceae. The main reaction to stress is a reduction of the numbers of more sensitive algal species. Even large changes in the thermal regime of water rarely cause a complete disappearance of a species. In the cooling systems of thermal power stations, 42-72% of individuals of sensitive species are destroyed (mainly at 30-35 C and above). Due to greater reproduction of cells surviving at high temperatures, the algal communities quickly attain their earlier abundance. Effects of turbines at thermal power plant on different taxonomic groups of algae may change the qualitative composition of communities. Chlorination of water at the heated water discharged usually weakens the cell photosynthesis and reduces the number of algal communities with an unchanged number of species. (Moore-IVI)
W85-04609

WATERBORNE OUTBREAK OF HEPATITIS A IN MEADE COUNTY, KENTUCKY,
Kentucky Dept. for Health Services, Frankfort.
G. H. Bergeisen, M. W. Hinds, and J. W. Skaggs.
American Journal of Public Health, Vol. 75, No. 2, p 161-164, February, 1985. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Hepatitis, *Meade County, *Kentucky, *Viruses, *Public health, *Drinking water, Epidemiology, Springs, Groundwater pollution, Rainfall.

Serologic testing was used to establish the diagnosis of Hepatitis A (HA) infection during an epidemic of the disease. In November 1982, Meade County, Kentucky health officials noted a sudden increase in the incidence of hepatitis A. Using a standardized interview of 73 cases (68 serologically confirmed), and 85 controls (all negative for antibody to hepatitis A virus), the most important risk factor identified was household use of untreated water from a single spring. Many Meade County residents obtain water from untreated sources and at the time of the outbreak almost everyone who used spring water got their water from Buttermilk Falls (BF). The water was pumped into trucks and hauled to homes for storage in cisterns. A cistern water source was reported by 56 cases (77%) and 40 controls (47%). Consumption of cistern water, adjusted for age and sex, was significantly associated with HA. Consumption of BF water, specifically, was significantly associated with with HA; a significant dose-response relationship was demonstrated for consumption of unboiled BF water and risk of developing HA - the more unboiled BF water consumed, the greater the risk of getting HA. Water samples taken from the spring during the outbreak were contaminated with fecal coliforms. Sinkholes in the limestone rock formations of Mead County are used for the dumping of human and animal wastes. Effluent from the underground systems appears at the surface as springs such as Buttermilk Falls. It is notable that rainfall for the county in the last four months of 1982 was 15.33 inches (3.37 inches above normal) suggesting the possibility of extensive washout of underground pools of contaminated water. (Collier-IVI)
W85-04658

FACTORS AFFECTING CLARITY OF NEW ZEALAND LAKES,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
For primary bibliographic entry see Field 2H.
W85-04670

EFFECTS OF FOUR HEAVY METALS ON SURVIVAL AND HATCHING RATE OF ARTEMIA SALINA (L.),
Athens Univ. (Greece). Zoological Lab. and Museum.
E. Kissa, M. Moraitou-Apostolopoulou, and V. Kiortsis.
Archiv fur Hydrobiologie, Vol. 102, No. 2, p 255-264, December, 1984. 1 Fig, 5 Tab, 31 Ref.

Descriptors: *Heavy metals, *Toxicity, *Life stages, *Brine shrimp, Cadmium, Chromium, Nickel, Cobalt, Eggs, Nauplii, Metals, Water pollution effects.

Acute lethalities to nauplii of Artemia salina were compared for four heavy metals (cadmium, chromium, nickel, cobalt) commonly discharged into coastal waters; LC50 48 hours were determined for three day old nauplii. Sublethal effects of low concentrations of these metals on the hatching rate of Artemia cysts were compared as well. Acute toxicity tests indicated an increased tolerance of Artemia to three (Cd, Co, Ni) of the four tested metals (LC50 48h, in mg/l): Cd: 159.611 + or - 0.176; and Co: 1.71.66 + or - 0.201. Artemia has not demonstrated such a high tolerance to chromium: LC50 48h = 7.911 + or - 0.066. Artemia eggs have shown a higher sensitivity to metals (except chromium) compared with Artemia nauplii: concentrations from 1/15 to 1/30 of the LC50 48h caused usually a 50% reduction of the hatching rate. For chromium a concentration of about the LC50 48h caused halving of the hatching rate. Chromium probably has a different toxic action when acting on survival and on hatching. (Collier-IVI)
W85-04674

ECOLOGY OF MEIOFAUNA IN AN ORGANICALLY POLLUTED ESTUARINE MUDFLAT,
Groningen Rijksuniversiteit (Netherlands). Biological Research Ems-Dollart Estuary.
For primary bibliographic entry see Field 2L.
W85-04676

MICROELEMENT CONTENT OF SOME SUBMERGED AND FLOATING AQUATIC PLANTS,
Botanikai Kutatointezete, Vacratot (Hungary).
For primary bibliographic entry see Field 2H.
W85-04678

CONFINEMENT AND WATER QUALITY-INDUCED STRESS IN LARGEMOUTH BASS,
National Fish Hatchery and Technology Center, San Marcos, TX.
G. J. Carmichael, J. R. Tomasso, B. A. Simco, and K. B. Davis.
Transactions of the American Fisheries Society, Vol. 113, No. 6, p 767-77, November, 1984. 4 Fig, 3 Tab, 53 Ref.

Descriptors: *Stress, *Bass, *Fish, *Water pollution effects, Fish physiology, Water temperature, Blood chemistry, Fish handling facilities, Thermal stress.

Plasma values of corticosteroids, glucose, chloride, and osmolality were determined in large-mouth bass Micropterus salmoides under various environmental conditions. No differences were observed in quiescent fish due to sex, size, time of day, or the types of holding facilities tested (tanks, raceways, ponds). Differences were observed in plasma glucose, chloride, and osmolality values among fish acclimated to 10, 16, and 23 C. Abrupt temperature changes caused elevations in plasma corticosteroid and glucose concentrations and reduced plasma chloride and osmolality. Confinement in a net, for up to 48 hours, caused elevated glucose and corticosteroids and reduced chloride and osmolality values. After 48 hours of confinement, fish required up to 14 days to recover normal plasma characters. Generally, short-term exposure to poor water quality (high concentrations of CO2 and NH3, and low concentrations of dissolved oxygen) altered plasma corticosteroids and glucose but had little effect on plasma chloride or osmolality. Net confinement plus poor water quality caused additional stress. Plasma glucose and corticosteroid values were good indicators of stress during application of acute stressors whereas chloride and osmolality were useful indicators of long-term stress and patterns of recovery after stressors were removed. (Author's abstract)
W85-04680

EFFECTS OF FREE AND COMBINED CHLORINE AND EXPOSURE DURATION ON RAINBOW TROUT, CHANNEL CATFISH, AND EMERALD SHINERS,
Wisconsin Univ.-Milwaukee. Center for Great

Lakes Studies.
A. S. Brooks, and J. M. Bartos.
Transactions of the American Fisheries Society, Vol. 113, No. 6, p 786-793, November, 1984. 1 Fig, 1 Tab, 24 Ref. Electric Power Research Institute contract RP 1435-1.

Descriptors: *Chlorine, *Water pollution effects, *Trout, *Shiners, *Catfish, *Fish, Toxicity, Hypochlorous acid, Chloramine, Hypochlorite, Water treatment.

Laboratory bioassays to determine the acute toxicity of monochloramine, dichloramine, hypochlorous acid, and hypochlorite ion to emerald shiners Notropis atherinoides, channel catfish Ictalurus punctatus, and rainbow trout Salmo gairdneri were conducted. Four exposure regimes typical of chlorination schedules at operating steam electric power plants were used. Fish were exposed for single 15-minute, 30-minute, 120-minute, and 4 x 30-minute periods. Based on median lethal concentrations (LC50s), the nominal solution of hypochlorous acid was the most toxic, followed closely by the solution dominated by dichloramine; nominal monochloramine and hypochlorite ion solutions had a third to a quarter the toxicity of the other two. On the average, emerald shiners were 1.8 times more sensitive than channel catfish and 3.3 times more sensitive than rainbow trout to the four forms of chlorine. The fish were most tolerant of chlorine during short-duration exposures and least tolerant during the continuous 120-minute exposures. The differences in toxicity noted among the chlorine forms suggest that, when chlorination regimes and regulations are established, careful attention should be paid not only to total residual chlorine but to both the chlorine forms and fish species present and the duration of exposure. (Author's abstract)
W85-04681

THERMAL MORTALITY PREDICTION EQUATIONS FOR ENTRAINABLE STRIPED BASS,
EA Engineering, Science, and Technology, Inc., Middletown, NY.
R. J. Kellogg, R. J. Ligotino, and S. M. Jinks.
Transactions of the American Fisheries Society, Vol. 113, No. 6, p 794-802, November, 1984. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Thermal pollution, *Mortality, *Bass, *Model studies, Life stages, Eggs, Larvae, Juveniles.

Thermal mortality prediction equations based on a logistic regression model were developed for eggs, for yolk-sac larvae, and for postyolk-sac larvae plus early juveniles of striped bass Morone saxatilis. Exposure temperature, exposure duration, acclimation temperature, and fish size were important explanatory variables. Mortality increased as test temperature and exposure duration increased and decreased as acclimation temperature and size increased. In addition to these main variables, interaction terms significantly improved the performance of the equations for yolk-sac larvae and for postyolk-sac larvae plus early juveniles. These mortality models can be used to make predictive assessments of the thermal component of entrainment mortality or to help determine power plant operating conditions that minimize the entrainment impact. (Author's abstract)
W85-04682

MANATEE USE OF POWER PLANT EFFLUENTS IN BREVARD COUNTY, FLORIDA,
Fish and Wildlife Service, Gainesville, FL. Denver Wildlife Research Center.
S. H. Shane.
Florida Scientist, Vol. 47, No. 3, p 180-187, Summer 1984. 3 Fig, 1 Tab, 16 Ref. Florida Power and Light Co contract 61552-86540.

Descriptors: *Manatees, *Mammals, *Powerplants, *Thermal pollution, *Indian River, *Florida, Heated water, Water pollution effects, Ecological effects.

The relationship between manatees and power plants was investigated at 2 power plants on the Indian River in Brevard County, Florida from January 1978-February 1980. Manatee presence in the power plant effluent zones was correlated with cold air and water temperatures. When air temperatures were below 16 C most manatees in the county were found in the effluent zones. Manatees in the effluent zones move with the wind-blown warm water plume, demonstrating a sensitivity to small changes in water temperature. Some individuals were frequently resighted at 1 plant, while others moved between the 2 plants. Because industrial warm water sources are less reliable than natural warm water refuges, it is recommended that no new artificial warm water effluents be constructed north of the species' traditional winter range. (Author's abstract)
W85-04696

OCCURRENCE OF DNA IN RIVER SEDIMENT: ITS MEANING AND RELATIONS WITH BENTHOS RESPIRATION, ORGANIC LOAD AND MACROINVERTEBRATES BIOMASS,
Savoie Univ., Chambery (France). Lab. d'Ecologie.
D. Fontvieille, B. Cazelles, and M. Fabre.
Ergebnisse der Limnologie, Vol. 19, p 91-100. December, 1984. 2 Fig, 4 Tab, 18 Ref.

Descriptors: *Deoxyribonucleic acid, *River sediments, *Sediments, *Respiration, *Macroinvertebrates, *Biomass, *Organic load, Carbon dioxide, Water pollution effects, Microorganisms.

DNA, total organic matter and respiration (CO2 production), were measured in the upper part of the sediments of a polluted brook in four stations below the input of a pigsty waste. From the relationship between DNA concentrations and CO2 production, it seems that the respiration originates more from microorganisms than from macroinvertebrates especially in stations where the benthic organic load is low. Some preliminary experiments are related dealing with the decomposition rate of DNA in sediments. The fast decomposition of free DNA (dissolved) in conditions partly natural is well demonstrated using the HOECHST 33258 fluorimetric method. On the contrary, the evidence of the decomposition of cell-walled DNA using the diphenylamine method appears only for 20% of the initial quantity during 40 hours. (Author's abstract)
W85-04699

EFFECT OF SOME HEAVY-METALS ON GLUCOSE ASSIMILATION IN POLLUTED WATERS,
Landesanstalt fuer Umweltschutz Baden-Wuerttemberg, Karlsruhe (Germany, F.R.).
M. W. Banoub.
Ergebnisse der Limnologie, Vol. 19, p 295-302, December, 1984. 6 Fig, 2 Tab, 17 Ref.

Descriptors: *Heavy metals, *Glucose, *Bacterial physiolgy, *Water pollution effects, Isotope studies, Mercury, Cadmium, Copper, Lead, Chromium, Metals, Toxicity.

The use of labelled glucose C-14 assimilation by the heterotrophic flora in natural and polluted waters was investigated. The effect of added concentrations of heavy metals Hg, Cu, Cd, Pb, and Cr on glucose assimilation was studied. Toxicity decreased with each metal in the above order, with wide variation in the response to each metal depending on the metabolic activity, the organic load as well as a probable natural adaptation to heavy metals by the different types of water. Pre-exposure to higher metal concentrations in the laboratory increased the metal toxicity. Efforts taken to normalize variations in metal toxicities in different waters on the basis of their Vmax and DOC may help in broad ranges. The values of EC 50 and EC 80 obtained here, apart from the varying types of water and their floras, lie within the range of mono-culture methods. Deviations from predicted metal-toxicities may be a valuable indicator of previous metal pollution. (Author's abstract)
W85-04705

TOLERANCE TO AND UPTAKE OF LEAD IN THE GREEN MUSSEL, PERNA VIRIDIS (L.),
National Univ. of Singapore. Dept. of Zoology.
W. H. Tan, and L. H. Lim.
Aquaculture, Vol. 42, No. 3/4, p 317-332, December 1, 1984. 3 Fig, 4 Tab, 35 Ref. NUS grant RP4/76.

Descriptors: *Lead, *Mussels, *Toxicity, *Mollusks, *Heavy metals, Metals, Animal tissues, Water pollution effects.

The acute toxicity of lead to the green mussel, Perna viridis, was studied. The median tolerance limit (Tlm) at 168 h was found to be 4.46 mg/l Pb(2+) for mussels with a shell length of 3-4 cm. Lead concentrations in the whole soft parts of P. viridis were determined after the animals had been exposed for 1, 2, 5 and 7 days to the metal at the above concentration with salinity maintained at 30 + or - 1% S and temperature at 26 + or - 1 C. The uptake was found to be linear with time. After 7 days, the average lead concentration in the tissues was 3495.5 micro g/g dry weight, giving a concentration factor of 784 and showing that P. viridis can concentrate the pollutant to a marked degree over the ambient level. The results emphasize the need to monitor heavy metal levels in P. viridis and other bivalves that are eaten to ensure that they are not potentially dangerous and to assist in site selection for aquaculture enterprises. (Author's abstract)
W85-04708

EVOLUTION OF THE COMMUNITY AT A STATION EXPOSED TO SEWAGE (MARSEILLE-CORTIOU) (EVOLUTION DU PEUPLEMENT D'UNE STATION SOUMISE A DES APPORTS D'EAUX D'EGOUT (MARSEILLE-CORTIOU)),
CICESE, P.O. Box 4844, San Ysidro, CA 92073.
A. Jorajuria.
Tethys, Vol. 11, No. 2, p 105-109, 1984. 1 Fig, 5 Tab, 15 Ref.

Descriptors: *Water pollution effects, *Marseille, *France, *Huveaune River, Benthos, Species composition, Wastewater pollution, Ecological effects.

Untreated wastewater of the town of Marseille (France) is diverted to the Cortiou station by means of large sewer; the highly polluted waters of a coastal river, the Huveaune, have been diverted to the sewer which now drains a basin of 603 km and one and a half million population equivalents. Surveys of the soft bottom benthic community in a station exposed to the Marseille-Cortiou outfall shows a change towards total destabilization of its structure over a two year interval. This results in a significant quantitative and qualitative reduction of species characteristic of various communities or of the substrate, and their replacement by opportunistic species. Further analysis would permit understanding of to what extent characteristic species in a disturbed environment would correspond to the maintenance of specific physico-chemical characteristics of a biotope. (Collier-IVI)
W85-04709

EFFECT OF POLLUTION ON THE COASTAL WATERS OF THE RED SEA IN FRONT OF JEDDAH, SAUDI ARABIA; 1. ENVIRONMENTAL CONDITIONS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Marine Science.
A. K. A. Behairy, and M. A. H. Saad.
Tethys, Vol. 11, No. 2, p 111-117, 1984. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Water pollution effects, *Red Sea, *Jeddah, *Saudia Arabia, *Coastal waters, Dissolved oxygen, Wastewater pollution, Water temperature, Air temperature, Hydrogen sulfide, Hydrogen ion concentration, Photosynthesis, Anaerobic conditions, Salinity.

Variations of some environmental conditions in the coastal Red Sea waters in front of Jeddah, which continuously receive untreated domestic wastes, were studied. The slight decrease in the bottom

water temperatures coincided with the shallowness of the study area. The lowest air and average water temperatures were recorded in January and the highest in October. Dissolved oxygen (DO) was depleted by waste disposal, and H2S was produced due to the anaerobic bacterial decomposition of the accumulated decayed organic wastes. The highest regional average DO values were found at locations relatively further away from pollution sources, where the photosynthetic activity has increased as indicated by the highest regional average Secchi values. The lowest regional average pH values found near the waste outfalls are mainly related to the direct effect of pollution, the remarkable decrease in the concentrations of dissolved salts due to dilution by effluents, and the great decrease in photosynthetic activity as a result of the highest turbidity. The highest average salinity values generally found in October and April coincided with the increase in the rate of evaporation brought about by elevation of temperature. (Author's abstract)
W85-04710

EFFECT OF POLLUTION ON THE COASTAL WATERS OF THE RED SEA IN FRONT OF JEDDAH, SAUDI ARABIA; 2. NUTRIENT SALTS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Marine Science.
A. K. A. Behairy, and M. A. H. Saad.
Tethys, Vol. 11, No. 2, p 119-125, 1984. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Coastal waters, *Red Sea, *Jeddah, *Saudi Arabia, *Nutrients, Wastewater pollution, Seasonal variation, Nitrate, Nitrite, Silicate, Phosphate, Denitrification.

Variations of nutrient concentrations in the coastal Red Sea waters in front of Jeddah, which continuously receive untreated sewage wastes, were studied. The increase or decrease in the values of each nutrient was found to depend upon certain factors. The seasonal variations in the average values of each nutrient at stations near the waste disposal are principally related to variations in the discharge rate of sewage wastes. However, the seasonal variations at locations relatively further away from pollution sources are mainly attributed to the different conditions responsible for increasing or decreasing the nutrient content in the different seasons. The considerably highest regional average values of nitrite, phosphate and silicate at locations in the vicinity of waste outfalls coincided with the direct additions of large loads of these nutrients from sewage effluents. However, the regional average nitrate values at these stations were noticeably low, due to the anoxic conditions where a remarkable part of nitrate discharged by sewage wastes was reduced to nitrite and ammonia by denitrifying bacteria in depletion of dissolved oxygen. The remarkably high average value of each nutrient calculated for the study area during the investigation period is due to the effect of pollution and the limited exchange between the waters of the study area and the open sea. (Author's abstract)
W85-04711

COPPER COMPLEXATION AND TOXICITY TO DAPHNIA IN NATURAL WATERS,
Canada Centre for Inland Waters, Burlington (Ontario).
U. Borgmann, and C. C. Charlton.
Journal of Great Lakes Research, Vol. 10, No. 4, p 393-398, 1984. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Toxicity, *Copper, *Daphnia, *Metals, *Water pollution effects, Tris, Bioassays.

Toxicity of copper to Daphnia magna in artificial medium, artificial medium plus algae, and natural water from Hamilton Harbour and Lake Ontario was determined, with and without added Tris, in order to test the assumption that free cupric ion concentrations are the same in equivalently toxic media even when total copper concentrations vary. Free cupric ion concentrations were calculated from the increase in the total copper concentration tolerated after Tris addition and from cupric ion electrode measurements. Copper toxicity was greatest in inorganic medium, lowest in inorganic medium plus algae and in Hamilton Harbour water, and intermediate in lake water. However, after Tris addition, toxicity was greatest in lake water and lowest in inorganic medium and inorganic medium plus algae. Both the bioassay and electrode data indicate that free cupric ion concentrations differ in different test waters when toxicity is the same. Free metal concentrations do not, therefore, provide a good measure of copper toxicity for Daphnia in natural waters. (Author's abstract)
W85-04716

CONTENT AND CHEMICAL FORM OF MERCURY AND SELENIUM IN LAKE ONTARIO SALMON AND TROUT,
Rochester Univ., NY. Dept. of Radiation Biology and Biophysics.
C. J. Cappon.
Journal of Great Lakes Research, Vol. 10, No. 4, p 429-434, 1984. 1 Fig, 4 Tab, 42 Ref.

Descriptors: *Mercury, *Selenium, *Heavy metals, *Lake Ontario, *Salmon, *Trout, *Fish physiology, Animal tissues, Bioaccumulation, Trace metals, Water pollution effects.

The content and chemical form of mercury and selenium were determined in the edible tissue of salmon (coho, chinook) and trout (lake, brown) taken offshore from Lake Ontario near Rochester, New York. For all species, total mercury content ranged from 0.3 to 0.8 micro g/g (fresh-weight), which is similar to concentrations commonly found in canned tuna. Most of the total mercury (63 to 79 percent) was present as methylmercury, the remainder being divalent inorganic mercury. For all species, 6 to 45 percent of the total selenium content was present as selenate (SeVI), the remainder being selenite (SeIV) and selenide (SeII). On a molar basis, total selenium content usually exceeded that of total mercury. Samples of smoked and unsmoked brown trout fillets were also examined. Based on the results of this study there is no immediate human health hazard from mercury and selenium. However, there is a need to report specific chemical forms of these metals in Lake Ontario salmonid fishes so that elevated concentrations can be better evaluated. (Author's abstract)
W85-04717

ENVIRONMENTAL IMPACT OF TWO, ADJACENT, HAZARDOUS WASTE DISPOSAL SITES IN THE NIAGARA RIVER WATERSHED,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
R. Jaffe, and R. A. Hites.
Journal of Great Lakes Research, Vol. 10, No. 4, p 440-448, 1984. 4 Fig, 1 Tab, 7 Ref. EPA grant 808961.

Descriptors: *Hazardous waste disposal, *Love Canal, *Niagara Falls, *New York, *Niagara River, Halogenated organics, Fate of pollutants, Path of pollutants, Water pollution sources, Sediments.

Sediment core samples were taken from the Niagara River at locations adjacent to the Love Canal and the 102nd Street dumps, two hazardous waste disposal sites in the City of Niagara Falls, New York. The samples were analyzed by capillary gas chromatographic mass spectrometry, and a variety of halogenated organic compounds (including chlorobenzene, -toluene, -naphthalene, -benzyl, and -norbornane derivatives) were indentified and quantified. Based on the qualitative and quantitative data obtained, the sources of these pollutants were identified, and the relative migration of chemicals from the two dumps to the Niagara River was established. The impact on the river is localized to the immediate vicinity of the outfall of the sewer draining the Love Canal neighborhood. Remedial action could be as easy as removing 20 truckloads of contaminated sediment from the river. (Author's abstract)
W85-04718

MACROINVERTEBRATES IN A SEWAGE-POLLUTED AQUIFER,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
L. W. Sinton.
Hydrobiologia, Vol. 119, No. 3, p 161-169, December, 1984. 1 Fig, 3 Tab, 26 Ref.

Descriptors: *Macroinvertebrates, *Wastewater pollution, *Water pollution effects, *Aquifers, *Land disposal, *Templeton, *New Zealand, Groundwater pollution, Crustaceans, Turbellarians, Oligochaetes, Amphipods.

The macroinvertebrate fauna in a polluted alluvial gravel aquifer downstream of a sewage irrigation area at Templeton, New Zealand, was surveyed using an existing array of unpumped wells. Three crustacean species - Phreatoicus typicus, Phreatogammarus fragilis and Paracrangonyx compactus - accounted for 98% of the organisms present. The remainder consisted of turbellarian and oligochaete worms and two further crustacean taxa - Paraleptamphopus subterraneus and a new species of the genus Paracrangonyx. Smaller invertebrates found included juveniles of the macroinvertebrate Crustacea and a new amphipod genus and species. Mean population density and dry weight biomass estimates for the three principal crustacean species in the groundwater underlying the disposal area were, respectively, 192 sq m and 0.43 g sq m for P. typicus, 55 sq m and 0.16 g sq m for P. fragilis, and 18 sq m and 0.04 g sq m for P. compactus. Approximately 10% of the crustacean specimens tested contained coliform bacteria and had apparently been feeding on sewage-derived material. The organisms tended to be more abundant in the more polluted wells by incidents of heavy contamination caused high mortality rates. Some calculations using energetics data from surface water studies suggested that the standing crop of aquifer macroinvertebrates could play a significant role in the consumption of sewage-derived organic matter reaching the phreatic zone beneath the Templeton site. (Author's abstract)
W85-04720

METHODS OF PH CALIBRATION OF SEDIMENTARY DIATOM REMAINS FOR RECONSTRUCTING HISTORY OF PH IN LAKES,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
R. B. Davis, and D. S. Anderson.
Hydrobiologia, Vol. 120, No. 1, p 69-87, January, 1985. 9 Fig, 5 Tab, 50 Ref.

Descriptors: *Diatoms, *Lake Sediments, *Hydrogen ion concentration, *Paleolimnology, *Bioindicators, *Norway, *Maine, *Vermont, *New Hampshire, Acid lakes, Sediments, Species composition, Water pollution effects.

The pH history of lakes can be inferred from diatom remains in dated sediment cores. To derive transfer functions for pH inference in acidic lakes, we counted diatoms in surface-sediment from 31 soft-water lakes in n. New England (NE) and 36 in Norway (N), covering pH 4.4-7.1. Cluster analysis of each data set indicates that pH 6 is an upper limit for a group of similar diatom assemblages. For each set multiple linear regressions were developed to relate three versions of the diatom data to pH of surface-waters: (1) relative frequencies of selected diatom taxa, (2) the first principal component (1PC) of these frequencies, and (3) the frequencies of Hustedt pH groups. Also, simple linear regressions were developed for two versions: (1) Index B and (2) Index Alpha, both based on pH groups. Regressions were run separately for lakes with pH $<$ or $=$ 6; these are most relevant for pH inference in acidic lakes. The best regressions (N: taxa and 1PC taxa) have r squared 0.69-0.91 and S sub e 0.24-0.31 pH units, the worst (NE: log alpha) have r squared 0.27-0.57 and S sub e 0.51. In all cases, errors for NE are greater than N, partly due to greater diversity of NE lakes. Regressions based on pH groups (directly and by indices) have smaller r squared and larger S sub e than those based on taxa and 1PC taxa. The Index Alpha is least useful because its requirement for alkaline diatom units is unsatisfied at many acidic lakes. Regressions based

on taxa may give erratic pH inferences due to sensitivity to unusual frequencies for individual taxa; this effect is reduced by using 1PC taxa. Four regressions based on pH < or = 6 lakes were used for inferring pH in a Pb-210 dated core from Nedre Malmesvatn, N (now pH 4.6). There is good agreement among three of the four (not for the regression based directly on taxa) that there has been a decrease of ca. 0.6 pH units starting in the late 1800's. (Author's abstract)
W85-04725

IRRIGATION OF SWINE LAGOON EFFLUENT ONTO PINE AND HARDWOOD FORESTS,
South Carolina Agricultural Experiment Station, Clemson.
For primary bibliographic entry see Field 5D.
W85-04741

ACID RAIN: DOUSING COMMUNITY RESOURCES,
For primary bibliographic entry see Field 5F.
W85-04750

5-ALPHA(H)-CHOLESTAN-3-ALPHA-OL IN SEDIMENTS: CHARACTERIZATION AND GEOCHEMICAL SIGNIFICANCE,
Geneva Univ. (Switzerland). Mass Spectrometry Center.
For primary bibliographic entry see Field 2K.
W85-04759

REVIEW OF THE FOOD AND DRUG ADMINISTRATION RISK ANALYSIS FOR POLYCHLORINATED BIPHENYLS IN FISH,
Everest Consulting Associates, Inc., Princeton Junction, NJ.
L. D. Maxim, and L. Harrington.
Regulatory Toxicology and Pharmacology, Vol. 4, No. 2, p 192-219, June, 1984. 4 Fig, 12 Tab, 35 Ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Fish, *Water pollution effects, *Risk factors, Regulations, Foods, Carcinogens.

The analysis made by the FDA of the risk to humans from consuming fish contaminated with polychlorinated biphenyls (PCBs) is reviewed. The methods used to arrive at the conclusions employed high dose experiments on animals and extrapolated the observed rates of certain types of cancer at these elevated doses to the low doses found in human diets. These extrapolations were then used to define a recommended tolerance level of 5 ppm, and proposed reduction to 2 ppm, for fish sold in interstate commerce. When confronted with methodological choices, the FDA consistently selected worst case or conservative assumptions over other alternatives of at least equal plausibility. This philosophy of choice was explicitly acknowledged by the FDA. What was omitted from the FDA analysis was the possible degree of overstatement of these risks. The results of replicate risk computation using alternative assumptions to examine the possible magnitude of overstatement of health risk are presented. This overstatement could easily account for a discrepancy of several orders of magnitude between actual and calculated risks. Taken together the points which are made challenge the analytical foundation underlying an FDA proposal to reduce the tolerance level from 5 to 2 ppm and, in addition, lend necessary perspective to the debate on the health risks of eating PCB-contaminated fish. (Baker-IVI)
W85-04775

ECOEPIDEMIOLOGY - A CASUISTIC DISCIPLINE DESCRIBING ECOLOGICAL DISTURBANCES AND DAMAGES IN RELATION TO THEIR SPECIFIC CAUSES: EXEMPLIFIED BY CHLORINATED PHENOLS AND CHLOROPHENOXY ACIDS,
Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
F. Bro-Rasmussen, and H. Lokke.
Regulatory Toxicology and Pharmacology, Vol. 4, No. 4, p 391-399, December, 1984. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Ecoepidemiology, *Chlorophenoxy acids, *Chlorinated phenols, *Koge Bay, *Denmark, Phenols, Industrial wastes, Fish, Aquatic plants, Organic compounds, Saw mills, Industrial wastewater.

Ecoepidemiology is a new concept created in analogy to human epidemiology and aimed at the study of ecotoxicological effects at the levels of ecosystems, biological communities, and populations in relation to causative environmental exposures, mostly by chemicals. Ecoepidemiology is described by presenting an example of unintentional dissipation and possible discharges of chlorophenols and phenoxy acids into the terrestrial environment and, as a more specific case, a marine, aquatic area, the Koge Bay, immediately to the south of Copenhagen, Denmark. The Koge bay Coastal area functions as a recipient for heavy urban sewage as well as discharges for several industries along the coastline and runoff from a rich agricultural area. Koge Bay is a coastal system with a reasonably high capacity as a recipient for emissions, outflows, and discharges due to the lively exchange of water which is characteristic for that region. Fish in the Bay have shown the earliest signs of specific contamination. The macrovegetation is severely disturbed in the Bay. Overall productivity for the benthic communities is below average for Danish coastal areas, although not significantly different from the Baltic Sea baseline level. Fish populations may suffer primarily from the sawmill discharges, which are characterized by a high BOD load, by the contribution of various phenols as well as by a considerable amount of sulfur dioxide deriving from the bleaching processes in the sawmill. Both the flora and fauna examples indicate that biochemical as well as physiological alterations within an ecosystem should be investigated. (Baker-IVI)
W85-04777

MAJOR ION CHEMISTRY AND SENSITIVITY TO ACID PRECIPITATION OF SIERRA NEVADA LAKES,
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack, J. L. Stoddard, and C. A. Ochs.
Water Resources Research, Vol. 21, No. 1, p 27-32, January, 1985. 1 Fig, 3 Tab, 30 Ref. OWRT project A-080-CAL and Water Resources Center project UCAL-WRC-W-590.

Descriptors: *Lakes, *Chemical properties, *Sierra Nevada, *Acid rain, *Ions, Alpine regions, Subalpine regions, Sulfate, Calcium, Bicarbonate, Alkalinity, Drainage basins, Geology.

Measurements were made of all major anions and cations for a set of high altitude lakes representative of the geological and ecological diversity of the Sierra Nevada. Watershed characteristics were examined as potential determinants of the major ion chemistry with emphasis on alkalinity. The lakes sampled span the length of the Sierra Nevada and occur on the eastern and western sides of the crest. Eighty percent are in the alpine and subalpine zones and the remainder lie in the montane zone. The lakes range in surface area from 0.3 ha to 578 ha; watersheds range in area from 14 ha to 8539 ha. The ratios of drainage area to lake area range from 2.2 to 273. The waters of the Sierra Nevada lakes were extremely dilute and very weakly buffered. The low alkalinity of the Sierran waters is especially striking. Seventy percent of the lakes sampled have summer alkalinities below 90 micro-eq/liter. The few lakes with alkalinities above 210 micro-eq/l are either located below 3000 m above sea level or in basins with calcareous rocks. Almost all Sierran lakes would be classified as highly sensitive to acid precipitation. The major cation in the lakes is calcium, and bicarbonate is the major anion in most. The role of drainage basin characteristics on the chemical composition of Sierran lakes was investigated with the result that a positive relationship was noted between sulfate, calcium, or alkalinity and volcanic or calcareous rocks. As of 1981 most of the subalpine and alpine lakes of the Sierra Nevada are very dilute and weakly buffered with a predominance of calcium and bicarbonate. The summer pH's range from circa 6 to 8. The lakes do not appear to show signs of acidification but are extremely sensitive to slight increases in the acidity of atmospheric precipitation. (Baker-IVI)
W85-04789

MODELING THE EFFECTS OF ACID DEPOSITION: ASSESSMENT OF A LUMPED PARAMETER MODEL OF SOIL WATER AND STREAMWATER CHEMISTRY,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
B. J. Cosby, G. M. Hornberger, and J. N. Galloway.
Water Resources Research, Vol. 21, No. 1, p 51-63, January, 1985. 7 Fig, 7 Tab, 46 Ref.

Descriptors: *Acid deposition, *Soil water, *Chemical properties, *Model studies, *Streams, Soil cation exchange, Aluminum hydroxide, Carbon dioxide, Soil chemical properties, Lumped parameter models, White Oak Run, Virginia.

Quantitative predictions of the effects of acid deposition on terrestrial and aquatic systems require physically based, process-oriented models of catchment soil water and streamwater chemistry. A desirable characteristic of such models is that they include terms to describe the important phenomena controlling a system's chemical response to acidic deposition, yet be restricted in complexity so that they can be implemented on diverse systems with a minimum of a priori data. An assessment is presented of a conceptual model of soil water and streamwater chemistry based on soil cation exchange, dissolution of aluminum hydroxide, and solution of carbon dioxide, all processes that occur in catchment soils and that have rapid equilibration times. The model is constructed using an 'average' or lumped representation of these spatially distributed catchment processes. The adequacy of the model is assessed by applying it to 3 years of soil water and streamwater chemistry data from White Oak Run, Virginia, a second-order stream in the Shenandoah National Park. Soil properties predicted by the model are in good agreement with presently available measurements of those soil properties. The success of the model suggests that lumped representations of complex and spatially distributed chemical reactions in soils can efficiently describe the gross chemical behavior of whole catchments (e.g., pH, alkalinity, and major ionic concentrations in surface waters). Further assessment of the adequacy of this conceptual approach will require more detailed empirical knowledge of the soil processes being modeled, particularly soil cation exchange and the variability of soil CO2 partial pressures. (Author's abstract)
W85-04792

SURVIVAL OF EGGS AND ALEVINS OF ATLANTIC SALMON (SALMO SALAR) IN RELATION TO THE CHEMISTRY OF INTERSTITIAL WATER IN REDDS IN SOME ACIDIC STREAMS OF ATLANTIC CANADA,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
G. L. Lacroix.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 292-299, February, 1985. 6 Fig, 2 Tab, 39 Ref.

Descriptors: *Salmon, *Immature growth stages, *Fish eggs, *Interstitial water, *Acid streams, Hydrogen ion concentration, Dissolved oxygen, Redds, Water pollution effects, Hatching.

Eggs of Atlantic salmon (Salmo salar) were incubated in spawning areas of five streams of mean pH 4.6-6.5. Hatching success (36.6-88.7%) for eggs planted after fertilization in the natural substrate of four acidic streams was highly correlated with the pH (4.5-5.0) of interstitial water, and the LL50 was about pH 4.7. Dissolved oxygen concentrations (> 6.0 mg/L) in the interstitial water in these streams were probably not limiting to embryos before hatching. In a near-neutral stream (pH 6.5), the comparatively lower hatching success (5.6-77.0%) was significantly correlated with minimum dis-

solved oxygen concentration (1.4-9.2 mg/L) in the interstitial water, and the mean survival of embryos was very low (16.2%) at oxygen concentrations < 6.0 mg/L. Conditions in the substrate where eggs were incubated until hatching were representative of those in natural salmon redds. In one of the acidic streams (pH 4.8), dissolved oxygen concentrations in the interstitial water were low (2.0-7.6 mg/L) after the hatch, and the emergence of salmon fry from natural redds was minimal, which indicated a low survival of alevins. Estimates of critical pH levels for salmon embryos differ between the laboratory and field approach and are probably site specific because survival in acid waters is determined by acidity, related chemical factors, and changes in water quality within the redd environment. (Author's abstract)
W85-04845

MINERAL DISTRIBUTION AND ECOLOGICAL ROLE OF A RECENTLY FORMED HALOPHYTE COMMUNITY IN THE GUANABARA BAY RIO DE JANEIRO,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
L. D. De Lacerda, W. C. Pfeiffer, and M. Fiszman.
Tropical Ecology, Vol. 24, No. 2, p 162-169, 1983. 1 Fig, 4 Tab, 23 Ref.

Descriptors: *Halophytes, *Plant communities, *Chromium, *Minerals, *Guananbara Bay, *Brazil, Water pollution effects, Estuarine environment, Sodium, Potassium, Calcium, Magnesium, Wetlands, Detritus.

The intensive use of the southwestern coastal areas of Guanabara Bay has caused changes in the natural arboreal strata, mainly mangrove, leaving behind some herbaceous plants resistant to the new situation. One of the most important of the newly formed communities is that of the two perennial halophytes Sesuvium portulacastrum and Phyloxeros vermicularis. The distribution of the nutrients Na, K, Ca and Mg, and the pollutant Cr was studied in a community composed of S. portulacastrum and P. vermicularis in a estuarine area of the bay. All the elements were differentially distributed between the two soil depths sampled, concentrations being higher in the surface layer (0-5.0 cm) than in the deeper one (20.0-30.0 cm). The soil organic matter is mainly responsible for the retention of all elements, except Cr, and directly controls their distribution in the soil. Litter, being the greatest nutrient reservoir, represents the major nutrient cycling component. Both species present a high degree of resistance to Cr pollution. Comparison of mineral concentrations in rain water and runoff indicates that the studied community is a continuous source of Na, K, Ca and Mg to the estuarine food chains. Chromium is retained, mainly complexed with litter, and cannot reach the estuarine ecosystem to cause any abrupt contamination. (Moore-IVI)
W85-04851

PRIMARY PRODUCTION AND DIURANAL VARIATION IN A TROPICAL FISH POND,
Government Post Graduate Coll., Chhindwara (India).
K. S. Unni.
Tropical Ecology, Vol. 24, No. 2, p 170-179, 1983. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Primary productivity, *Diurnal variation, *Fish ponds, Water pollution effects, Laundry, Wastewater pollution, Thermal stratification, Dissolved oxygen, Alkalinity, Eutrophication.

The gross primary production of a fish pond receiving sewage and being used for domestic laundry, amounted to 36.01 g O2/sq m/day by the diurnal integrated curve method and 45.2 g O2/sq m/day by the light and dark bottle method. Production was negative at 1 m depth due to 52-140% consumption of oxygen for respiration. A distinct thermal stratificaton was found during the day. Electrical conductivity varied both vertically and horizontally (434-515 micro-mho/cm). A well marked inverse relationship between dissolved oxygen and free CO2 and between phenolphthalein and methyl orange alkalinities were recorded. Closteriopsis, a desmid, was in bloom ranging between 21-176 million cells/L. Closteriopsis, Anabaena and Anabaenopsis showed distinct diurnal movements. Cyclops, Brachionus, Keretella, and polyarthra also exhibited nocturnal movement to the surface. (Author's abstract)
W85-04852

PERIPHYTON COMMUNITY CHANGES ALONG A HEAVY METALS GRADIENT IN A LONG NARROW LAKE,
Victoria Univ. (British Columbia). Dept. of Biology.
A. Austin, and J. Deniseger.
Environmental and Experimental Botany, Vol. 25, No. 1, p 41-52, February, 1985. 3 Fig, 4 Tab, 44 Ref.

Descriptors: *Heavy metals, *Periphyton, *Water pollution effects, *Mine wastes, *Buttle Lake, *Upper Campbell Lake, *British Columbia, Species diversity, Population dynamics, Zinc, Copper, Cadmium.

A lead-zinc-copper mine on Vancouver Island, British Columbia has been a source since 1966 of heavy metal input into a long, narrow oligotrophic lake, Buttle Lake, subject to little previous perturbation. The lake is located in a heavily glaciated valley with steep rock walls and a broad, flat bottom. The lake has an estimated retention time of 1.03 years, an average depth of 45 m, an average width of 1 km, and overall length of 30 km. Upper Campbell lake was also sampled. It is shallower with a mean depth of 22 m, overall length of 17.5 km, and a water retention time of 0.27 years. Levels of nitrates, nitrites, ammonia, orthophosphate, total phosphorus and silica varied little throughout the lake system and seasonal fluctuations were small. Concentrations of heavy metals have risen since inception of the mine. Levels decrease as a fucntion of distance from the south basin of Buttle Lake. Copper, zinc and cadmium frequently exceed Environment Canada criteria for the protection of freshwater aquatic life in soft water. The periphyton community at all five sampling stations was dominated by Navicula cryptocephala. (Baker-IVI)
W85-04860

EFFECTS OF DECHLORINATED SEAWATER ON FISH BEHAVIOR,
Occidental Coll., Los Angeles, CA. Dept. of Biology.
For primary bibliographic entry see Field 5D.
W85-04862

PCB RESISTANCE WITHIN PHYTOPLANKTON POPULATIONS IN POLLUTED AND UNPOLLUTED MARINE ENVIRONMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
E. M. Cosper, C. F. Wurster, and R. G. Rowland.
Marine Environmental Research, Vol. 12, No. 3, p 209-223, 1984. 2 Fig, 1 Tab, 60 Ref.

Descriptors: *Polychlorinated biphenyls, *Phytoplankton, *Water pollution effects, Sandy Hook, New Jersey, Montauk, New York, Diatoms, Marine environment, Photo-adaption.

A comparison between clones of two species of diatoms, Asterionella japonica and Ditylum brightwellii, isolated from Sandy Hook, New Jersey (polluted site) and Montauk, New York (unpolluted site) indicated that some of the clones from Sandy Hook were more resistant to polychlorinated biphenyls (PCB). A. japonica was less sensitive to PCB than D. brightwellii since seven clones of A. japonica from both sites were tolerant of 25 micro-g/liter PCB whereas no clones from either site of D. brightwellii showed such resistance. Growth under high light intensity increased the sensitivity to PCB in all clones except one super-resistant clone from Sandy Hook which was not affected even by additions of 50 micro-g/liter to the growth medium. This interactive effect of light on PCB sensitivity may relate to the photoadaptive characteristics of each clone. (Author's abstract)
W85-04864

TOXICITY OF EFFLUENTS FROM A TIO2 PLANT TO THE HARPACTICOID COPEPOD NITOCRA SPINIPES BOECK,
Uppsala Univ. (Sweden). Inst. of Zoophysiology.
K.-J. Lehtinen, B.-E. Bengtsson, and B. Bergstrom.
Marine Environmental Research, Vol. 12, No. 4, p 273-283, 1984. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Toxicity, *Titanium dioxide, *Copepods, *Industrial wastes, Water pollution effects, Reproduction, Metals, Precipitates, Brackish water, Benthos.

The effluents from industries producing titanium dioxide were used to demonstrate how environmental factors such as temperature modify the toxicity and behavior of metals. The undiluted TiO2 industrial wastewater is characterized by an extreme acidity, high concentrations of iron and titanium, and low concentrations of other heavy metals. Tests with the harpacticoid copepod, Nitocra spinipes, were performed in brackish water (7 0/00), at 4 C, 7 C, and 21 C. Temperature was found to influence the acute toxicity of the waste water. LC50 values for N. spinipes were 0.087% (4 C), 0.105% (7 C) and 0.12% (21 C) of undiluted wastewater. At room temperature the animal's fecundity was affected at dilutions between 0.0003% and 0.001% and between 0.03% and 0.3%. An acute toxicity test with the dried solid metal fraction resuspended in clean brackish water had an acute LC50 value of 7.6% of undiluted wastewater. The acute toxicity of the effluent increases with decreasing temperature, but the fecundity test demonstrate a complex toxicity pattern. At extremely high dilutions, where no precipitate occurs, the production of offspring was affected. This effect disappeared at higher concentrations where precipitate began to occur, but at higher concentrations with more precipitate, the fecundity was again drastically affected. This points to a strong toxic or mechanical effect of the precipitate itself, and the result from the test with dried precipitate confirms this observation. In the field, this fraction seems to be capable of damaging benthic biota over large areas which receive precipitate from the titanium dioxide industry. (Moore-IVI)
W85-04866

EFFECTS OF MERCURY ON THE PROSOBRANCH MOLLUSC CREPIDULA FORNICATA: ACUTE LETHAL TOXICITY AND EFFECTS ON GROWTH AND REPRODUCTION OF CHRONIC EXPOSURE,
Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab.
J. E. Thain.
Marine Environmental Research, Vol. 12, No. 4, p 285-309, 1984. 8 Fig, 7 Tab, 22 Ref.

Descriptors: *Toxicity, *Mercury, *Limpets, *Growth, *Reproduction, Heavy metals, Larvae, Spawning, Water pollution effects, Marine environment.

Exposure to a mercury-equilibrated algal suspension containing 0.25, 0.42 and 1 micro-g Hg/liter as mercuric chloride in solution reduced the growth and condition of pairs of adults of the slipper limpet Crepidula fornicata in a 16-week period. Reproduction rates and larval survival to settlement were also reduced over the first three spawning when the exposed pairs reached sexual maturity. The adult and larval 96-h LC50s were 330 and 60 micro-g Hg/liter, respectively, as mercuric chloride in solution, indicating that a 'safety factor' of 0.1 needs to be applied to adult data to protect the most sensitive stage in the life cycle. However, the chronic exposure of the maturing adults showed that levels of inorganic mercury below the 'safe' concentration derived from the adult 96 h LC50 affected growth and reproductive success. (Author's abstract)
W85-04867

EFFECT OF EFFLUENT HIGH IN CHROMIUM ON MARINE SEDIMENT AEROBIC HETEROTROPHIC BACTERIA,
Otago Univ., Dunedin (New Zealand). Dept. of Microbiology.
J. Aislabie, and M. W. Loutit.
Marine Environmental Research, Vol. 13, No. 1, p 69-79, 1984. 4 Fig, 2 Tab, 30 Ref.

Descriptors: *Aerobic bacteria, *Marine sediments, *Chromium, *Sawyers Bay, *New Zealand, Tannery wastes, Industrial wastes, Water pollution effects, Effluents.

Analysis of the types and frequency of occurrence of the aerobic heterotrophic bacteria from a sediment receiving tannery effluent (Sawyers Bay, New Zealand) indicated that the populations differed significantly from that of a sediment which did not receive the effluent. There was also a seasonal variation in the populations. Gram positive isolates made up from 32 to 92% of the population, depending on the sampling time. The attempt to assess whether the presence of Cr in the polluted sediment had selected isolates tolerant to Cr gave interesting results. If Cr(III) (0.1 micromol/ml Cr) was incorporated into the isolating media a larger number of organisms could be isolated from Sawyers Bay sediment than if no Cr was used. This effect was not seen for organisms isolated from the control site, the Leith Mouth. Why this stimulation should occur is not known. When Cr(VI) was added, the number of colonies on the isolating medium was less than on the plates containing no Cr. The tolerance of certain organisms to quite high concentrations of Cr(VI) is evident. In view of the very high concentration of Cr in the Sawyers Bay sediment, 20.38 to 71.15 micromol/g, it is expected that bacteria surviving in that environment have a tolerance beyond 0.1 micromol/ml Cr (III) in Plate Count Agar in an estuarine salts solution. (Baker-IVI)
W85-04869

SIMULTANEOUS EXPOSURE OF ENGLISH SOLE (PAROPHRYS VETULUS) TO SEDIMENT-ASSOCIATED XENOBIOTICS: PART 1 - UPTAKE AND DISPOSITION OF 14C-POLYCHLORINATED BIPHENYLS AND 3H-BENZO(A)PYRENE,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
J. E. Stein, T. Hom, and U. Varanasi.
Marine Environmental Research, Vol. 13, No. 2, p 97-119, 1984. 4 Fig, 3 Tab, 42 Ref.

Descriptors: *Water pollution effects, *Fish, *Polychlorinated biphenyls, *Benzo(a)pyrene, Radioactive tracers, Sediment contamination, Pyrenes, Organic compounds, Sole.

English sole were exposed to environmentally realistic levels of sediment-associated tritiated benzo(a)pyrene (3 micro-g BaP/g sediment) and C-14 labeled Aroclor (1 micro-g PCBs/g) separately and together for up to 10 days. The concentrations of BaP and its metabolites in tissues reached steady-state by the first day of exposure, whereas PCBs did not approach steady-state concentrations until the tenth day of exposure. Thus, the net accumulation of BaP and its metabolites by sole was significantly less than the net accumulation of PCB and its metabolites. Although the levels of BaP and its metabolites in English sole sampled from BaP-contaminated areas will probably be low, their presence would indicate that BaP is being continually absorbed and metabolized by these fish to potentially carcinogenic and mutagenic compounds. In addition to differences in the extent of accumulation of BaP and PCN-derived radioisotopes by English sole, the tissues and fluid distribution of these two xenobiotics was dissimilar. The rank of concentrations of PCB-derived radioactivity in tissues and bile was: bile = liver > brain > kidney = gill > skin = blood = muscle and for BaP-derived radioactivity the order was: bile > liver > gill > kidney > skin = blood > muscle > brain. Hydrolysis of bile from PCB/BaP-exposed sole with beta-glucuronidase/arylsulfatase released 35% of the BaP-derived radioactivity and 32% of the PCB-derived radioactivity as primary metabolites. (Baker-IVI)
W85-04870

SUBLETHAL EFFECTS OF OILED SEDIMENT ON THE SAND WORM, NEREIS (NEANTHES) VIRENS: INDUCED CHANGES IN BURROWING AND EMERGENCE,
Oregon State Univ., Newport. Marine Science Center.
B. L. Olla, A. J. Bejda, A. L. Studholme, and W. H. Pearson.
Marine Environmental Research, Vol. 13, p 121-139, 1984. 3 Fig, 3 Tab, 53 Ref.

Descriptors: *Sediments, *Polychaetes, *Water pollution effects, *Behavior, *Oil pollution, Industrial wastes, Oil spills, Toxicity.

A variety of intertidal invertebrates, including polychaetes, exposed to oil under standard toxicity tests have been shown to be relatively tolerant. While oil may not often be acutely lethal, the animals may be affected in other ways. The burrowing and emergence behavior of sand worms in sediment contaminated with sublethal concentrations of Prudhoe Bay crude oil ranging from 74 to 5222 ppm was studied in the laboratory. Nereis virens appeared to be relatively tolerant to oil with less than 40% mortality occurring after 96 hours exposure to concentrations as high as 5222 ppm. Even relatively low concentrations of about 74 ppm induced marked changes in behavior, including total or partial emergence from oiled sediment. These results point to the fact that caution should be exercised in using death to predict the consequences of environmental contamination. Changes in behavior are among a number of various measures - for example, physiological or biochemical - which are being used more frequently to assess the sublethal effects of contaminants. The relatively rapid reversal of behavioral debilitation which occurred following removal of the worms from oil, suggested that debilitation was a manifestation of narcotization. (Baker-IVI)
W85-04871

EFFECTS OF ORGANIC POLLUTANTS ON METHANOGENESIS, SULFATE REDUCTION AND CARBON DIOXIDE EVOLUTION IN SALT MARSH SEDIMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
R. P. Kiene, and D. G. Capone.
Marine Environmental Research, Vol. 13, p 141-160, 1984. 1 Fig, 4 Tab, 38 Ref. NOAA grant Na-80-RAD 00057, EPA grant R809475011, Hudson River Foundation grant 14/83B/129.

Descriptors: *Methanogenesis, *Sulfate reduction, *Carbon dioxide, *Salt marshes, *Water pollution effects, Organic compounds, Sediment, Anaerobic conditions, Sulfates, Lindane, Endrin, Benzene, Phenanthrene, Arochlor.

Anaerobic salt marsh sediments were amended with a variety of organic pollutants and the effects on methanogenesis, sulfate reduction and carbon dioxide evolution were examined. The levels of pollutants used in the study were high relative to the levels found in many coastal sediments. The addition of several compounds (benzene, phenanthrene, Arochlor 1221, endrin and lindane) to salt marsh sediments resulted in no signifcant effects on any of the activities studied. In most cases where effects were noted at 1000 micro-g/g, effects were not significant at either 100 or 10 microg/g. Compounds such as Arochlor 1254 and Temik, which stimulated methanogenesis but had no effect on sulfate reduction of carbon dioxide production may have been degraded and metabolized by the methanogenic community. Sulfate reduction accounted for 25 to 150 times the carbon flow relative to methanogenesis. It appears that, over the short term, sulfate reduction and methanogenesis are tolerant of relatively high levels of a range of organic pollutants. (Baker-IVI)
W85-04872

TRACE METAL-BINDING PROTEINS IN MARINE MOLLUSCS AND CRUSTACEANS,
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
D. W. Engel, and M. Brouwer.
Marine Environmental Research, Vol. 13, No. 3, p 177-194, 1984. 6 Fig, 2 Tab, 23 Ref.

Descriptors: *Trace metals, *Metallothioniens, *Crabs, *Lobsters, *Oysters, Zinc, Copper, Cadmium, Water pollution effects, Metabolism, Detoxification, Marine environment.

Marine organisms inhabiting coastal and estuarine waters can be exposed to elevated levels of trace metals through both biogeochemical processes and pollution. Some marine invertebrates concentrate trace metals in their tissues, and the occurrence of metallothionein has been correlated with elevated levels of trace metals in these organisms. Field and laboratory experiments were designed to examine how oysters, blue crabs and lobsters manage accumulated cadmium, copper and zinc. Metallothioneins were found in all animals examined; concentrations of metallothioneins and the amount of bound trace metals are related to time of exposure. There is variability in the numbers and types of metal-binding proteins within and between species. The laboratory developed metallothionein models for blue crabs and lobsters may be useful in predicting the partitioning of trace metals in animals living in environments polluted with trace metals. Invertebrate metallothioneins can function as detoxifying proteins, but in unstressed animals, these proteins are involved in the metabolism of nutrient metals. The synthesis and degradation of metallothioneins in marine invertebrates may be highly correlated with the growth, development and physiological status, rather than simply being detoxifying proteins. (Moore-IVI)
W85-04873

BENTHIC-PELAGIC COUPLING IN SEWAGE-AFFECTED MARINE ECOSYSTEMS,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
R. Spies.
Marine Environmental Research, Vol. 13, No. 3, p 195-230, 1984. 1 Fig, 5 Tab, 107 Ref. DOE contract W-7405-ENG-48.

Descriptors: *Marine environment, *Wastewater pollution, *Benthos, *Pelagic life, *California, Habitats, Fish, Shrimp, Polychaetes, Crustaceans, Outfalls, Effluents, Food chains, Chlorinated hydrocarbons, Trophic-step magnification.

Coupling between degraded benthic habitats and populations of epibenthic and pelagic organisms is evident around major sewage outfalls in the Southern California Bight. The distribution of bottom-feeding fishes appears to be affected, but sampling has not been intensive enough to rigorously define patterns for more than a few species. Some evidence suggests that changes in fish abundance may be related to changes in the distribution and abundance of benthic prey; those species (e.g. Dover sole) that can adapt their diets to take advantage of dense populations of opportunistic polychaetes may be found in large numbers around outfalls. Some benthic crustacean feeders are at a disadvantage. Sewage effluent is an allochthonous source of organic matter to the food web and Dover sole and ridgeback shrimp both show shifts in stable isotope ratios consistent with the thesis that sewage-derived organic matter in sediments is trophically transferred to epibenthic organisms. Constructing a carbon budget based on the delta C-13 shifts in these species from an area of a major outfall relative to a distant control station suggests that there is an in situ source of isotopically very light carbon in outfall sediments, perhaps from CO2 fixation by chemoautotrophs and biological methane oxidation. Benthic-pelagic coupling is also evident in the accumulation of chlorinated hydrocarbons by fish and other organisms: At the two major Los Angeles area outfalls log-transformed liver-to-sediment concentration ratios of chlorinated benzenes, which are accumulated to moderate levels in fish, show a linear relationship to the log of Kow (the octanol-to-water partioning coefficient) of these compounds. Chlorinated hydrocarbons with greater lipid solubility, e.g. PCB and p,p-DDE, are concentrated to very high levels.

Studies of food webs using Cs/K as a measure of trophic level suggest that trophic-step magnification is concentrating these compounds in higher trophic levels. (Author's abstract)
W85-04874

EXPERIMENTAL MARINE ECOSYSTEM RESPONSE TO CRUDE OIL AND COREXIT 9527: PART 2 - BIOLOGICAL EFFECTS,
British Columbia Univ., Vancouver. Dept. of Oceanography.
T. R. Parsons, P. J. Harrison, J. C. Acreman, H. M. Dovey, and P. A. Thompson.
Marine Environmental Research, Vol. 13, No. 4, p 265-275, 1984. 2 Fig, 23 Ref.

Descriptors: *Marine environment, *Water pollution effects, *Oil spills, *Dispersants, Cleanup operations, Oil pollution, Food chains, Primary productivity, Hydrocarbons, Phytoplankton, Zooplankton.

Three experimental ecosystems were employed to test the effect of the dispersant Corexit 9527, with and without Prudhoe Bay crude oil, on the ecology of a temperate pelagic ecosystem. Corexit 9527, by itself, at an initial concentration of about 2 ppm within the 2-4 m layer did not affect the ecology of a planktonic food chain containing primary, secondary and tertiary producers. There is some evidence, however, that the Corexit was metabolized by the bacteria which were consistently more numerous and had a higher metabolic activity than in the control. The concentration of Corexit 9527 at about 1 ppm was clearly sufficient to influence the heterotrophic production of the water column. The effect of crude oil mixed with Corexit 9527 was quite different from Corexit 9527 alone. Primary productivity was severely depressed up to the eighth day of the experiment and then slowly recovered after day 8 to give rise to largely microflagellates ecology instead of centric diatoms. It appears that the dispersed crude oil in these experiments behaved similarly to other petroleum hydrocarbons with respect to phytoplankton and bacterial communities but that the dispersant/crude oil mixture may have been more toxic towards the zooplankton community. Corexit 9527 should not be added to spilled oil during spring bloom conditions but at other times the use of this dispersant may have some beneficial effect, especially if the safety of bird populations is considered. (Baker-IVI)
W85-04875

VASCULAR RIFFLE FLORA OF APPALACHIAN STREAMS: THE ECOLOGY AND EFFECTS OF ACID MINE DRAINAGE ON JUSTICIA AMERICANA (L.) VAHL,
Corps of Engineers, Pittsburgh, PA. Pittsburgh District.
M. Koryak, and R. J. Reilly.
Proceedings of the Pennsylvania Academy of Science, Vol. 58, No. 1, p 55-60, June, 1984. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Water pollution effects, *Acid mine drainage, *Mine wastes, Ecological distribution, Aquatic plants, Plant growth, Stream erosion, Channel morphology, Substrate.

Justicia americana is a stout-based colonial plant, abundant in most of the larger, low to moderate gradient streams of the upper Ohio River basin. The distribution of J. americana is related to acid drainage from bituminous coal mining operations in the upper Ohio River drainage basin. Possible fluvial and biological consequences of the colonization or absence of Justicia are considered. Luxuriant growths were noted on gravel bars and riffles of larger, unpolluted streams in the basin. Acid mine drainage severely depresses the growth of the plant, leaving gravel shoals and riffles in the acidic streams either barren or dominated by other emergent species. Particular among these new species is Eleocharis acicularis. The elimination of J. americana from suitable habitat adversely affects channel morphology, substrate composition, general aesthetic quality and aquatic stream life in the region. (Baker-IVI)
W85-04884

ALACHLOR TOXICITY TO A FRESHWATER TELEOST CLARIAS BATRACHUS,
D.A.V. Coll., Muzaffarnager (India). Dept. of Zoology.
K. A. Goel, Kalpana, Sandhya, and V. P. Agrawal.
Current Science, Vol. 53, No. 19, p 1050-1052, October, 1984. 1 Tab, 12 Ref.

Descriptors: *Pesticide toxicity, *Fish, *Alachlor, Toxicity, Herbicides, Water pollution effects.

Alaclor is a herbicide widely used for the weeds of cereals, legumes and cotton. Live fish (Clarias batrachus) were treated with the sublethal concentration of 0.001% alachlor in water at 25 degrees C at pH 6.8 for 15 days. Exposure of C. batrachus to alachlor resulted in a significant increase in the total leukocyte count, MCV, MCH, in the activities of AlPase, AcPase, GOT, GPT and blood urea, and a significant decrease in erythrocyte count, Hb%, MCHC and PCV. The decrease of serum bilirubin and chloresterol after treatment was not significant. The changes which were significant indicate the fish body is under stress on exposure to alachlor. Distorted metabolism resulted from liver dysfunction or from cellular injuries in different tissues. (Baker-IVI)
W85-04885

COMPARATIVE SURVEY OF THE ERPOBDELLA OCTOCULATA (L.) POPULATIONS IN THE AFON CRAFNANT, N. WALES, ABOVE AND BELOW AN INPUT OF ZINC FROM MINE-WASTE,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
M. Willis.
Hydrobiologia, Vol. 120, No. 2, p 107-118, January, 1985. 7 Fig, 2 Tab, 20 Ref.

Descriptors: *Leeches, *Mine wastes, *Zinc, *Water pollution effects, Reproduction, Growth, Bioaccumulation, Heavy metals, Food.

The life-cycle, growth, and reproductive success of a stream-dwelling Erpobdella octoculata (L.) were studied over a 19-month period at two sites, one above and one below an input of zinc pollution from mine-waste. Samples were collected monthly using quadrats. The blotted wet weight of all leeches was measured. An histological technique was employed to determine sexual maturity. Reproductive success was measured by estimating the numbers of cocoons and number of eggs per cocoon at each site. A wet ashing technique, followed by analysis using flame atomic absorption spectrometry, was used to determine the extent of bioaccumulation of zinc. 'Total' zinc and other metals in the waters were similarly analyzed. Differences were found between the populations at the two sites. The life-history of the Erpobdella above the contamination was comparable to that found for other stream-dwelling populations previously studied. Observed differences in densities of leeches between sites in the present and in previous studies by other workers may be due to recorded differences in the abundance of available food. At the polluted site, there was evidence that (a) there was a delay in cocoon deposition and hence hatching of young, (b) the adult leeches produced more misshapened and empty cocoons, (c) no relationship existed between the area of cocoons with eggs and number of eggs present, and (d) the proportion of young to adult leech was smaller at the polluted site. At the polluted site, higher levels of zinc were recorded in the tissues of Erpobdella and there was some evidence for the active intake of zinc by the leech. (Author's abstract)
W85-04886

HEAVY METALS IN THE BOMBAY HARBOUR AREA,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
B. Patel, V. S. Bangera, S. Patel, and M. C. Balani.
Marine Pollution Bulletin, Vol. 16, No. 1, p 22-28, January, 1985. 5 Fig, 8 Tab, 13 Ref.

Descriptors: *Heavy metals, *Bombay harbor, *India, *Water pollution effects, Clams, Mudskippers, Sediments, Anoxic conditions, Industrial wastes, Wastewater pollution, Benthos.

Bombay harbor is one of the major sinks, on the western peninsula of the Indian subcontinent, receiving anthropogenic pollutants including heavy metals, radio-nuclides and hydrocarbons in addition to sewage. To evaluate possible impacts of a few heavy metals on the harbor ecosystem, the distribution patterns of Zn, Mn, Cu, Fe, Co, Ni, Cd, Cr, Pb and Sr in water, sediment and two benthic species, the blood clam Anadara granosa and gobiid mudskipper Boleophthalmus boddaerti were studied over the period 1976-1980. The present levels of the ten elements in biotic and abiotic matrices were found to be far below those that are known to affect adversely the life and quality of benthic communities. Furthermore, the concentrations of these elements in various compartments neither revealed any systematic temporal or spatial fluctuations nor reflected the substantial increase in the total budget over the past 8-12 years. Also these levels were within the range reported in the nearshore and oceanic environs along the west coast. In view of this, the poor growth and high percentage mortality observed in the clam Anadara granosa fished from the Sewri clam bed compared to that of the stock harvested from the Trombay region in the harbor may well be due to anoxic conditions caused by organic pollutants present in the domestic sewage and industrial wastes released in the vicinity of the Sewri clam bed. (Author's abstract)
W85-04892

EMBRYO ABNORMALITIES IN THE PERIWINKLE, LITTORINA 'SAXATILIS', AS INDICATORS OF STRESS IN POLLUTED MARINE ENVIRONMENTS,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 5A.
W85-04893

COMPARATIVE STUDY OF RESPIRATION RATES OF SOME AQUATIC OLIGOCHAETES IN RELATION TO SUBLETHAL STRESS,
Institute of Ocean Sciences, Sidney (British Columbia).
R. O. Brinkhurst, P. M. Chapman, and M. A. Farrell.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 5, p 683-699, 1983. 11 Fig, 6 Tab, 33 Ref. Canadian DDS contract 07SB.FP 833-9-0965.

Descriptors: *Oligochaetes, *Respiration rate, *Stress, Water pollution effects, Hydrogen ion concentration, Salinity, Water temperature, Cadmium, Mercury, Sodium pentachlorophenol, Pollution tolerance.

Aquatic oligochaete species selected on the basis of pollution tolerance or intolerance as determined from field studies were used to determine respiration rates under standard conditions, after exposure to sublethal levels of environmental variables (pH, salinity, temperature) or toxicants (Cd, Hg, sodium pentachlorophenol) alone or in pairs. Respiration rates, critical oxygen levels and degree of regulation were not correlated with field-determined tolerance to organic pollution. Stress factors caused increased or lowered respiration rate, loss of regulation (partial or total) and sometimes shifts in critical oxygen level. Regulation was improved in the face of some stresses. Combined stresses produced additional changes in respiration rates and regulation. These responses were complex, which makes them useful indicators of specific stress factors but also indicate complex mechanisms behind the observed changes. (Author's abstract)
W85-04905

COMPARISON OF PLANKTON-WATER CHEMISTRY RELATIONSHIPS IN THREE ACID STRESSED LAKES IN NOVA SCOTIA, CANADA,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.

For primary bibliographic entry see Field 2H.
W85-04911

INFLUENCE OF WATER HYACINTH COVER ON THE PHYSICO-CHEMICAL CHARACTERISTICS OF WATER AND PHYTOPLANKTON COMPOSITION IN A RESERVOIR NEAR JAIPUR (INDIA),
Rajasthan Univ., Jaipur (India). Dept. of Botany.
B. Gopal, R. K. Trivedy, and P. K. Goel.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 859-865, 1984. 2 Tab, 17 Ref.

Descriptors: *Water hyacinth, *Phytoplankton, *Physicochemical properties, *India, Reservoirs, Water pollution, Eutrophication, Water temperature, Hydrogen ion concentration, Dissolved oxygen, Nutrients, Cyanophyta, Chlorophyta.

Water hyacinth (Eichhornia crassipes (Mart.) Solms.) invaded a eutrophic reservoir receiving domestic sewage near Jaipur (India) during 1975 and gradually developed a complete thick cover over the whole water body during Sept.-Oct. 1978. The physico-chemical characteristics of the water and the phytoplankton composition were studies during Sept. 1977-Sept. 1979 by fortnightly sampling. The changes observed during the second year of study are ascribed to the water hyacinth cover. The important changes were: lowering of water temperature, pH, dissolved oxygen content and nitrate nitrogen, and increase in total alkalinity, free carbon dioxide, chemical oxygen demand, ammonia nitrogen, sulfides, calcium, magnesium and phosphate phosphorus. The changes in the phytoplankton were both qualitative and quantitative. The green algae, particularly the species of Ankistrodesmus, Chlorella, Crucigenia and Selenastrum, increased considerably and replaced the blue-green algae, of which Oscillatoria and Microcystis disappeared totally. The densities of several other taxa changed significantly. (Author's abstract)
W85-04913

COLORADO COOPERATIVE FISHERY RESEARCH UNIT STUDIES OF TWIN LAKES, COLORADO: 1980 REPORT OF FINDINGS,
Colorado Cooperative Fishery Research Unit, Fort Collins.
E. P. Bergersen, and M. Maiolie.
Available from the National Technical Information Service, Springfield, VA 22161. Bureau of Reclamation Report REC-ERC-82-8, December 1981. 59 p, 83 Fig, 2 Tab, 18 Ref, 1 Append. Contract/Grant No. 7-07-83-V0700.

Descriptors: *Lakes, *Ecological effects, *Baseline studies, *Powerplants, *Trout, *Shrimp, *Sedimentation rates, *Limnology, Environmental effects, Vegetation effects, Water level fluctuations, Lake sediments, Population density, Organic matter, Sediment transport, *Colorado, Twin Lakes (Colorado).

Baseline data on the Twin Lakes system was gathered to fill gaps in the present knowledge of the preoperational phase of the Mt. Elbert Pumped-Storage Powerplant, to test monitoring methodologies, and point out monitoring problems that might be encountered during the operational phase of the project. A study on lake currents characterized and documented natural, seasonal patterns in surface and bottom currents in the two-lake system. The study on lake trout spawning habits showed that it is unlikely that lake trout in Twin Lake spawn in water less than 1.5 m deep. The expected daily water level fluctuations 0.7 to 1.1 m should not result in the exposure of lake trout eggs. A photographic method of estimating Mysis shrimp densities eliminates depletion of the population. Shrimp are at least 2.4 times as abundant in Twin Lakes as previously thought, with densities in the vicinity of the powerplant as high as 232 shrimp/sq m. Estimates of sedimentation rates by sediment traps and inflow/outflow suspended sediment sampling differed greatly. The best time to monitor powerplant impacts on sediment movement and deposition appeared to be during the winter months. Potential organic contribution from vegetation inundated by new lake levels was estimated to be over four times the present average annual primary production of the system. A water level control scheme is suggested to minimize the effects of a large organic influx.
W85-04937

CHLOROPHENOLS AND THEIR IMPURITIES IN THE CANADIAN ENVIRONMENT: 1983 SUPPLEMENT,
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W85-04941

AQUATIC TOXICITY OF 2,6-DICHLOROBENZAMIDE (BAM), A DEGRADATION PRODUCT OF THE HERBICIDE DICHLOBENIL,
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands). Lab. for Ecotoxicology.
C. J. Van Leeuwen, and H. Maas.
Environmental Pollution (Series A), Vol. 37, No. 2, p 105-115, 1985. 3 Fig, 5 Tab, 21 Ref.

Descriptors: *Herbicides, *Pesticide toxicity, *Dichlorobenzamide, *Dichlobenil, Guppies, Trout, Daphnia, Algae, Toxicity, Larvae, Aquatic weed control.

Dichlobenil (2,6-dichlorobenzonitrile) is a broad-spectrum herbicide of which the aquatic toxicological properties are well documented compared to the scarcity of data on the toxicity of its main degradation product BAM (2,6-dichlorobenzamide). Therefore toxicity tests with BAM were carried out with several freshwater species. Short term experiments showed that BAM was moderately toxic to guppies Poecilia reticulata, rainbow trout Salmo gairdneri, daphnids Daphnia magna and the algae Chlorella pyrenoidosa and Scenedesmus pannonicus. In long term studies with daphnids concentrations up to 320 mg/l did not significantly alter survival and reproduction. An embryo-larval test with rainbow trout, however, showed a significant reduction of survival and growth as well as a delay of yolk resorption at concentrations equal to or exceeding 18 mg/l. In combination with the data reported in the literature it may be concluded that degradation of dichlobenil into BAM results in a reduction of toxicity and further biodegradability. Normal field applications of this aquatic herbicide are not expected to impose a great risk to aquatic life. (Author's abstract)
W85-04944

ACUTE TOXICITY OF COPPER TO THREE LIFE STAGES OF CHRIONOMUS TENTANS AS AFFECTED BY WATER HARDNESS-ALKALINITY,
Miami Univ., Oxford, OH. Dept. of Zoology.
J. D. Gauss, P. E. Woods, R. W. Winner, and J. H. Skillings.
Environmental Pollution (Series A), Vol. 37, No. 2, p 149-157, 1985. 3 Tab, 21 Ref.

Descriptors: *Toxicity, *Copper, *Midges, Water pollution effects, Water hardness, Alkalinity, Eggs, Larval growth stage.

The relative sensitivites of the eggs, first- and fourth-instar larvae of the midge Chironomus tentans to an acute copper stress as affected by the hardness-alkalinity of the test water were compared. Mean EC50s for first-instar larvae exposed in soft and medium water were not significantly different. First-instar larvae were less sensitive to copper in hard water than in either soft or medium water. Mean EC50s for fourth-instar larvae were not significantly different in medium and hard water but both of these were significantly higher than in soft water. First-instar larvae were significantly more sensitive to copper than were fourth-instar larvae for each water type. Eggs were the most copper resistant life stage tested. If sensitivity to copper is representative of sensitivity to other chemicals, the practice of using fourth instar larvae in toxicity tests may grossly underestimate the sensitivity of the species to toxicants. (Baker-IVI)
W85-04946

5D. Waste Treatment Processes

ADSORPTION AND COMPLEXATION MECHANISMS OF HEAVY METAL UPTAKE IN ACTIVATED SLUDGE,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
P. S. Lawson, R. M. Sterritt, and J. N. Lester.
Journal of Chemical Technology and Biotechnology, Vol. 34B, No. 4, p 253-262, December, 1984. 4 Fig, 5 Tab, 28 Ref.

Descriptors: *Metal removal, *Activated sludge, *Complexation, *Adsorption, Wastewater treatment, Heavy metals, Copper, Cadmium, Manganese, Nickel.

Differences were observed between the uptake of cadmium, copper, manganese and nickel by activated sludge biomass: their removal was studied when a range of metal concentrations was added to resuspended mixed liquor solids in the absence of possibly competitive organic ligands. The predominant mechanism of metal removal was passive uptake with some indication of binding site specificity for copper and possibly manganese. The data obtained were interpreted in the form of adsorption isotherms. The results were used to calculate conditional stability constants (K') of the complexes formed, and the complexation capacity of the biomass for heavy metal uptake. Studies were conducted over a range of sludge ages from 3 to 12 days. Log K' values between 4.6 and 6.7 were found. However, there was no direct relationship between sludge age and K'. EDTA was used to desorb bound metal: this provided a means of differentiating between the surface complexes and unexchangeable metal such as that taken up intracellularly. There was a difference in the adsorption affinity series of the metals when EDTA was present. This indicated that more than one mechanism for metal uptake was operating, and that the relative importance of physical and chemical absorption varied with each metal. (Author's abstract)
W85-04411

PILOT-PLANT EVALUATION OF A DEEP SHAFT LINKED TO CONVENTIONAL AERATION WITHOUT INTER-STAGE SETTLEMENT TO GIVE A FULLY-NITRIFIED EFFLUENT,
Wessex Water Authority, Bristol (England).
M. S. Robinson.
Water Pollution Control, Vol. 83, No. 1, p 58-70, 1984. 6 Fig, 9 Tab, 33 Ref.

Descriptors: *Wastewater treatment, *Nitrification, *Aeration, *Deep shaft treatment, Ammonia, Biochemical oxygen demand, Suspended solids, Nitrogen, Pilot plants.

The deep-shaft method of sewage treatment consists of a vertical aeration lane sunk 60-150 m below ground level. Settled sewage and returned activated sludge are fed into the downcomer section of the shaft and air is introduced into the riser to initiate and maintain circulation and also into the downcomer as process air. In a pilot scale study a deep shaft has successfully been added in series with an existing aeration lane without inter-stage settlement, and the complete system nitrified in the F:M range 0.15-0.24. The minimum sludge age needed to maintain full nitrification was 3-4 days in summer and about 10 days in winter. The best effluent quality from the pilot plant was achieved under conditions of constant design flow after installation of an anoxic zone. Under conditions of full diurnal variation in flow the 95 percentile effluent quality was 13:12:4.5 (SS:BOD:amm.N). A 50% increase in load reduced the 95 percentile effluent quality to 13:17:6.3 and a further increase in load (75%) brought about by increasing the flow (16%) reduced the performance still further to 26:38:13. The deep shaft itself was responsible for all the BOD load removed and 52% of the ammoniacal load. (Baker-IVI)
W85-04452

SEWAGE SLUDGE TREATMENT AND DISPOSAL - THE WAY AHEAD,
For primary bibliographic entry see Field 5E.
W85-04455

RESEARCH RELATED TO WATER POLLUTION CONTROL IN SOUTH AFRICA,
National Inst. for Water Research, Pretoria (South Africa).
G. R. Botha.
Water Pollution Control, Vol. 83, No. 2, p 184-190, 1984. 17 Ref.

Descriptors: *Water pollution control, *South Africa, *Reviews, Wastewater treatment, Pulp and paper industry, Textile industry, Organic compounds, Mining industry, Wastewater disposal, Composting, Aerobic digestion, Reverse osmosis, Public health.

The intensification and growing sophistication of industry and unprecedented urbanization in South Africa have resulted in a tremendous increase in the volume and complexity of sewage and industrial effluents. This, in turn, has created many new problems relating to and including the necessary pollution control measures, treatment methods, increasing salinity of surface waters, health hazards, marine disposal and sludge disposal. A limited overview is presented of some interesting recent and current research projects related to these problems in South Africa. Specific mention is made of the treating of industrial effluents (textile effluents, pulp and paper effluents, other high loading organics, mining industry effluents); the treatment and disposal of sewage sludge (the utilization of digested sewage sludge on land, composting of primary sewage sludge and surplus activated sludge, and autothermic aerobic digestion of sewage sludge); treatment of soluble industrial organic wastes; reclamation of water from secondary sewage effluent by the reverse osmosis process; and health aspects of water supplies. (Baker-IVI)
W85-04456

EFFECTS OF THE RECHARGE ON SEWAGE EFFLUENTS UPON THE QUALITY OF CHALK GROUNDWATER,
For primary bibliographic entry see Field 5C.
W85-04462

TREATMENT OF SEWAGE FOR USE IN MUNICIPAL IRRIGATION IN ABU DHABI, UAE,
Taylor (John) and Sons, London (England).
J. Robinson, and L. J. Smith.
Water Pollution Control, Vol. 83, No. 3, p 387-399, 1984. 3 Fig, 4 Tab.

Descriptors: *Abu Dhabi, *Wastewater treatment, *Wastewater irrigation, Activated sludge process, Water reuse, Water pollution control, Nitrification, Disinfection, Chlorination.

Abu Dhabi City, the major center of population in the United Arab Emirate State of Abu Dhabi saw the establishment of its first sewerage and sewage treatment facilities in 1976. The policy of maximum re-use of treated sewage effluent was established from the outset and has been adhered to throughout subsequent development. Effluent is used solely for municipal irrigation of roundabouts, gardens and central reservations within the city. In each of the three sewage-treatment plants which have successively served the city, treatment has been based on the activated-sludge process with mechanical surface aeration. Per capita sewage flows and strengths are noted with BOD being 60 g/l and SS 55 g/d. Full nitrification resulted in a reduction in alkalinity from 300 mg/l to 46 mg/l and a fall in pH value from 76. to 7.1. After chlorination with a dose of 15 mg/l Cl2, alkalinity reduced further to 27 mg/l and pH value of 6.8. With pre-seeding of the aeration tanks to establish nitrifying organisms the new sewage treatment works produced a fully nitrified effluent witin 10 days of receiving crude sewage flows. High sulfide concentrations in the crude sewage had no adverse effects on biological treatment or the attainment of nitrification. The adverse effects on nitrite formed by partial nitrification on disinfection with chlorine is illustrated. (Baker-IVI)
W85-04464

DECREASING RATE OF BIOCHEMICAL OXIDATION OF SEWAGE,
T. Stones.
Water Pollution Control, Vol. 83, No. 3, p 435-437, 1984. 3 Fig, 3 Tab, 4 Ref.

Descriptors: *Oxidation, *Wastewater treatment, *Biochemical oxygen demand, Wastewater oxidation, Domestic wastes, Dissolved oxygen.

The first stage of biochemical oxidation of sewage that occurs when it is diluted with clean aerated water is a second-order reaction in which the rate of oxidation at any instant is governed jointly by the unsatisfied biochemical oxygen demand (BOD) and the residual dissolved oxygen concentration. Using slightly revised data, calculations were made of the rates of oxidation operative at the intervals during the course of biochemical oxidation when measurements were made of the residual dissolved oxygen concentration. The rates of oxidation occurring at these various intervals expressed as a percentage of the initial rate are presented together with the extent of oxidation from which it is seen that after 2 days the rate of oxidation has already decreased to 37.7% of the initial rate with 47.0% of the first-stage BOD having been satisfied. After 5 days the rate of oxidation had decreased further to 14.8% of the initial rate and the proportion of the oxygen demand that has been satisfied had reached 73.2%. After 10 days the rate of oxidation fell to 4.8% of the initial rate so that the proportion of the oxygen demand that had been met had risen only to 89.3%. After 15 days, when the first stage of oxidation is nearing completion, the rate is then less than 2% of that at the beginning. Thus, when 20% of the first stage BOD has been satisfied the rate of oxidation is 69.5% of the initial rate but only 34.0% thereof when 50% has been satisfied. (Baker-IVI)
W85-04468

IMPORTANCE OF SPECIATION METHODS IN ANALYTICAL CONTROL OF WATER TREATMENT PROCESSES WITH APPLICATION TO FLUORIDE REMOVAL FROM WASTE WATERS,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
For primary bibliographic entry see Field 5A.
W85-04485

QUANTITATIVE ESTIMATION IN COD UNITS OF REFRACTORY ORGANIC COMPOUNDS PRODUCED BY ACTIVATED SLUDGE MICROORGANISMS,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Chudoba.
Water Research, Vol. 19, No. 1, p 37-43, 1985. 10 Fig, 1 Tab, 19 Ref.

Descriptors: *Chemical oxygen demand, *Activated sludge, *Microorganisms, *Organic compounds, Culturing techniques, Oxygen demand, Wastewater treatment.

Data on the amounts of refractory organic compounds produced by activated sludge microorganisms under various conditions of cultivation were collected and treated in order to find the main factors influencing their production. The following systems were compared: batch non-proliferating and proliferating, continuous with high and low mean cell residence time and semicontinuous with separate aerobic sludge stabilization. It has been found that there exists a linear relationship between the refractory microbial products and the initial substrate concentration, both expressed in COD units. Both the slope and intercept of the relationship depend on the mean cell residence time or the observed specific growth rate. Depending on the cultivation conditions, the refractory products can amount to 1-10% of the substrate consumed. It has also been found that the amount of refractory compounds, expressed in COD units, released from 1 g of aerobically decomposed biomass varies from 15 to 25 mg/g. (Author's abstract)
W85-04486

BIODEGRADABILITY OF TWO PRIMARY ALCOHOL ETHOXYLATE NONIONIC SURFACTANTS UNDER PRACTICAL CONDITIONS, AND THE TOXICITY OF THE BIODEGRADATION PRODUCTS TO RAINBOW TROUT,
Shell Chemicals U.K. Ltd., London (England).
A. H. Turner, F. S. Abram, V. M. Brown, and H. A. Painter.
Water Research, Vol. 19, No. 1, p 45-51, 1985. 2 Fig, 7 Tab, 23 Ref.

Descriptors: *Biodegradation, *Nonionic surfactants, *Toxicity, *Trout, Wastewater treatment, Detergents, Surfactants.

Biodegradation mechanisms of, and toxicity of the degradation products of, the major types of nonionic surfactants, alchohol ethoxylate and alkylphenol ethoxylate, are not well known. A field trial was performed to measure the biodegradability of two alcohol ethoxylate nonionic surfactants typical of household detergent formulations, 'Dobanol' 45-7 and 'Dobanol' 45-11. The surfactants were dosed to biological filters in a mixture with domestic sewage; influent levels were 10 and 25 mg/1 of each surfactant. Within a temperature range of 5-10 C, 96-98% degradation was achieved, showing that even under highly unfavorable conditions these nonionic surfactants remained highly biodegradable. The surfactants had no adverse effects on the filters in terms of the usual sanitary parameters (BOD, COD, TOC and ammoniacal nitrogen). Tests on the effluents indicated no residual acute lethal toxicity to rainbow trout (Salmo gairdneri) within an exposure period of 7 days. Under current conditions of usage and disposal, fatty alcohol ethoxylates do not present an environmental problem. (Collier-IVI)
W85-04487

DETOXIFICATION OF EFFLUENTS IN A MACROPHYTE TREATMENT SYSTEM,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
K. H. Bowmer.
Water Research, Vol. 19, No. 1, p 57-62, 1985. 1 Fig, 3 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Animal wastes, *Macrophytes, *Aquatic plants, *Cattails, Wheat, Farm wastes, Biological wastewater treatment, Algae, Fatty acids, Toxicity.

Screened, settled, and diluted feces and urine flushed from a hog farm was percolated through the gravel substrate of an aquatic plant filter system in which Typha domingensis Pers. (cattail) was grown hydroponically. The effluent was diluted 2-3 fold to a conductivity of 2500 micro S/cm. A mixture of acetic, propionic and butyric acids at concentrations equivalent to those found in the effluent (16.1, 6.7 and 3.3 mM, respectively) reduced the transpiration, fresh weight production and root fibrosity of Typha seedlings in nutrient solution, the effect being more severe at high salinity. Wheat germination bioassay results showed that at the concentrations found in the effluents, phytotoxicity was primarily caused by acetate with a smaller contribution from proprionate. Relatively high concentrations of fatty acids were lost from the macrophyte filter system within a few hours although they remained stable in an open dilution tank for at least one week. In laboratory incubation experiments algae occurring in the aufwuchs on the gravel substrate played a critical role in dissipation by supplying oxygen to associated bacteria, rather than by heterotrophy, since decay was inhibited by addition of the photosynthetic inhibitor, terbutryne. The effects of flow rate on the operation of the macrophyte system should by investigated with the objective of minimizing phytotoxicity where this is a limiting factor. Gravel size should reduced to maximize surface area, providing that hydraulic conductivity can by maintained, because high loadings of algae in the epipelic slime

at the gravel surface contributes to the efficient operation of the system. (Collier-IVI)
W85-04489

T2-COLIPHAGE UPTAKE BY MOSQUITO LARVAE,
Kinneret Limnological Lab., Tiberias (Israel).
M. Gophen.
Water Research, Vol. 19, No. 1, p 89-91, 1985. 4 Tab, 18 Ref.

Descriptors: *Mosquitos, *Wastewater treatment, *Coliphages, *Viruses, Degradation, Disinfection, Microorganisms.

Degradation of T2-Coliphage viruses by mosquito larvae was demonstrated in filtered raw domestic sewage. The presence and density of mosquito larvae in waters of sewage purification systems is not limited by dissolved oxygen because they utilize atmospheric gas. Uptake of T2-Coliphages by mosquito (Culex pipiens molestus) larvae was measured at three temperatures and different concentrations of Coliphages. Larvae were fed on three types of food: either H-3 or C-14 labelled T2-Coliphage separately, or a mixture of both suspended in filtered raw sewage at 20, 25, or 30 C. One cpm was found to be equivalent to 2.1 Coliphage for C-14 or 40,000,000 Coliphage for H-3. Control experiments, using larvae killed with formaldehyde, showed that very low absorption of radioactive material to the larvae occurred, amounting to only 0.1-0.5% of the Coliphage ingested by living larvae. All the H-3 labelled Coliphages depleted from the media when fed as a single food source accumulated in the larvae. The C-14 labelled material that was depleted form the media but not accumulated in the larvae (90%) was probably ingested then egested and sank to the bottom with fecal pellets and/or partly respired. Based on C-14/H-3 ratios in larvae relative to the feeding media, viruses were not only ingested but also degraded and assimilated by the larvae. Mosquito larvae should be considered as a useful component in sewage purification systems. In areas where diseases carried by adult animals are common, prevention of adults emergence should be carried out. (Collier-IVI)
W85-04493

INFLUENCE OF THE CHARGE DENSITY OF CATIONIC POLYELECTROLYTES ON SLUDGE CONDITIONING,
Istituto di Ricerca sulle Acque, Bari (Italy).
G. Tiravanti, F. Lore, and G. Sonnante.
Water Research, Vol. 19, No. 1, p 93-97, 1985. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Wastewater treatment, *Sludge conditioning, *Coagulation, *Polyelectrolytes, Electrolytes, Colloids, Chemical coagulation.

Commercial polyelectrolytes, generally used for sludge conditioning, are poorly characterized as far as the charge density is concerned. Five cationic polyelectrolytes at different strength, having similar molecular weight (1-5 million), were selected. Their charge densities were measured by a conductometric method and found to be between 1.5 and 3.7 mequiv/g. These polymers were used for conditioning five different sludges produced in full-scale wastewater treatment plants and the optimal doses were correlated to the sludge concentration taking into account the values of the charge density. The quite good correlation found, according to the theory of charge neutralization of colloids of opposite sign, seems to be a useful criterion for predicting the optimum polyelectrolyte dose for sludge conditioning. (Author's abstract)
W85-04494

PERFORMANCE CHARACTERISTICS OF THE ANAEROBIC BAFFLED REACTOR,
Stanford Univ., CA. Dept. of Civil Engineering.
A. Bachmann, V. L. Beard, and P. L. McCarty.
Water Research, Vol. 19, No. 1, p 99-106, 1985. 5 Fig, 6 Tab, 18 Ref.

Descriptors: *Anaerobic conditions, *Baffled reactors, *Wastewater treatment, Chemical oxygen demand, Fixed film reactors, Methane, Bacteria, Costs.

An anaerobic sludge blanket process, termed the anaerobic baffled reactor (ABR), has been developed and shows promise for industrial wastewater treatment. It combines the advantages of high stability and reliability with a high void volume. The risk of clogging and sludge bed expansion with resulting high microbial losses is reduced and there is no need for special gas collection or biological solids separation systems. Organic loadings as high as 36g COD/l/day have been achieved with COD removal rates of more than 24g COD1/l/day and methane production rates exceeding 6 volumes per day per unit volume of reactor. The hypothesis, that the ABR may be adequately modeled as a fixed-film reactor, has been supported. Therefore, a unified approach, based on fundamentals of bacterial kinetics and mass transport, appears useful for modeling this and similar systems. Pilot plant studies are necessary to determine the scaling factors of the system as well as the overall efficiency and costs. (Author's abstract)
W85-04495

BOWHOUSE SEWERAGE AND SEWAGE DISPOSAL SCHEME OF FIFE REGIONAL COUNCIL,
K. C. Wilson.
Water Pollution Control, Vol. 82, No. 1, p 42-48, 1983. 2 Fig, 2 Tab, 11 Ref, 2 Append.

Descriptors: *Wastewater treatment facilities, *Bowhouse Works, *Scotland, Wastewater, Pumps, Wastewater treatment.

A centralized wastewater treatment plant was developed at Bowhouse for the Burghs of Ladybank, Auchtermuchty and Falkland, and three small villages in Fife County. Centralized treatment necessitated pumping sewage from each of the three existing works to a point adjacent to the River Eden. The Bowhouse Works was completed, apart from a few minor works and the installation of a sludge thickening plant, in December 1980. The startup troubles experienced with the pumps and blockages encountered in the Auchtermuchty rising main have largely been resolved, and the new works, which is not yet up to full design capacity is currently producing a mean final effluent quality of 6 mg/l BOD and 5 mg/l SS with maxima of 12.5 mg/l and 87.5 mg/l, respectively. This is well below the consent limits set by the Tay RPB. (Baker-IVI)
W85-04508

USE OF PERFORMANCE INDICATORS IN SEWAGE TREATMENT APPRAISAL,
Yorkshire Water Authority (England).
H. B. Tench.
Water Pollution Control, Vol. 82, No. 1, p 61-76, 1983. 8 Fig, 11 Tab.

Descriptors: *Wastewater treatment, *Quality control, *Performance indicators, Management, Evaluation, Planning, Economic aspects, Biochemical oxygen demand, Costs.

It is the responsibility of operational management to achieve a satisfactory standard of service at a minimum cost. Performance indicators help management to achieve these goals by standardizing the ways of measuring levels of service and costs and by measuring service and cost and calculation of averages to provide norms against which performance may be judged, and to give a means of progressively improving individual plant performance so that the overall average also improves. The indicators are divided into resource utilization indicators intended to provide information on the cost structure and the resources which create those costs; and plant performance indicators to give information on the standard of service supplied. Work performance indicators may give insight into the reasons for cost and performance variations. An application of performance indicators to Southern Division, Yorkshire Water Authority is offered as an example of the use of indicators. (Baker-IVI)
W85-04510

MEASUREMENT OF THE PERFORMANCE OF SEWERAGE SYSTEMS AND ASSOCIATED HYDRAULIC STRUCTURES - RECENT DEVELOPMENTS,
A. J. Baughen, and A. R. Eadon.
Water Pollution Control, Vol. 82, No. 1, p 77-86, 1983.

Descriptors: *Sewer systems, *Wastewater facilities, *Data acquisition, Monitoring, Hydraulic structures, Recorders, Measuring instruments, Maintenance, Computers.

There is a shortage of information on the performance of existing sewerage systems and the more extensive use of direct measurement is suggested as the means of providing additional data on this area of wastewater treatment evaluation. Available monitoring devices discussed include hydraulic devices, chemical dilution tests, velocity and depth measurements, and the electromagnetic gauge. Recorders should be capable of being left for long periods to reduce attendance costs. They should be vandal proof and not draw attention to themselves nor require expensive underground chambers. While low-powered for safety reasons, they should be cheap to operate and not require frequent changing of expensive dry batteries or specially printed charts. The time base should be accurate and not require correction. While giving a rapid analogue reading it should not require tedious measurement to obtain digital readings and integration, either for the whole period measured or for shorter periods. The cost of the apparatus should not be so high as to make the benefits of recording dubious on a cost-benefit basis. There should be provision for recording events only. The instrument should be readily portable. The results obtained should be reproducible and as accurate as can be obtained. The frequency of the record should be sufficient and comparable with a pen chart. A display on the instrument should show the signal being recorded for setting up and in situ checks. Micro computers may be of use in this area of work. (Baker-IVI)
W85-04511

RESURRECTION OF DEIGHTON SEWAGE TREATMENT WORKS,
Yorkshire Water Authority (England).
C. N. L. Cree.
Water Pollution Control, Vol. 82, No. 1, p 87-101, 1983. 8 Fig, 2 Ref.

Descriptors: *Wastewater treatment facilities, *Deighton, *England, Industrial wastewater, Chemical industry, Textile industry, Sludge disposal, Maintenance, Pretreatment.

Deighton Sewage Treatment Works, located downstream of Huddersfield on the River Colne, had progressively been overloaded by chemical industry and woolen mill effluents. By 1974, Deighton Sewage Treatment Works was inadequately maintained and not functioning correctly. The works inlet control penstock was seized in the open position, jettisoning a substantial proportion of the crude sewage directly to stream. All tanks and channels were full of septic sludge which was recycling around the works to the extent that effluents were often worse than influents. The hydraulic capability of the works was totally inadequate and three major overflows were continually in operation. In 1974, new managers took over. The first task of management was to rapidly analyze and interpret the components of the problem. Sea disposal operations were undertaken for the humus sludge. The toxic chemical sludges were pressed for disposal at a toxic waste disposal site. The municipal sludge was septic, unscreened, and contained detritus; as a result, it was unpumpable, and had to be hosed and physically chopped up before it would run to the pumps. Existing facilities were refurbished or recommissioned, and plans were made to expand the existing capacity. Chemical manufacturers were required to pretreat wastes. (Baker-IVI)
W85-04512

BOD REMOVAL EFFICIENCIES IN TWO STABILIZATION LAGOONS IN SERIES IN MALAYSIA,
Engineering-Science, Inc., Arcadia, CA.
R. M. Bradley.
Water Pollution Control, Vol. 82, No. 1, p 114-122, 1983. 5 Fig, 1 Tab, 26 Ref.

Descriptors: *Stabilization lagoons, *Wastewater treatment, Malaysia, Kuala Lumpur, Wardieburn Lagoons, Biochemical oxygen demand, Evaluation, Design criteria.

Stabilization lagoons are widely used in tropical countries and elsewhere as an effective and economic means of treating domestic sewage. Many lagoon systems are capable of operation at significantly higher efficiencies than those predicted by the design criteria. An analysis of the operating data for the Wardieburn lagoon system in Kuala Lumpur, Malaysia is offered and the recorded biochemical oxygen demand (BOD) removal rates are compared with those predicted by various design criteria. The Wardieburn lagoon system comprizing two lagoons of equal surface area and depth in series reduces the BOD and SS levels of the feed sewage by 79 and 50%, respectively. Average BOD reduction of 65 and 39% occur in the primary and secondary lagoons, respectively. Algae can contribute 50-60% of the BOD in the secondary lagoon effluent and about 10% of the BOD in the primary lagoon effluent. The BOD removal rate constants in the primary and secondary lagoons at the mean operating temperature of 29 C are 0.423 and 0.165/d, respectively. The BOD removal rate constant in the secondary lagoon is only 39% of that in the primary lagoon. The primary lagoon functions as a facultative lagoon most of the time, although the anaerobic layer may extend close to the surface for short periods. The combined Wardieburn lagoon volume of 14,600 cu m is only 24% of that required to achieve a similar BOD removal in a single facultative lagoon designed on a conservative basis. Maximum BOD removal efficiency in a series system can be achieved by maximizing the BOD load on each lagoon. (Baker-IVI)
W85-04515

INDUSTRIAL EFFLUENT TREATMENT AT SEWAGE-TREATMENT WORKS: THE TADCASTER EXPERIENCE,
Yorkshire Water Authority (England).
M. A. Tidswell, J. A. Hudson, and K. D. Staples.
Water Pollution Control, Vol. 82, No. 2, p 227-242, 1983. 4 Fig, 2 Tab, 4 Ref, 2 Append.

Descriptors: *Wastewater treatment, *Tadcaster, *England, *Breweries, Odor control, Industrial wastewater, Water pollution control, Activated sludge process, Automation, Data processing.

During 1970-1972, new sewers were built in Tadcaster specifically to convey industrial effluents from three breweries by gravity to a new industrial pumping station. The effect of this was to concentrate pollution from the town and from the breweries in a comparatively short length of the River Wharfe downstream from the sewage treatment works. The flow of the river at the outfall is greatly influenced by the ebb and flow of the tide, and with the substantial discharge of effluent with a high oxygen demand there have been serious fish kills due to a number of coincident factors. Efforts have been made to control pH and nutrient release, improve sludge handling, deodorize wastes, and control the entire system through proper instrumentation. The Tadcaster experience has shown that it is possible to resolve effectively major industrial effluent pollution problems in a small town with willing cooperation between a major group of industrialists and their water authority. The process evaluations and the detailed design all indicate that the oxygen-enriched activated-sludge process is effective, economic and an attractive method of biologically treating a strong carbohydrate effluent such as a brewery effluent. The operation of the plant is expected to confirm the assessments made in design that further material process advantages and economies might be derived from the balancing of flows and loads to high rate treatment plants. The completed plant embraces several aspects of advanced technology not the least being the control, automation and data processing equipment which at Tadcaster is regarded as appropriate technology. (Baker-IVI)
W85-04521

TIP LEACHATE TREATMENT USING HYDROGEN PEROXIDE,
Interox Chemicals Ltd., Widnes (England).
J. A. L. Fraser, and A. F. E. Sims.
Water Pollution and Control, Vol. 82, No. 2, p 243-255, 1983. 1 Fig, 9 Tab, 45 Ref.

Descriptors: *Leachates, *Wastewater treatment, *Hydrogen peroxide, *Sulfides, Microorganisms, Solid waste disposal.

Water collected on landfill sites, and rivers or streams receiving tip leachates, are frequently contaminated with sulfides giving rise to noxious odors and black coloration. Heavy microbial growths in receiving waters have also proved a nuisance. Hydrogen peroxide (35% w/w) has been used to combat these problems. Hydrogen peroxide has proved easy to handle, readily miscible with water, selective in application and of particular value in emergency situations. It is complementary to aeration systems for full leachate treatment, environmentally acceptable and gives rise to neither polluting by-products nor deleterious bioaccumulation. It has destroyed sulfide odors in leachates, cleared lagoons of black iron sulfide and reduced filamentous bacterial and fungal growths in receiving streams. Application methods in use include dosing at pumping stations by gravity feed or injection, dilution and spraying, and floating peroxide across the surface of small lagoons using wind action. On large lagoons hydrogen peroxide has been injected into the intake or discharge pipes of static diesel-driven pumps recirculating and jetting leachate. Peroxide has been gravity fed into channels during leachate transfer, or in emergencies can be spread on lagoons from a boat. These techniques have been adopted by many private landfill operators and UK County Councils. Four case histories are presented to highlight initial operational problems. The use of hydrogen peroxide is demonstrated and improvements in leachate quality described. (Author's abstract)
W85-04522

SCREENING: A NEW APPROACH,
R. W. Little, and G. L. Symes.
Water Pollution Control, Vol. 82, No. 2, p 256-262, 1983. 1 Fig, 6 Tab, 2 Ref.

Descriptors: *Mechanical equipment, *Screens, *Contra Shear, Wastewater treatment, Outfalls, Solids.

Probably the most troublesome area in the operation of a sewage treatment works is the preliminary treatment plant, the removal of screenings and grit. Another area where screenings are a problem is in sea outfalls. The Contra-Shear screen is described and its use depicted. The principle of operation is that the inflow is introduced via a surge chamber and weir onto the inside of a counter-rotating wedgewire screen with the wires running horizontal to the unit axis. The shear velocity created by the rotating and the tangential introduction of the flow onto the screen face gives definitive solids separation and increases hydraulic capacity for a given screen size. The solids agglomerate at the bottom of the screen and are moved through a drainage area before being discharged from the unit by the rotary motion and segmented bars welded to the inside drum face. A series of washwater jets operate intermittently to clean the screen and there is no difficulty in using the screened effluent as washwater. The use of the Contra Shears in sewage-treatment works may reduce the normal maintenance requirements on the downstream processes and lead to savings in manpower and costs. On sea outfalls, they could be used to produce an effluent equivalent to or better than a drum screen, while discharging the screening in an easily handleable form. (Baker-IVI)
W85-04523

NUTRIENT REMOVAL TRIALS AND BIOASSAY EVALUATION AT BUDDS FARM SEWAGE-TREATMENT WORKS, HAVANT,
Southern Water Authority, Worthing (England).
G. S. Ford, R. L. G. Rees, P. G. Soulsby, and D. Lowthion.
Water Pollution Control, Vol. 82, No. 3, p 381-391, 1983. 4 Fig, 4 Tab, 5 Ref.

Descriptors: *Nutrient removal, *Havant, *England, *Wastewater treatment, Nitrogen, Phosphorus, Denitrification, Flow, Management, Water pollution control, Environmental effects.

Budds Farm sewage-treatment works is situated at Havant in Hampshire and the effluent discharges directly to the northeast corner of Langstone Harbor. Rapid growth in the area has brought about a tremendous increase in the flow to the works which increased dangers to the ecology of the region. The only practical solution seemed to be a conversion process to remove nitrogen and phosphorus from the effluent. Conventional denitrification was introduced by anoxic reaction between settled sewage and returned activated sludge at the activated-sludge plant. A significant quantity of phosphate and nitrate were removed by this process. Removal of nitrogen from unsettled filter effluent in the anoxic zone of the aeration plant was successfully achieved, increasing the quantity of nitrogen removed from the total effluent. Ferric sulfate added to the mixed liquor in the aeration plant is used to partially remove phosphate without reducing the efficiency of the normal treatment processes. Bioassay tests and investigations in the harbor have demonstrated that phosphate removal from Budds Farm effluent is not necessary and this expensive process has been discontinued. Nitrogen removal is being continued as a routine process at the plant. (Baker-IVI)
W85-04526

OPTIMIZATION OF COLESHILL ACTIVATED-SLUDGE PLANT OPERATING CONDITIONS,
Severn-Trent Water Authority (England).
B. Fryer, and P. Musty.
Water Pollution Control, Vol. 82, No. 4, p 443-456, 1983. 8 Fig, 3 Tab, 7 Ref, 3 Append.

Descriptors: *Wastewater treatment, *Optimization, *Activated sludge process, *Denitrification, Dissolved oxygen, Aeration, Ammonia, Nitrates.

Unit 3 of the Coleshill sewage-treatment plant was commissioned in stages when housing developments led to much greater flow than could be afforded full treatment by the existing works. Unit 3 was not designed to achieve nitrification. Steps were taken to derive the optimum performance from the Coleshill sewage-treatment works, the goals being to produce a well nitrified effluent and to minimize the loss of solids resulting from denitrification occurring in the secondary settlement tanks. A substantial improvement in the degree of nitrification at the works has been achieved by introducing continuous dissolved oxygen monitoring, increased plug flow and load equilibration. Effluent ammonia N concentrations have frequently been less than 0.5 mg/l. The introduction of anoxic zones at the inlets of aeration tanks has resulted in an overall reduction in effluent nitrate nitrogen levels of about 20 mg/l. Rising sludge due to denitrification has been considerably reduced. (Baker-IVI)
W85-04590

ACCELERATED COLD DIGESTION: A NEW LOOK AT AN OLD TECHNIQUE,
Yorkshire Water Authority (England).
P. Lowe, and S. Williamson.
Water Pollution Control, Vol. 82, No. 4, p 457-470, 1983. 18 Fig, 4 Ref.

Descriptors: *Sludge digestion, *Wastewater treatment, *Cold digestion, Anaerobic digestion, Sludge treatment.

In the Lower Calder Area of the Yorkshire Water Authority (England) there are several small to

medium sized works serving populations ranging from 100 to 20000 and one large works at Calder Vale serving 75000. In 1974 a centralization of sludge treatment was put into practice and the tankering of sludge into the Calder Vale works from the other plants began. Sludge treatment was achieved by mesophilic digestion, after which sludge is stored for about 3 months in earth bank lagoons prior to disposal as liquid to agricultural land. To handle increasing loads of waste volume, several small scale experiments were set up to determine if mesophilic digested sludge could be blended with raw sludge in a controlled process environment to accelerate cold digestion and thereby reduce the time scale to achieve a manageable system. Experimental results at Calder Vale, coupled with field trials at Crofton and Great Cliffe showed that the potential to stabilize raw sludge using already mesophilic digested sludge can be a further extension of the digestion process. This mixing did not reduce the need to provide more intensified mesophilic digesters, but did enlarge their scope and, hence, make any economic considerations as to their provision more attractive. As far as the treatment of sludge at small works is concerned, it reduces the need to transport all the sludge to a central works since at least 33% of it can be disposed of to atmosphere in a gaseous state. Much work remains to be carried out to optimize the accelerated cold digestion concept but, it provides the operator with a useful route towards final sludge disposal as the study continues. (Baker-IVI)
W85-04591

AEROBIC TREATMENT IN 'OXITRON' BIOLOGICAL FLUIDIZED BED PLANT AT COLESHILL,
Severn-Trent Water Authority (England).
G. Hoyland, and P. J. Robinson.
Water Pollution Control, Vol. 82, No. 4, p 479-493, 1983. 11 Fig, 4 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Aerobic digestion, *Fluidized beds, Biological wastewater treatment, Sand, Biofilms, Activated sludge process.

The performance and economics of the Oxitron System for use in the treatment of settled sewage are evaluated. The relationship between the concentration and size of sand grains in reactor and the physical properties of the biofilms that grow on grains is considered. The concentration of biological solids in a biological fluidized bed (BFB) is strongly related to the upward velocity and grain size of the sand, but is insensitive to the concentration of sand. At the same organic loading, an Oxitron BFB plant installed at Coleshill had an inferior performance compared to the conventional activated-sludge (AS) plant. At low loadings the BFB and AS effluents contained similar suspended solids concentrations, but the soluble BOD concentration of BFB efflents were comparatively high. At high loading, the BFB effluent had a similar soluble BOD to the AS effluent but contained a comparatively high concentation of AS. The poor BFB performance may be partly attributed to growth in the bed of over-sized particles comprising thick biofilms containing inactive microorganisms. The proprietory oxygenator associated with the BFB plant can input to the reactor oxygen equivalent to a concentration of 35 mg/l. The consumption of oxygen in BFB and AS plants is similar. An economic comparison suggests that carbonaceous oxidation in a BFB plant at most sewage-treatment works would probably be more expensive than treatment in a conventional AS plant. Operating costs of the BFB plant for the provision of gaseous oxygen and electricity consumption probably account for about 50% of the total costs. (Baker-IVI)
W85-04593

A/O PROCESS - BIOLOGICAL TREATMENT WITH NUTRIENT REMOVAL,
A. G. Best.
Water Pollution Control, Vol. 82, No. 4, p 494-500, 1983. 5 Fig, 3 Tab, 5 Ref.

Descriptors: *Biological wastewater treatment, *Nutrient removal, Phosphorus, Denitrification, Phosphorus removal, Aerobic conditions, Anaerobic conditions, Wastewater treatment.

A biological system for biochemical oxygen demand, phosphorus and nitrogen removal has been successfully developed. This process, the A/O process, is a single sludge, suspended-growth system which combines a staged anaerobic section, deficient in both dissolved and chemically-bound oxygen, with a conventional stage aerobic section. In the oxic section, nitrification can be accomplished by operating at a properly selected solids retention time. When denitrification is required an anoxic section, deficient in dissolved oxygen but not nitrogen oxides, is included between the anaerobic and oxic zones. An internal recycle is used to transfer nitrified mixed liquor from the oxic section back to the anoxic section. Influent wastewater is mixed with recycled sludge from the secondary clarifier at the front end of the anaerobic section. The mixed liquor then flows to the anoxic section, if present, and then to the oxic section. The anaerobic zone provides the selective stress for generating high phosphorus removing organisms. The phosphate molecules are linked together by energy-rich phosphoanhydride bonds whose free energy of hydrolysis is greater than that released in the ATP to ADP reaction. (Baker-IVI)
W85-04594

PRACTICAL ASPECTS OF ENERGY SAVING IN WASTEWATER DISPOSAL,
Humphreys (Howard) and Sons, London (England).
G. F. G. Clough.
Water Pollution Control, Vol. 82, No. 4, p 510-517. 2 Fig, 4 Ref.

Descriptors: *Wastewater treatment, *Treatment plants, *Energy, *Costs, Economic aspects, Pumps, Monitoring, Management planning, Economic efficiency.

Energy may be saved in wastewater disposal systems without disproportionately increasing the use of other resources. In practice there is considerable scope for doing this because many plants are not operating under the conditions for which they were designed. The cost of energy has increased relative to other resources since many plants were originally designed, and is expected to increase still further. The practical problem is how to modify an existing plant at minimum cost to suit the conditions existing at the present time and those likely to occur in the immediate future. The more promising areas for action are: matching the plant to the load; pumping; aeration; instrumentation; the use of digester gas; and space heating. One of the more pressing needs is a general improvement in flow measurement. Monitoring is an essential part of energy saving but if it is based on inaccurate flow measurement the results may be useless or misleading. Small pump efficiency is generally low but improvements may be hard to quantify. Another future developmemt is that automatic control systems will make an increasing contribution to energy saving. (Collier-IVI)
W85-04595

TREATMENT OF FERRUGINOUS GROUND WATER FROM AN ABANDONED COLLIERY,
G. A. Best, and D. I. Aikman.
Water Pollution Control, Vol. 82, No. 4, p 557-566, 1983. 6 Fig, 13 Tab, 10 Ref.

Descriptors: *Mine drainage, *Wastewater treatment, *Coal mines, Scotland, Biological treatment, Alkaline water, Ferruginous mine drainage, Groundwater, Sludge drying.

Investigation into the treatment of an alkaline and ferruginous type of discharge are described. The discharge originated from an abandoned colliery in Scotland. The principle chemical characteristics of alkaline and ferruginous discharges is that, after aeration, all the ferrous salts are converted into the insoluble ferric form which precipitates as hydrated ferric oxide. The method of treatment involves aeration by a stepped cascade followed by a biological filter and then settlement of the insoluble iron for 18 hr in shallow lagoons. The drainage of the sludge to a handleable consistency takes about 1 month, and could be carried out either in the lagoons or on separate drying beds. This treatment process will reduce the iron content of the 125 cu m/hr discharge by about 75% from the original 28 mg/l and will produce an effluent which will not jeopardize the good quality fishery in the receiving River Ayr. (Baker-IVI)
W85-04596

SALINE IRRIGATION WATER: EFFECTS ON SOIL CHEMICAL AND PHYSICAL PROPERTIES,
Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 3C.
W85-04618

FILTER FOAM - PERFECT IN MANY FIELDS (FILTERSCHAUM - PERFEKT IN VIELEN BEREICHEN),
For primary bibliographic entry see Field 5F.
W85-04632

DRIER SLUDGE ENDS LANDFILL LEACHING CONCERNS,
Wastewater Treatment Plant, Brewer, ME.
M. Taylor.
Water Engineering and Management, Vol. 131, No. 13, p 30-31, December, 1984. 2 Fig.

Descriptors: *Sludge treatment, *Belt filter press, *Sludge drying, Wastewater treatment, Sludge disposal, Dewatering.

Built to handle a difficult influent consisting of typical municipal wastewater combined with concentrated industrial waste, the treatment plant serving Brewer, Maine, had a serious sludge dewatering problem. The poorly dewatered sludge, disposed of in a landfill, was seriously aggravating existing leaching problems. In 1981 the effluent standards imposed by the State of Maine's Department of Environmental Protection on plant discharges were being threatened. Spring coil vacuum filters used for nearly a decade in the plant were capturing only about 50% of the solids in the waste activated sludge dewatering process. By switching to a belt filter press 85% of the daily 8 dry tons of solids generated from the combined industrial municipal waste activated sludge is now captured. Energy savings have amounted to about 28,000 kwh/month. (Baker-IVI)
W85-04650

OXYGEN INJECTION CUTS ODORS,
Airco Industrial Gases, Murray Hill, NJ.
E. Mozell.
Water Engineering and Management, Vol. 132, No. 1, p 40 and 42, January, 1985. 1 Fig, 1 Tab.

Descriptors: *Oxygen, *Wastewater treatment, *Odor control, Management, Oxidation.

When injected into raw sewage, pure oxygen can help end noxious odors and improve the efficiency of subsequent sewage treatment processes. Such injection systems are simple and easy to install. One of the most recent applications was to assist in controlling odors at a newly expanded wastewater treatment plant. The source of problem odors at the plant was found to be four new 100 ft diam, 32 ft deep units in which the waste stream is trickled through honeycombs of plastic filter media. Aerobic bacteria on the surface of the media convert soluble organic matter into settleable organic matter. Air is circulated through the filters which serve as a release point for the sewage entrained odor compounds and as a point source odor generator. While a long term solution is being sought, influent sewage is being diluted with oxygenated recycled wastewater from the nitrification process. Another of the responses to the odor problem was to install an oxygen injection system, where oxygen is injected into the influent mixture at the discharge side of the main pumping station. The feed rates are set manually by the personnel and range from 1,000 to 3,000 SCF/hour. While the

odor has not been eliminated entirely, these systems have been helpful in diminishing the problem. (Baker-IVI)
W85-04652

TWO-PHASE ANAEROBIC FERMENTATION OF LIQUID SWINE WASTE TO METHANE,
Budapesti Mueszaki Egyetem (Hungary).
T. Cseh, L. Czako, J. Toth, and R. P Tengerdy.
Biotechnology and Bioengineering, Vol. 26, No. 12, p 1425-1429, December, 1984. 6 Fig, 1 Tab, 14 Ref. NSF grant INT 820-3996.

Descriptors: *Animal wastes, *Methane, *Anaerobic digestion, *Wastewater treatment, *Manure, Volatile solids, Lignin, Fatty acids, Proteins.

Anaerobic digestion is the most flexible means of swine waste disposal; it satisfies the requirements of both economic recycling and environmental protection. Two-phase anaerobic digestion of liquid swine manure has been developed with options for single-cell protein (SCP) or methane production. In the acidogenic phase at two to four days retention time, and 2.5-7.0% dry matter (DM) concentration, 8-46% of the volatile solids was solubilized. Maximum reactor capacity was 3.86 g/L at 7.0% DM concentration, but optimal operation was achieved at 4.5% DM concentration at four days retention time. The second methanogenic phase was operated continuously and had a maximum specific methane production rate of O.70 L/L day at 12 days retention time. With recirculation, the rate was 1.16 L/L day at 8.5 days retention time with 52.7% conversion of organic matter. Maximum digestibility was 66% of the lignin free organic matter. Efficiency of acidogenic solubilization of volatile solids in liquid swine waste linearly decreases with the load. Selection of the optimal operation point depends on the intended use of the process. If maximum gain of gas or volatile fatty acids for SCP is the goal and the value of the substrate is slight, optimization for maximum reactor capacity is warranted. (Collier-IVI)
W85-04659

BIOLOGICAL DENITRIFICATION IN A FLUIDIZED BED,
Indian Inst. of Tech., Bombay. Dept. of Chemical Engineering.
N. K. Narjari, K. C. Khilar, and S. P. Mahajan.
Biotechnology and Bioengineering, Vol. 26, No. 12, p 1445-1448, December, 1984. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Denitrification, *Fluidized bed process, *Wastewater treatment, *Biological treatment, Biological wastewater treatment, Nitrates, Nutrient removal.

In a fluidized bed reactor, wastewater is sent upwards at a velocity faster than the minimum fluidization velocity and the intensive organism growth on the carrier particle consumes the biodegradable waste contaminants present in the wastewater. A fluidized bed biofilm reactor using sand as the carrier particle was employed to study the effects of superficial velocity on the removal of nitrates as well as on the growth of the biofilm. Velocity was found to affect significantly both nitrate removal and biofilm growth. The lowest superficial velocity used, 2.5 cm/s, was ca. 3.5 times the minimum fluidization velocity; the nitrate removal rate (g/h) was 0.85. The nitrate removal rate was maximum, 1.39 g/h, for a velocity of 4.2 cm/s. An increase in velocity to 5.4 cm/s led to a decrease in removal rate, 1.24 g/h. Rate of growth of biofilm was highest at a velocity of 4.2 cm/s. As the velocity increases, the increased drag and shear on the bioparticles sloughs off a portion of the attached film and, consequently, the film thickness decreases. The optimum mass velocity at which the thickness of the biofilm was maximum was ca. 2500 kg/sq m/min. An analysis based on heterogenous catalysis was used to describe the reaction and mass transport in the denitrification process; the hydrodynamic aspects are related to fluidization principles. The differential material balance balance equations for the substrate can be written in two phases: biofilm and bulk liquid. These two weakly coupled differential equations can be solved simultaneously with the proper boundary conditions. Both steady-state and startup experimental data were used to test the correlation obtained from the analysis. The substrate effluent concentration was correlated with various dimensionless numbers; the correlation obtained by analysis fits the data very well. Using the analysis, one can estimate the efficiency of biological denitrification in a fluidized bed under known operating conditions. (Collier-IVI)
W85-04660

MICROBIAL HETEROTROPHIC ACTIVITY ASSESSMENT IN A WASTE-WATER TREATMENT SYSTEM,
National Inst. for Water Research, Pretoria (South Africa).
D. F. Toerien.
Ergebnisse der Limnologie, Vol. 19, p 305-312, December, 1984. 5 Tab, 15 Ref.

Descriptors: *Microorganisms, *Wastewater treatment, *Heterotrophic bacteria, *Glucose, Bacteria, Aufwuchs, Surface sediments, Macrophytes, Animal wastes, Cattails, Bacterial physiology.

The heterotrophic activities of different microbial communities, viz. those of the bacterioplankton, 'Aufwuchs', surface sediment layer, a sludge (deposited solids) layer and a surface film at the water-air interface of an artificial macrophyte bed used for the treatment of piggery effluent were quantified. The Wright and Hobbie (1966. Ecology, 47: 447-464) method (with the measurement of labeled-CO2 evolution) was adapted to determine the glucose uptake kinetics of the bacterioplankton, sludge layer, sediment surface and surface film at the water-air interface. The method worked well despite the fact that very high Vmax values (> 3000 micro g/l/h) and very short turnover times (< 0.01 h) were encountered for glucose uptake in the water column and/or the sludge layer. Disturbance of 'Aufwuchs' increased its glucose uptake and changed its glucose uptake kinetics. Consequently a method was developed whereby pieces of leaves of Typha domingensis with intact 'Aufwuchs' were used in assessment of labeled-glucose uptake and mineralization. The coefficient of variation of the rate of glucose uptake by 'Aufwuchs' in different locations of the macrophyte was approximately 40%. The above methods can be recommended for the quantification of the microbial activities of waste-water systems. (Author's abstract)
W85-04706

SHORT-TERM UPTAKE OF HEAVY METALS BY PERIPHYTON ALGAE,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
For primary bibliographic entry see Field 5B.
W85-04721

CHEMICAL FLOCCULATION FOR SUSPENDED SOLIDS REMOVAL AT REMOTE MINE SITES,
Commonwealth Technology, Inc., Lexington, KY.
J. S. Tapp, B. J. Barfield, and M. L. Griffin.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1332-1338, September-October, 1984. 7 Fig, 5 Tab, 13 Ref.

Descriptors: *Flocculation, *Suspended solids, *Mine drainage, *Chemical coagulation, Settling basins, Sedimentation, Polyelectrolytes, Water treatment.

Meeting applicable suspended solids effluent limitations with simple gravity settling may be difficult depending on the nature of the suspended material to be removed. The effectiveness of using polyelectrolyte chemical flocculation agents for enhancing the removal of suspended solids in runoff from mined areas was investigated in pilot scale tests with the goal of improving the effectiveness of sediment ponds with inflow concentrations typical of remote sediment ponds. These studies show that chemical flocculants enhance removal of sediment at high concentrations and that adequate mixing is important to the process. Adequate mixing was obtained by a passive system composed of a corrugated pipe for high energy initial mixing and a baffle system for lower energy final mixing. In a constant flow test run, the total suspended solids concentration was reduced to less than 45 mg/l, while without chemical treatmemt more than 300 mg/l was present in the outflow; coagulant concentrations used ranged from 0 to 40 mg/l. (Collier-IVI)
W85-04730

IRRIGATION OF SWINE LAGOON EFFLUENT ONTO PINE AND HARDWOOD FORESTS,
South Carolina Agricultural Experiment Station, Clemson.
R. O. Hegg, A. T. Shearin, D. L. Handlin, and L. W. Grimes.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1411-1418, 1984. 6 Fig, 7 Tab, 11 Ref.

Descriptors: *Wastewater irrigation, *Animal wastes, *Forests, Potassium, Phosphorus, Calcium, Magnesium, Effluents, Wastewater disposal.

Growth responses of a loblolly pine plantation and a mixed hardwood stand were measured to the application of swine lagoon effluent. The capacity of the forest soil to assimilate the organic matter and nutrients of the swine lagoon effluent was also determined. There were significant accumulations of P, K, Ca, and Mg in the forest soils from nearly all application rates of swine effluent. Mature pine trees (45 yr old) did not show increased diameter growth after five years of swine effluent applications, but there was a significant height increase at the highest application rate of 81 cm/yr. Mature hardwood shows a significant increase in growth at all swine effluent application rates. Application of swine effluent onto forestland is an appropriate method of disposal because of the convenience and management features. (Baker-IVI)
W85-04741

NEW IDEAS RESHAPING TREATMENT TECHNOLOGIES,
Lorenz (William T.) and Co., Boston, MA.
W. T. Lorenz.
American City and County, Vol. 100, No. 2, p 56 and 61-62, February, 1985. 1 Fig.

Descriptors: *Wastewater treatment, *Maintenance, Management, Operation, Water reuse, Conservation, Planning, Decision making, Computers.

Public officials are evaluating innovative, and cost-effective technologies, as well as exploring alternative financing methods for wastewater treatment. Package wastewater treatment plants are one solution to sewage treatment problems. Membrane technologies, as part of package treatment plants, are also in greater demand where higher quality effluent is desired, perhaps for recycling or reuse. There is a growing demand for instrumentation and sampling systems for monitoring the compositions and concentrations of substances found in influent resulting from industrial wastes streams. Computer based services and software for wastewater treatment facilities are fast becoming an important industry. For small treatment plants, the trend is toward onsite microcomputer operations that can reduce staff requirements by as much as 75%. Significant proposals in water recycling are now underway, due to improved economics, tighter water supplies and tradeoffs between treating water supplies and recycling. Two major obstacles to the process of potable water from sewage are the high costs and the potential health hazards posed by reclaimed water. The potential market for operation and maintenance services in wastewater treatment plants is enormous with local governments spending more than $6 billion in 1984 for these functions at wastewater treatment plants. (Baker-IVI)
W85-04751

COMMERCIAL MINING TECHNIQUE OFFERS A NEW APPROACH TO REMOVING HEAVY METALS FROM SLUDGES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
J. G. Henry, and L. Wong.
Water and Pollution Control, Vol. 122, No. 3, p 56-57, May/June, 1984.

Descriptors: *Biological wastewater treatment, *Sludge treatment, *Heavy metals, *Bacterial leaching, Extraction, Bacteria, Wastewater treatment, Cadmium, Copper, Nickel, Zinc.

A biological process currently under study appears to have great potential for the reduction of heavy metal concentrations in sewage sludges. The process is defined as the dissolution of metals from insoluble minerals either directly by the metabolism of microorganisms or indirectly by the products of their metabolism. In the direct mechanism the leaching bacteria attack mineral sulfides directly by enzymatic cations. Because of the oxidation of mineral sulfides, metals will become solubilized. The principal microorganism associated with bacterial leaching is Thiobacilus ferrooxidans. Bacterial leaching has been used commercially in the mining of low grade copper and uranium ores. The fact that heavy metals exist in the reduced sulfide form in an aerobically digested sewage sludge suggested that bacterial leaching could be used to extract metals from the sludge. Very good metal extraction efficiencies can be achieved: Cd 86%, Cu 65%, Ni 78%, and Zn 87%. The most significant advantage of the method is that extraction can be achieved at a much lower cost than other existing methods. (Baker-IVI)
W85-04767

CONTROLLING SEWAGE TREATMENT PLANT ODOURS,
London Pollution Control Div. (Ontario).
R. A. Wheeler.
Water and Pollution Control, Vol. 122, No. 5, p 22-23, 36, October, 1984. 1 Fig.

Descriptors: *Odor control, *Wastewater treatment, *Potassium permanganate, *Oxidants, Oxidation, Hydrogen sulfide, Belt presses.

The city of London, Ontario has five treatment plants with a design capacity of almost 42.3 million gallons per day. At the Greenway plant, which operates as the pollution control center, belt presses were used to replace vacuum filters. Using the belt presses enabled much of the hydrogen sulfide gas produced to escape into the atmosphere both in and outside the plant. Use of hydrogen peroxide to transform H2S into elemental sulfur or soluble sulfates presented difficulties in handling and length of time needed for the reaction to occur. Potassium permanganate was tried as an alternative oxidant. As a result of positive tests, a feeder was installed to feed potassium permanganate into the sludge. Not only were health objectives met, but an increase in throughput was noted along with a reduction in chemical costs and maintenance reduction. (Baker-IVI)
W85-04769

SEWAGE PLANT PROVIDES ENERGY FOR DISTRICT HEATING SYSTEM,
Triton, Washington, DC.
R. J. Willcocks.
Water and Pollution Control, Vol. 12, No. 5, p 24-25, September/October, 1984. 1 Fig.

Descriptors: *Wastewater treatment, *Sludge treatment, *Waste heat, *Energy conservation, Heating.

Operations staff at a sewage treatment plant have been experimenting with the two stage anaerobic digesters to optimize the process. Significant increases in the production of digester gas have resulted, leading to the possibility that the plant will be expanded and the captured heat produced by the engine generator will be used to heat the raw sludge, digester and filter buildings and a nearby school. By improving the digester design, the existing digester volume will be used better, thus postponing or possibly eliminating the need for large digesters in the expanded plant. Utilization of surplus gas from 1978 to 1980 represented savings in excess of $10,000 per year in natural gas and represented one half of the available surplus. At present the remainder is being flared. (Baker-IVI)
W85-04770

FLOW BALANCING SYSTEM FOR STORMWATER AND COMBINED SEWER OVERFLOW,
P. H. Stevers.
Water and Pollution Control, Vol. 122, No. 6, p 14, 17-18, December, 1984. 2 Fig.

Descriptors: *Combined sewer overflows, *Flow regulators, *Storm runoff, *Flow balancing method, Overflow, Urban runoff, Flood peak, Plug flow.

Environmental problems caused by urban runoff and combined sewer overflow are becoming increasingly serious. There are many technical solutions to the problem of flow equalization such as artificial ponds, mechanical retaining devices within the pipes and culverts, and concrete tanks. A flow balancing method (FBM) is described which operates on the principle of plug flow and consists of a series of cells in a water body constructed by suspending reinforced plastic curtains from floating pontoons. When the influent water flow rate exceeds the pumping rate to the treatment plant, the excess water begins to displace the lake water in the adjacent cell. This displacement process will eventually fill all the cells with polluted water if the influent rate remains greater than the pumping rate. The reverse occurs when the pumping rate exceeds the influent flow rate. This causes the lake water to reenter the FBM in the last cell and displace the polluted water. Once all of the polluted water has been displaced by the lake water, the FBM is ready for another surge in the influent flow rate. The FBM can be used as a settling basin and is a low cost alternative to conventional balancing systems. The main reason for the cost advantage is that the FBM is situated in the recipient water body so little or no land is required. It is also very energy efficient since the pressure head required to pump water back to a treatment facility is very low. (Baker-IVI)
W85-04772

MAIN RESULTS OF A PROJECT FOR ARTIFICIAL GROUND-WATER RECHARGE FROM SECONDARILY TREATED SEWAGE IN THE MUNICIPAL FOREST OF THE CITY OF LANGEN (LOWER MAIN REGION) (DIE WICHTIGSTEN ERGEBNISSE EINES PROJEKTES ZUR KUNSTLICHEN GRUNDWASSER-ANREICHERUNG MIT WEITERGEHEND BEHANDELTEM ABWASSER IM LANGENER STADTWALD (UNTERMAINREGION)),
Hessische Landesanstalt fuer Umwelt, Wiesbaden (Germany, F.R.).
B. Toussaint.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 4, p 107-117, October, 1984. 12 Fig, 1 Tab, 12 Ref.

Descriptors: *Artificial recharge, *Effluents, *Groundwater pollution, Groundwater recharge, Langen, Germany (Federal Republic), Nitrates, Organic carbon, Water pollution control, Water quality.

During the years 1980-1982 about 514,600 cu m biologically posttreated sewage effluents were made to infiltrate into a Quaternary porous aquifer of 30 m thickness in the Langen municipal forest. Two thirds of the infiltrate, which could be identified for a distance of about 300 m in the underground, became efficient for storage. The extracted ground water showed heavy anthropogenic contamination; the purification capacity of the underground has proved to be not at all as efficient as supposed in general. Although the secondarily treated sewage water fulfilled, except for its high nitrate content, the requirements for drinking-water quality according to the current regulations, the level of unregulated dissolved organic carbon (which may contain hidden organic pollutants) was found to be high. Therefore, it is advised to dispense with further recharge measures. Instead, it is necessary to intensify the preventive ground-water protection. (Author's abstract)
W85-04809

NEED FOR CHEMICAL PHOSPHATE REMOVAL,
Directorate of Water Affairs, Johannesburg (South Africa).
H. J. Best.
Water, Sewage and Effluent (Johannesburg), Vol. 9, p 21-23, 1982. 2 Tab, 8 Ref.

Descriptors: *South Africa, *Phosphorus removal, *Wastewater treatment, Eutrophication, Biological treatment, Water quality standards.

In South Africa, rapid development in the catchments of the major rivers with a corresponding increase in the nutrient loads draining into these rivers, has caused the presence of algae and aquatic weeds in streams and impoundments to become almost a national phenomenon. While fully eutrophic impoundments are still relatively few in number, treatment difficulties are also experienced with waters from sources generally considered to be mesotrophic and oligotrophic. Adverse effects of enrichment include increased purification costs for water; increased level of training and expertise required by water treatment operators; clogging of pump intakes; losses of livestock from toxins produced by certain algal strains; and loss in recreational value of lake surfaces. The main sources of phosphates in South African impoundments are point discharges of sewage effluents and runoff from agricultural lands and urban areas. Biological removal of nutrients from biological filter plants seems to be only feasible with the addition of external carbon sources. In the case of existing and minor activated sludge plants within the sensitive areas and where modification to biological nutrient removal status cannot be economically justified, chemical precipitation is the only viable solution to meet the phosphate standards. (Baker-IVI)
W85-04821

SOME ASPECTS OF THE USE OF OXIDATION TECHNIQUES IN THE TREATMENT OF SEWAGE,
D. Hebden.
Water, Sewage and Effluent (Johannesburg), Vol. 9, p 57-67, 1982. 4 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Oxidation, *Municipal wastewater, Biological wastewater treatment, Activated sludge process, Oxidation ponds, Tricklng filters, Suspended solids, Total organic carbon, Aeration, Disinfection, Chlorine.

Primary solids removal is used where the wastewater contains a high enough concentration of large, dense suspended or settleable solids to make removal economical. Biological treatment can be accomplished in a number of ways, but the basic characteristics of the system is the use of mixed bacterial cultures for the conversion of pollutants. In most cases, organic materials are converted to oxidized end products, mostly carbon dioxide and new bacterial cells. Biological processes are most commonly used for secondary treatment, conversion of organics remaining after a primary sedimentation process is applied to remove suspended solids. Two configurations are in common use: film flow and suspended. Suspended culture processes in use include activated sludge, aerated lagoons, oxidation ponds, and anaerobic treatment processes. Other biological processes of current importance include lagoons, anaerobic digesters and nitrogen conversion systems. Most biological treatment processes have the primary purpose of removing organic material from a wastewater. The importance of inorganic nutrients and suspended solids is considered. Discussion also centers around the activated sludge process, hydraulic residence time, extended aeration processes, pure oxygen activated sludge systems, aerated lagoons, oxidation lagoons, maximum oxygen

transfer rates, disinfection, desirable properties of disinfectants, chlorine, and the rate of disinfection with chlorine and the advantages and disadvantages of using chlorine as a disinfectant. (Baker-IVI)
W85-04822

EFFECTS OF DECHLORINATED SEAWATER ON FISH BEHAVIOR,
Occidental Coll., Los Angeles, CA. Dept. of Biology.
J. E. Hose, T. D. King, and J. S. Stephens, Jr.
Marine Environmental Research, Vol. 11, No. 1, p 67-76, 1984. 2 Tab, 30 Ref. Southern California Edison contract C0650901.

Descriptors: *Dechlorination, *Fish behavior, *Seawater, Wastewater treatment, Chlorination, Opaleye, Goby, Oxidants, Toxicity, Avoidance, Halogenated hydrocarbons, Effluents.

Dechlorination of water has been proposed as a method of removing the toxicity of chlorinated industrial and municipal effluents. Behavioral responses of motile marine organisms such as fish to effluent-borne pollutants may modify actual toxicant exposures. Behavioral responses to chemically dechlorinated seawater were studied using two species of marine fish associated with power plant discharge areas off Southern California. Opaleye (Girella nigricans) neither avoided nor were attracted to chlorinated seawater containing 0.1 mg/liter total residual oxidants (TRO) which had been dechlorinated using equimolar or excess sodium thiosulfate. Blue-banded goby (Lythrypnus dalli) did not avoid dechlorinated seawater initially containing 0.1 or 0.9-1.0 mg/liter TRO. Elimination of chlorine-produced oxidants by thiosulfate dechlorination resulted in 100% survival in both species. Exposure of fish to organohalogen byproducts formed during chlorination would theoretically be minimized by avoidance of chlorinated effluent when compared with exposure to a dechlorinated effluent containing a similar level of halogenated organics and which is not avoided by fish. (Moore-IVI)
W85-04862

ANAEROBIC TREATMENT OF CONCENTRATED INDUSTRIAL WASTEWATER,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
P. Corbo, and R. C. Ahlert.
Environmental Progress, Vol. 4, No. 1, p 22-26, February, 1985. 9 Fig, 2 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, Methane, Digestion, Anaerobic conditions, Industrial wastes, Leachates, Landfills, Organic compounds, Fatty acids.

Test results are given for anaerobic digestion with the production of methane as a possible treatment for industrial landfill leachate. The study of volatile fatty acids during batch experiments provides several insights into the degradation of organic solutes in the complex wastewater used. A one tenth dilution of leachate led to a very slight lag period for the removal of acetate, propionate, and butyrate, with an unadapted culture of selected organisms. Leachate components do not affect the bacterial culture adversely, at a fairly high concentration. The buildup of conservative or nondegradable compounds could affect the bacteria in a continuous process. An overall dissolved organic carbon reduction of 61% was noted during a batch experiment using a leachate dilution of five per cent and a culture adapted to leachate. The build up of butyrate indicates a breakdown of other, larger organic species in the leachate. When a culture selected for volatile fatty acid degradation was used, this effect was not observed. Apparently the organisms responsible for the formation of butyrate from higher compounds are not present in this culture. Inhibition of methane occurs when the leachate adapted culture is dosed with leachate, presumably because of sulfate reducers. This problem can be eliminated by removing the sulfuric acid step from the pretreatment scheme or selecting a culture from a seed that does not contain sulfate reducers. (Baker-IVI)
W85-04877

FATE OF CONTAMINANTS DURING TREATMENT OF H-COAL PROCESS WASTEWATERS,
Department of Energy, Pittsburgh, PA. Pittsburgh Energy Technology Center.
C. J. Drummond, R. P. Noceti, R. D. Miller, T. J. Feeley, III, and J. A. Cook.
Environmental Progress, Vol. 4, No. 1, p 26-33, February, 1985. 3 Fig, 7 Tab, 8 Ref.

Descriptors: *Coal liquifaction, *Industrial wastewaters, *Wastewater treament, Coal gasification, Ammonia, Cyanide, Hydrogen sulfide, Phenol, Organic compounds.

The treatment train investigated is capable of significantly improving the quality of H-Coal liquifaction process wastewater, reducing contaminant concentrations to low levels. The detailed characterization of the effluents from each of the unit operations in the treatment sequence allows a determination of the degree of treatment required for specific applications for reuse in the facility or for discharge to the environment. The observed aquatic toxicity of the wastewater was drastically decreased over the treatment train employed indicating that any contaminants remaining in the wastewater do not contribute significantly to its aquatic toxicity. Measurements of the constituents in the sludges formed during treatment indicate that certain elements could accumulate in the lime sludge and the bio-sludge, requiring proper disposal. (Baker-IVI)
W85-04878

GASIFIER WASTEWATER TREATMENT: PHASE I COOLING TOWER ASSESSMENT,
North Dakota Univ., Grand Forks. Energy Research Center.
M. D. Mann, W. G. Willson, and J. G. Hendrikson.
Environmental Progress, Vol. 4, No. 1, p 33-39, February, 1985. 4 Fig, 7 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Cooling water, *Coal gasification, Stripped gas liquor, Water reuse, Wastewater renovation, Makeup water, Biofouling, Corrosion.

The effectiveness of using minimally treated wastewater as makeup to a cooling tower was investigated. Ammonia, alkalinity, phenol, and other non-hydantoin organics were removed from the cooling water by stripping and/or biological degradation with the phenol concentration in the exhaust air exceeding the odor threshold. Foaming of the circulating water will be a problem using stripped gas liquor (SGL) as makeup, and foaming control will be needed. Both glycol and silicon based agents were used successfully to control foaming during the test. The SGL feed cooling system supported a high level of biological activity, predominantly Pseudomonas aeruginosa. This high level led to severe biofouling of all carbon steel surfaces. Biofouling control will be a key factor in maintaining clean heat transfer surfaces in an industrial system using similar wastewater. General corrosion rates of 12.5 to 24 mils/year were measured for carbon steel in various parts of the system. Corrosion rates increased with increasing temperature and velocity. Carbon steel will not provide an adequate service life if used as thin walled heat exchanger tubing without the use of corrosion inhibitors and biocides. Both 304L and 316 stainless steel heat exchanger tubes showed no significant metal loss from either general or pitting corrosion. Hydration of Type V concrete occurred after exposures to the SGL cooling water, resulting in increased friability and loosening of the bonding between the concrete and the aggregate. The use of SRG similar to that produced by the UNDERC pilot gasifier as cooling tower makeup water is limited by a number of potentially serious operating problems. This water could be used for cooling tower makeup only after additional treatment or possibly with the use of biocides, corrosion inhibitors and other control methods. (Baker-IVI)
W85-04879

WASTEWATER TREATMENT SYSTEMS FOR SYNTHETIC FUELS PLANTS BASED ON PEAT AND OIL SHALE,
I. Frankel, and M. Drabkin.
Environmental Progress, Vol. 4, No. 1, p 39-43, February, 1985. 8 Fig, 4 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Synthetic fuels, *Oil shale, *Peat, Industrial wastes, Mine wastes, Water reuse.

Wastewater treatment systems being used or proposed for use in synthetic fuel projects which were based on peat and oil shale are reviewed. The wastewater technologies used are functions of three major factors: nature of the fossil fuel raw material, nature of the fuel conversion process, and site-specific considerations such as zero discharge of wastewater. At Northern Peat Energy a combined anaerobic aerobic process is proposed for wastewater treatment. At the Peat Methanol Associates Peat Gasification Project the basic approach to wastewater treatment is to treat process and non-process wastewater separately, followed by discharge of the combined treated effluent to surface waters under an NPDES permit. At Seep Ridge water and oil are separated in a heater/treater unit followed by an API separator for the oily water which is then steam stripped for removal of ammonia and other gases, combined with lesser quantities of wastewater from other sources, and pumped with water treatment chemicals into the KTI Thermosludge boiler. At the Paraho-Ute Project the oil shale project is based on zero discharge with reuse of all wastewaters, principally for spent shale moisturization. At Cathedral Bluffs, the principal source of input water into the treatment system is the mine water. The Union Oil Parachute oil shale project will feature zero discharge of wastewaters. All wastewaters will be used in cooling and wetting the retorted shale prior to placement on a spent shale pile in the valley of the East Fork Parachute Creek. (Baker-IVI)
W85-04880

OXIDATION OF CYANIDES IN INDUSTRIAL WASTEWATERS BY OZONE,
Drexel Univ., Philadelphia, PA. Dept. of Environmental Engineering.
M. D. Gurol, W. M. Bremen, and T. E. Holden.
Environmental Progress, Vol. 4, No. 1, p 46-51, February, 1985. 9 Fig, 1 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Oxidation, *Cyanides, Industrial wastes, Kinetics, Cyanates, Copper.

Various industrial processes such as metal finishing, photographic bleaching, and iron and steel manufacturing produce substantial amounts of wastewater which may contain free cyanide and metal complexes of cyanide. Ozone is an alternative process for the oxidation of cyanide. In the absence of any metals, ozone reacts primarily with the cyanide ion with a very fast rate; its reaction with hydrogen cyanide is negligible. The reaction is first order with respect to ozone and fractional order with respect to cyanide ion. This fractional order is an indication that the reaction is not a simple, bimolecular elementary reaction, but involves the formation and reaction of free radicals. Upon oxidation of each mole of cyanide, one mole of ozone is consumed, and one mole of cyanate is produced as the intermediate product of the reaction. Oxidation of cyanate by ozone is a slow reaction; therefore, cyanate accumulates in the solution until cyanide is oxidized completely. The oxidation of cyanide at high pH is expected to be mass-transfer limited under the operating condition of most experimental and full-scale ozone contactors. The kinetic regime for operations at neutral pH should depend upon the mass-transfer characteristics of the ozone contactors as well as the concentration of cyanide in water. The presence of copper causes a significant increase in the oxidation rate of cyanide, but does not affect the stoichiometric relations. The mechanism of copper-catalysis involves an oxidation-reduction reaction between Cu(II) and cyanide ion. The complexation of cyanide with iron hinders the oxidation of cya-

nide significantly. Cyanate is not detected as an intermediate product. (Baker-IVI)
W85-04881

STUDY OF DOMESTIC SEWAGE WASTE TREATMENT BY THE POLYCHAETES, NEANTHES JAPONICA AND PERINEREIS NUNTIA VAR. VALLATA, ON AN ARTIFICIAL TIDAL FLAT,
Tohoku Univ., Sendai (Japan). Biological Inst.
Y. Kurihara.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 5, p 649-670, 1983. 10 Fig, 11 Tab, 17 Ref.

Descriptors: *Biological wastewater treatment, *Polychaetes, *Tidal flats, Pilot plants, Activated sludge, Chlorinity, Water temperature, Wastewater treatment.

A new biological method of treating sewage waste, mass cultures of the polychaete annelids Neanthes japonica and Perinereis nuntia var. vallata, is being developed. The effects of environmental factors on the food consumption, survival and growth of the polychaetes were studies in continuous culture systems in the laboratory. Both species could ingest large quantities of activated sludge discharged from sewage treatment plants and egest about half of the sludge as fecal pellets. The maximum daily sludge consumption by adult N. japonica ranged from 500 to 1000 mg/100 sq cm of sand area at 10 0/00 chlorinity and 20 C water temperature. The conditions under which P. nuntia consumed sludge most rapidly included a chloride concentration from 10 0/00 to 20 0/00, a water temperature between 20 and 30 C, and a substrate consisting of sand and gravel, exposed periodically. With these conditions, it is expected that P. nuntia could ingest sewage sludge at a rate of about 150 to 300 mg/100 sq m of sand bed daily. A pilot plant with an artificial brackish lagoon, consisting of an aeration tank and a sand tank in which a large number of N. japonica were kept, was constructed and operated for 7 months. When effluent from the aeration tank containing domestic sewage diluted with seawater was conducted to the sand tank, the effluent filtered through the sand bed had excellent transparency and reduced COD. A pilot plant for an artificial lagoon, which consisted of a seawater tank and a worm tank where P. nuntia were kept, was operated for one year. The worms could propagate themselves for several generations and developed normally in the worm tank. The daily ingestion rate was estimated to be about 60 mg sludge/100 sq cm of sand bed. (Moore-IVI)
W85-04903

CONTROL AND TREATMENT TECHNOLOGY FOR THE METAL FINISHING INDUSTRY. IN-PLANT CHANGES.
Industrial Environmental Research Lab.-Cincinnati, OH.
Report EPA 625/8-82-008, Summary Report, January 1982. 30 p, 10 Fig, 10 Tab, 15 Ref.

Descriptors: *Industrial wastes, *Cost analysis, *Wash water, *Wastewater treatment, *Industrial wastewater, *Waste recovery, *Metal-finishing wastes, Cost-benefit analysis, Regulations, Wastewater disposal, Wastewater, Recycling, Wastewater pollution, Wastewater management, Case studies, Wastewater renovation.

This report describes the first steps an electroplating plant should take to comply with either the U.S. EPA wastewater treatment and disposal guidelines or Resource Conservation and Recovery Act regulations. Drag-out of process solutions and contamination of rinse waters may be reduced by controlling the viscosity of plating solutions. Wetting agents will reduce drag-out loss by as much as 50%. Positioning of the workpieces on the rack, the workpiece withdrawal and maintenance and design of racks and barrels can all affect the drag-out. The recovery of plating bath chemicals by a grain board, drip tank, fog rinsing or a drag-out tank is recommended. Rinse water recycling or the use of multiple rinse tanks can reduce the amount of water use and water treatment costs. Cost evaluations for rinsing recovery schemes for Ni, Cr and cyanide Zn plating systems are given. Procedures and a case study for the initial plant assessment to reduce plating industry pollution are outlined.
W85-04929

CONTROL AND TREATMENT TECHNOLOGY FOR THE METAL FINISHING INDUSTRY. ION EXCHANGE.
Industrial Environmental Research Lab.-Cincinnati, OH.
Report EPA 625/8-81-007, Summary Report, June 1981. 46 p, 26 Fig, 22 Tab, 19 Ref.

Descriptors: *Ion exchange, *Metal-finishing wastes, *Industrial wastes, *Wastewater treatment, *Recycling, *Industrial wastewater, *Separation techniques, *Cost analysis, Wastewater renovation, Waste recovery, Wastewater management, Anion exchange, Cation exchange, Metals, Heavy metals, Performance evaluation, Wash water, Water reuse.

Ion exchange process theory is reviewed and evaluated in three major areas of application in the metal finishing industry in terms of performance, state of development, cost, and operating reliability. Application of the ion exchange process in a wastewater purification and recycle system will significantly reduce water consumption and the volume of wastewater discharged. Ion exchanged can be used in two different forms for end-of-pipe pollution control; it can polish the effluent from conventional hydroxide precipitation to lower the metal concentration in the discharge, and it can treat wastewaters directly to remove heavy metal and metal cyanide pollutants. In general, ion exchange systems are suitable for chemical recovery applications where the rinse water feed has a relatively dilute concentration of plating chemicals and a relatively low degree of concentration is required for recycle of the concentrate. Ion exchange is well suited for processing corrosive solutions and has been used commercially for recovery of plating chemicals from acid-Cu, acid-Zn, Ni, Sn, Co, and Cr plating baths. Ion exchange has also been used to recover spent acid solutions and to purify plating solutions for longer service life.
W85-04931

BASIC TECHNOLOGY OF THE PULP AND PAPER INDUSTRY AND ITS ENVIRONMENTAL PROTECTION PRACTICES,
Environmental Protection Service, Ottawa (Ontario).
N. McCubbin.
Available from EPS, Environment Canada, Ottawa K1A 1C8, Ontario. Environmental Protection Programs Directorate Training Manual EPS 6-EP-83-1, October 1983. 204 p, 54 Fig, 26 Tab, 28 Ref.

Descriptors: Pulp and paper industry, *Reviews, *Canada, *Pulp wastes, *Wastewater treatment, *Waste disposal, Pulp washing, Environmental protection, Water pollution control, Industrial wastes, Kraft mills, Sulfite liquors, White water, Primary wastewater treatment, Solid wastes, Costs, Tertiary wastewater treatment, Effluents.

The technology of pulp and paper manufacture in Canada is described with particular focus on environmental protection. Pretreatment of mill effluents includes removal of grit, coarse material and debris, neutralization of acid or alkaline wastes, and directing occasional large flows or concentrated streams to spill tanks or basins. Primary effluent treatment processes reduce the biodegradable portion of the dissolved organic constituents. Tertiary treatment of organic constituents also takes place. Tertiary treatment also removes color, odor, taste, toxins, dissolved chemicals and gases, residual suspended solids and biodegradable material. Most mills employ internal sampling and monitoring of effluents in addition to those specified in Pulp and Paper Effluent Regulations. Total effluent treatment costs (primary and secondary) in 1982 for baled pulp, linerboard, newsprint produced through the groundwood sulfite process and newsprint produced through the TMP process were 16 million, 10 million, 20 million, and 12 million dollars, respectively. Disposal of solid wastes must be in accord with regulatory requirements. The sources and control of atmospheric emissions in the pulp and paper mill are also discussed.
W85-04932

STATUS REPORT ON ABATEMENT OF WATER POLLUTION FROM THE CANADIAN PETROLEUM REFINING INDUSTRY - 1980.
Environmental Protection Service, Ottawa (Ontario).
Economic and Technical Review Report No. EPS 3-WP-83-3, March 1983. 35 p, 6 Fig, 10 Tab, 3 Ref, 2 Append.

Descriptors: *Wastewater treatment, *Oil industry, *Regulations, *Oil wastes, *Water pollution control, Canada, Waste disposal, Waste management, Oil, Wastewater disposal, Industrial wastes, Oil refineries, Oil pollution.

This report assesses the state of compliance in 1980 of the Canadian petroleum refining industry with effluent regulations and guidelines to limit pollutant discharges under the Federal Fisheries Act of 1973. Of the 36 operating refineries in Canada at the end of 1980, one had no discharge during the year, five were in compliance 100% of the time, 17 exceeded the discharge limits up to 5% of the time, and 13 exceeded the limits more than 5% of the time. Among the latter 13 refineries, four had treatment provided off-site, and three were treating wastewaters which may be classified as petrochemical effluents with their refinery effluents. The problems encountered in the last six refineries were due to operating difficulties or lack of appropriate treatment facilities. A number of these facilities have undertaken corrective measures. Of all test results required by the regulations and guidelines, 32% were not reported due to discrepancies and deficiencies in municipal and federal requirements and in interpreting guidelines. These problems are being addressed and analytical procedures described in the regulations and guidelines are being updated. A number of Canadian agencies are characterizing refinery effluents for trace organic compounds and determining the fate of these treatment systems.
W85-04940

EFFECTS OF A TEXTILE FACTORY EFFLUENT ON SOIL AND CROP PLANTS,
Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, and A. U. Khan.
Environmental Pollution (Series A), Vol. 37, No. 2, p 131-148, 1985. 7 Tab, 33 Ref.

Descriptors: *Textile mill wastes, *Plant growth, *Soil chemistry, Sodium, Potassium, Calcium, Magnesium, Sodium, Water pollution effects, Wastewater irrigation.

Effluent from a textile factory was characterized and its effect observed at various concentrations (25, 50, 75, and 10%) on soil chemical properties, seed germination and growth of two plants. The effluent was highly alkaline, had considerable amounts of ammonia-N, total P, chlorides, sulfates, Na, Ca and Mg. In the soil, the greatest change caused by the application of the effluent was an increase the organic matter content followed by ammonia-N, K, Na, P, Ca and Mg. Pot soils supporting kidney bean and lady finger (Abelmoschus esculentus) plants irrigated with various effluent concentrations were also analyzed. The concentrations of water soluble salts and other nutrients were lower in the soils supporting these plants compared to soils without plants irrigated with effluent. A gradual increase in the sodium content of both plants was noted with increasing effluent concentrations, the highest values being found in plants grown with undiluted effluent. The concentrations of K, Ca and Mg were highest in the fast growing plants. Seeds sown in soils treated with 100% effluent took the longest time for germination followed by the 75% treatment, whereas no delay was noted in germination with other effluent concentrations. The shoot length, root length, size of leaves, number of leaves and dry weight of

plants for both the crops were maximum in 50% effluent irrigated pot soils followed by 25, 75, and 100% as compared to control. (Baker-IVI)
W85-04945

PURE O2 RETROFIT DOUBLES PLANT'S CAPACITY,
Wiedeman and Singleton, Inc., Atlanta, GA.
K. Duchon, and S. Buchanan.
Water Engineering and Management, Vol. 132, No. 2, p 22-24, February, 1985. 5 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Oxygen, Water pollution control, Wastewater treatment facilities, Oxygen diffusion system, Clarifiers.

Mounting problems at the Boar Tusk Creek Wastewater Treatment Plant in Conyers, Georgia were centered mainly on the need to expand capacity, seemingly without the space to meet that need. A year long upgrade project included the installation of a new oxygen diffusion system. The plant had been operating at a level 50% over its 500,000 gpd design capacity. The 20 year old plant yielded an effluent quality that was consistently 50 mg/l BOD5 and 125 mg/l TSS, both far in excess of contemporary standards. To upgrade the plant required less than a year and most of that time was taken up by construction of two additional final clarifiers and other work, including modifications to the sludge-handling equipment and general plant repairs. (Baker-IVI)
W85-04953

DISPERSION MODEL FOR WASTE STABILIZATION PONDS,
Asian Inst. of Tech., Bangkok (Thailand).
C. Polprasert, and K. K. Bhattarai.
Journal of Environmental Engineering, Vol. 111, No. 1, p 45-59, February, 1985. 5 Fig, 2 Tab, 31 Ref, 1 Append.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Dispersion, Model studies, Mathematical equations, Hydraulic detention time, Kinematic viscosity, Design criteria.

The phenomena occurring in waste stabilization ponds are complex, consisting of the biochemical reaction of algal-bacterial symbiosis and hydraulic flow treatment processes. To be accurate in design and to obtain reliable results, pond design should be based on the respective reactions and processes occurring in them. The partially-mixed or dispersed-flow equation is proposed for use in pond design for organic and bacterial reductions. This equation considers the effects of hydraulic detention time, reaction rate coefficients, and the dispersion factor including short-circuiting, and other hydraulic transport processes which influence the pond's performance. A dispersion prediction formula for ponds is proposed which relates the pond's dispersion factor to the hydraulic detention time, kinematic viscosity, and the pond's geometric shape, i.e., length, width, and depth. The formula and constants proposed should be considered only tentative; they need to be tested with more pond data, including variations in flows, inlet and outlet devices, and wind conditions. A design engineer should first become familiar with the local conditions and situations, before proceeding to design a pond system in that particular location. Field observations of existing or similar ponds, together with experience in pond design, greatly helps in designing an effective and economic pond system. (Moore-IVI)
W85-04966

NITROGENOUS WASTEWATER TREATMENT BY ACTIVATED ALGAE,
Indian Inst. of Tech., Bombay. Dept. of Chemistry.
S. K. Gupta.
Journal of Environmental Engineering, Vol. 111, No. 1, p 61-77, February, 1985. 8 Fig, 3 Tab, 23 Ref, 1 Append.

Descriptors: *Biological wastewater treatment, *Activated algae, *Nitrogen, Wastewater treatment, Bacteria, Algae, Nitrification, Alkalinity, Ammonia, Urea, Industrial wastewater, Fertilizers.

The wastewaters from the nitrogenous fertilizer industry containing a high concentration of ammonia and urea can be detrimental to the receiving bodies of water if discharged without treatment. Of the biological methods, the flocculating algal-bacterial system (activated algae) appears to be the most attractive process for the removal and conservation of nutrients from wastewater in a tropical country like India, where sunlight is available in plenty almost throughout the year. A bench scale biological treatability study by activated algae process was performed with synthetic wastewater containing about 700 mg/l of NH4(+)-N and 400 mg/l of urea. The wastewater could be processed at all nitrogen removal rates. The yield coefficient and decay coefficient for heterotrophic bacteria were 0.06 (COD basis) and 0.019/day (COD basis) respectively. The yield coefficient and decay coefficient for nitrifiers were 0.06 and 0.02/day respectively. NH4(+)-N seemed to inhibit bacteriological growth, as the yield coefficients values were significantly lower. Nitrification was observed at all the nitrogen loadings. Diffusion of NH3 into the atmosphere was the dominant mechanism of nitrogen removal. Recommended design criteria for activated algae treatment of nitrogenous wastewater are solids retention times of 10 to 40 days, hydraulic residence time of about 2-5 days, ammonia removal rates of 0.6/day to 1.8/day, COD removal rates of 0.5/day to 1.6/day, influent alkalinity of about 3,000 mg/l as CaCO3 and pH between 7.5 and 8.5. (Moore-IVI)
W85-04967

RESIDENCE TIME IN STORMWATER DETENTION BASINS,
Syracuse Univ., NY. Dept. of Civil Engineering.
S. J. Nix.
Journal of Environmental Engineering, Vol. 111, No. 1, p 95-100, February, 1985. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Detention reservoirs, *Storm runoff, *Residence time, Wastewater treatment, Mathematical equations, Steady flow, Storm wastewater, Simulation.

Stormwater detention basins act as pollution control devices because they provide time, residence time, for pollutants to settle or decay. The definition of residence time is volume divided by the flow rate which is theoretically applicable only when steady-state conditions prevail as in constant volume and flow rate. Potentially large discrepancies between the theoretical and steady state values of mean residence time are shown under the non-steady conditions found in stormwater detention basins. This occurs because the steady-state definition ignores previous events. The effect of the past, encompassed in the probability density function, is reduced as the inflow hydrographs become less dynamic and approach steady state. Consequently differences between the theoretical and steady state values become less pronounced. The simulation examined shows that a better estimate is obtained if the volume of water in the basin is divided by the average of the inflow and outflow rates. The steady state definition of residence time should be applied only with caution to stormwater detention basins. The steady-state definition is probably a poor indicator of the basin's pollution control capability. (Baker-IVI)
W85-04968

5E. Ultimate Disposal Of Wastes

SEWAGE SLUDGE TREATMENT AND DISPOSAL - THE WAY AHEAD,
T. Calcutt, and J. Moss.
Water Pollution Control, Vol. 83, No. 2, p 163-171, 1984. 2 Fig, 4 Tab.

Descriptors: *Sludge disposal, *Wastewater treatment, *United Kingdom, Ocean dumping, Land disposal, Economic aspects, Wastewater disposal.

The present situation regarding sewage treatment and disposal in the United Kingdom is reviewed. Budget cuts in the wastewater industry have necessitated a new look at the major concerns and issues. One relatively recent development the industry views with some apprehension is the increasing influence of the European Commission on sewage disposal practice through proposals aimed at introducing a degree of harmonization into environmental legislation over the Community. The anxiety centers around fears that these proposals could divert some of the limited financial resources available away from areas of higher priority. Disposal to sea has, for geographical reasons, developed to become an important element in the overall United Kingdom disposal strategy, whereas in other European Economic Community countries more extensive use is made of the landfill option. If sludge disposal at sea from vessels were to be restricted, attention could then be logically focused upon sewage disposal through pipelines. The major issue relating to the use of the sea for the treatment and disposal of waste products revolves around the level of environmental impact which is acceptable. There are two main areas where the wastewater disposal industry needs to focus attention over the next few years. There is a need to ensure that the substantial sums devoted to the treatment and disposal of sewage continue to be used to maximum effect and there is a need to ensure that future environmental policy has a sound scientific basis and provides good environmental value for money. (Baker-IVI)
W85-04455

PROBLEMS ASSOCIATED WITH THE DISPOSAL OF TRADE EFFUENT TO SEWERS - CHARGING AND CONTROL,
Severn-Trent Water Authority (England).
N. Harkness.
Water Pollution Control, Vol. 83, No. 3, p 367-375, 1984. 1 Tab, 17 Ref.

Descriptors: *Wastewater disposal, *Economic aspects, *Industrial wastes, Legislation, Water pollution control.

The opportunity to discharge trade (industrial) effluent to sewers was seen by the United Kingdom Royal Commission on Sewage Disposal at the beginning of the century as a means of reducing the severe effects of industrial effluent pollution by direct discharges to inland rivers. The trade effluent control and charging policies thus seem to be based on concepts formulated at least 70 years ago and on legislation introduced 46 years ago. At the same time, however, the administration of water services has undergone profound changes. Considering the relationship between trade effluent charging and control, charges may be a factor in influencing the loads of organic discharges or even volume of low strength trade effluent but cannot be used as an instrument for such purposes. Setting of trade effluent unit charges appears to be undertaken very much in the processes of setting outer water charges although the individual measurement of trade effluent strengths for charging purposes continues to be associated with control procedures. (Baker-IVI)
W85-04463

CHANGES IN THE EXTRACTABILITIES OF THE HEAVY METALS IN WATER-LOGGED SLUDGE-TREATED SOILS,
Oxford Univ. (England). Soil Science Lab.
P. H. T. Beckett, E. Warr, and P. Brindley.
Water Pollution Control, Vol. 82, No. 1, p 107-113, 1983. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Heavy metals, *Sludge disposal, *Land disposal, Zinc, Copper, Nickel, Lead, Anaerobic conditions, Saturated soils.

The interactions of three contrasting sludges from one treatment works with five contrasting soils were compared over 36 months under anaerobic conditions. The extractabilities of Cu, Ni and Zn in the sludge-treated soils were greater than the extractabilties of the native Cu, Ni, and Zn in soils alone, except for Zn in one soil whose high background level suggested that it was already contaminated. The extractabilities of Ni or Zn from sludge alone were greater than from mixtures of sludges and soils. The extractability of Cu from the

mixtures was comparable to that in sludge alone. Cu extractability increased with the duration of anaerobic storage in nearly every sludge, soil or sludge-soil mixture, except in mixtures with soil 6. Cu extractability tended to be greater in the slightly acid soils and lower in the more organic soils. Ni extractability in sludges alone increased with time and in two cases then fell. In sludge-soil mixtures it showed a very small but consistent decrease, either from the beginning or after a small initial rise. In sludges alone Zn extractability increased a little with time or remained constant. In sludge-soil mixtures it showed little change. For anaerobic conditions, heavy metals in contrasting sludges move towards similar forms of combination on prolonged interaction with soil, which is similar to what occurs under aerobic conditions. Thus it is reasonable to assume that one set of guidelines for disposal on to agricultural land will serve for all normal sludges. (Baker-IVI)
W85-04514

DESTRUCTION OF PATHOGENS AND PARASITES IN SEWAGE SLUDGE BY CHEMICAL MEANS,
North West Water Authority, Warrington (England).
A. F. Godfree, R. Bevins, and F. Jones.
Water Pollution Control, Vol. 82, No. 4, p 471-478, 1983. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Sludge conditioning, *Disinfectants, *Pathogenic bacteria, *Parasites, DF 955, Pathogens, Bacteria, Sludge disposal, Land disposal, Toxicity.

Laboratory and field trials were carried out with a formalin-based compound, DF 955, used to kill pathogens and parasites in sewage sludge. A contact period of not less than 1 hr was necessary to allow the desired kill of bacteria. There was little difference between the rates of kill with 1% or 1.5% DF 955. Field trials were conducted using a 1% (v/v) DF 955 concentration for a 1 hr contact period to determine any practical problems that may exist. No apparent problems were noted in the soil, earthworm population or the covering flora. Immediately following application the earthworm population did fall slightly, but the levels were quickly reestablished. The use of concentrations in excess of 1% resulted in greatly altered earthworm populations and the rapid scorching of all plant species. (Baker-IVI)
W85-04592

AVAILABILITY TO PLANTS OF PHOSPHATE IN SLUDGES PRECIPITATED FROM THE EFFLUENT FROM SEWAGE TREATMENT,
Oxford Univ. (England). Dept. of Agriculture.
M. Kuile, R. E. White, and P. H. T. Beckett.
Water Pollution Control, Vol. 82, No. 4, p 582-589, 1983. 31 Fig, 4 Tab, 16 Ref.

Descriptors: *Sludge disposal, *Phosphates, *Plants, Vegetation, Environmental effects, Iron, Aluminum, Calcium, Sludge drying, Anaerobic treatment, Wastewater treatment.

Batches of Fe-sludge, Al-sludge and lime sludge were prepared by flocculating the effluent from the secondary stage of sewage treatment with Fe2(SO4)3, Al2(SO4)3 and Ca(OH)2 at rates of 45, 40 and 100 mg/l of effluent, respectively. The fresh floc, containing 1-3% dissolved solids was subdivided for use as follows: fresh sludge applied immediately to the test soils; anaerobic sludge kept for 9-11 days in air tight polypropylene containers with glucose added to give a concentration of 5% in the lime sludge which was lower in organic content than the Fe- and Al-sludges; and dried sludge - air dried for 22 days. The three types of sludge were analyzed for organic matter, phosphate, iron and aluminium, calcium carbonate, and pH. When used fresh or after anaerobic storage for about 10 days, the sludges were ranked lime-sludge >> Al-sludge > Fe-sludge. Only the lime sludge showed promise as a P fertilizer. Using Ca(OH)2 as a precipitant also has the advantages of cheapness and producing a good floc. With the exception of Al-sludge on the ironstone soil, drying reduced the effectiveness of all three sludges to < 10% that of MCP. This was probably due to the formation of less soluble and more stable crystalline phosphates on drying and is a serious drawback to the use of these materials as fertilizers as they would have to be dried for ease of handling and transport. In general tertiary sludges would appear to be unsuitable substitutes for soluble P fertilizers under practical farming conditions. (Baker-IVI)
W85-04597

LET THE SEAS DO THE DISPOSAL,
Water Services, Redhill (England).
V. French.
Water Engineering and Management, Vol. 131, No. 13, p 22-24, December, 1984. 3 Fig, 2 Ref.

Descriptors: *Sludge disposal, *Outfalls, *Oceans, Planning, Design criteria, Tunnels, Pipelines, Fate of pollutants, Toxicity, Public health, Environmental effects.

A sludge disposal system should be achieved at the lowest cost without causing risk to public health, harm to living resources, damage to amenities, or restriction on normal activities. Several requirements should be met: no depletion of dissolved oxygen at the dumpsite; no smell that can be detected; rapid dispersion of discharge; no slick at the point of discharge; no settlement of solids on the seabed or the foreshore; and toxic levels that will not affect marine life. To determine the safety of a particular site, hydrodynamic characteristics must be firmly established. The design of the outfall should be such that the plume from one diffuser will not merge with that from its neighbor at any state of the tide. Problems peculiar to the outfall diffuser are the need to maintain a non-depositional or scour velocity in the mainpipe, and the wide range of flows that must be allowed for. In tunneled outfalls where the velocity is low, suspensions such as sand and silt tend to settle and the mixture of seawater and sewage can promote the growth of marine plants. Soil investigation of a possible sea outfall site is essential if disastrous consequences are to be avoided. (Baker-IVI)
W85-04648

THERMAL TREATMENT 'ENERGIZES' SAN MATEO SLUDGE,
Deutsche Akademie der Wissenschaften zu Berlin (German D.R.).
F. Cebalt.
Water Engineering and Management, Vol. 131, No. 13, p 25-27, December, 1984. 3 Fig, 1 Tab.

Descriptors: *Sludge treatment, *Sludge disposal, *Thermal treatment, Heat recovery, Conservation, Energy, Wastewater treatment.

A four year operating experience with a thermal process incorporating waste heat recovery has demonstrated that sludge is indeed a viable source of usable energy at a wastewater treatment plant. The wastewater treatment facility at San Mateo generates over 125,000 gpd of waste solids. Since this plant is hemmed in by heavily populated areas to the north, west, and south and by the Bay to the east, thermal treatment of sludge, followed by waste heat recovery, was incorporated in the design. Sludge is first thickened to 3-5% solids in a gravity thickener. Then it is thermally conditioned in the Zimpro low-pressure wet oxidation unit designed for a maximum throughput of 88 pgm. On two vacuum filters the conditioned sludge dewaters to a cake of 35-45% solids. Then it is fed to a 6 bed multiple hearth furnace. Heat is recovered from furnace off-gases in a waste heat recovery boiler where about 4,000,000 Btu per hr of steam is generated and reused as the heat source for the Simpro unit. Ash, 130 cu yards per month, is hauled to a landfill. Temperatures into the waste heat recovery boiler range from 1060-1325 F and from 550-650 F out of the boiler. (Baker-IVI)
W85-04649

WASTEWATER DISPOSAL AND UTILIZATION IN AGRICULTURE IN POLAND AND HUNGARY,
University of Agriculture, Godollo (Hungary).
L. Vermes, and J. Kutera.
Effluent and Water Treatment Journal, Vol. 24, No. 12, p 465-469, December, 1984. 1 Fig, 6 Tab, 15 Ref.

Descriptors: *Wastewater disposal, *Wastewater irrigation, *Poland, *Hungary, Land application, Water reuse, Agriculture, Wastewater treatment.

Soil-treating systems designed and operated with the necessary professional skill often produce removal efficiencies that are comparable to, or even better than, those attainable in any other type of sewage treatment system and at lower expenditures in energy and money. Case histories from Poland and Hungary are offered. At Wroclaw, Poland about 170,000 cu m of sewage are treated daily on 1050 ha of irrigated fields. The impact of sewage treatment has been evaluated by scientific centers, sanitary and water quality inspectors, based on analyses of the drain effluents, the groundwater below the drainage network, and on the water in drilled wells and the ditches collecting the seepage waters. The pollutants, both organic and mineral in nature, are removed at high efficiency. Sewage irrigation appears to present a realistic option to renew the ground water resources. In Gyula, Hungary, food industry wastewater combined with domestic sewage receive primary mechanical and partial biological treatment, and are then disposed of in the soil at the Gyula town sewage disposal plant, where around 7,000 cu m of sewage are handled daily. After short intermediate storage, the pretreated effluent is pumped through a buried delivery pipe to the ditch network of a poplar plantation where it percolates into the soil. The results of water quality analyses, hydrobiological and bacterial tests show that the sewage is treated efficiently, except for dissolved salts and, in some periods, the bacterial parameters. The system at Kecskemet, Hungary is more complex in that sewage from the town of around 80,000 inhabitants is used on plowed lands and disposed of either on a poplar plantation, or on a filter field. (Baker-IVI)
W85-04664

SEDIMENT DETENTION POND MODEL USING CSTRS MIXING THEORY,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
B. N. Wilson, and B. J. Barfield.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1339-1343, September-October, 1984. 9 Fig, 1 Tab, 4 Ref.

Descriptors: *Sedimentation, *Settling basins, *Sedimentation basins, *Model studies, Basins, Suspended solids, Plug flow models.

Current design techniques that are used to predict the performance of sedimentation ponds are based on plug flow models which do not allow for any mixing between inflow plugs and previously stored water. A detention pond model was developed based on the theory of continuous-flow stirred tank reactors in series (CSTRS). This model allows mixing between inflow plugs and previously stored fluid. Sediment deposition was calculated by conducting a mass balance in eight layers of pond depth. The model predicted the shape of the sedimentgraph quite well and overall the resonse of the sedimentation basin was simulated more accurately by the model than by a plug flow model. (Collier-IVI)
W85-04731

REVOLUTIONARY EXPERIMENTS TURN SLUDGE INTO FUEL,
S. Davey.
Water and Pollution Control, Vol. 122, No. 6, p 10-12, December, 1984. 3 Fig.

Descriptors: *Sludge utilization, *Oil, *Fuel, Sludge drying, Energy conservation.

In many urban cities sludge disposal is a serious problem, accounting for as much as 50% of the total wastewater treatment costs. Researchers have developed a process which converts sewage sludge into oil, having an energy value comparable to diesel fuel, char (a substance resembling lignite

coal) and noncondensible gases. If economically and technically viable at full scale, this process could have important ramifications for areas throughout the world where sludge disposal and energy shortages are serious problems. The process has been successfully demonstrated on both a batch and a continuous laboratory scale system and is said to be much simpler than other techniques. Sludge is first dried to 90-95% solids and then heated for up to thirty minutes in an oxygen-free environment, where it is transformed into oil, char, and noncondensible gases. The process works best with sludges that are contaminated with heavy metals. Researchers believe that catalyzed vapor phase reactions convert organics in the sludge to straight chain hydrocarbons, much like those present in crude oil. (Baker-IVI)
W85-04771

TOXICOLOGIC STUDIES ASSOCIATED WITH THE AGRICULTURAL USE OF MUNICIPAL SEWAGE SLUDGE AND HEALTH EFFECTS AMONG SEWAGE TREATMENT PLANT WORKERS,
New York State Coll. of Veterinary Medicine, Ithaca.
J. G. Babish, G. S. Stoewsand, J. M. S. Kranz, J. N. Boyd, and V. D. Ahrens.
Regulatory Toxicology and Pharmacoloy, Vol. 4, No. 3, p 305-321, September, 1984. 1 Tab, 69 Ref.

Descriptors: *Public health, *Sludge disposal, *Land disposal, Toxicity, Wastewater treatment, Groundwater pollution, Water pollution sources, Metals, Cadmium, Polychlorinated biphenyls, Organic compounds.

The proposed use of municipal sewage sludges as soil amendments on agricultural land involves potential health risks. Sludges may contain toxic heavy metals, synthetic organics, and pathogens. Studies of animals inhabiting sludge-amended soils, or foraging on crops grown on such soils, have shown an increased deposition of cadmium and polychlorinated biphenyls in animal tissues, hepatic microsomal enzyme induction, altered blood profiles, appearance of mutagens in blood and excreta, and lowered feed intake, feed efficiency and milk production. Epidemiological evidence of possible adverse health effects among sewage plant workers exposed to aerosolized pathogens or synthetic organic vapors during wastewater treatment or land spreading of sludge is still inconclusive. Other possible deleterious environmental effects include pollution of groundwater and toxicity to birds consuming worms or insects inhabiting sludge treated soils. A tabular summary of the toxicologic observations in animals (organisms) fed plants grown on sludge amended soils is presented. Current federal sludge management policy is reviewed. (Baker-IVI)
W85-04776

RECOVERY OF SPENT SULFURIC ACID FROM STEEL PICKLING OPERATIONS.
Environmental Research Center, Research Triangle Park, NC.
Technology Transfer Capsule Report. 25 p, 11 Fig, 5 Tab.

Descriptors: *Waste disposal, *Waste recovery, *Recycling, *Wastewater treatment, *Steel industry, *Sulfuric acid, *Cost analysis, Industrial wastes, Comparison studies, Wastewater disposal, Land disposal, Waste management, Wash water, Neutralization, Steel, Acids, Acidic water.

Methods of recovering sulfuric acid from spent pickle liquor are discussed with the aim of allowing small manufacturers to select the treatment technologies best suited for their facilities. Crystallization of Fe salts in pickle liquor can be induced by cooling or evaporating water from the solution. Added water occurs in the pickling process during steel rinsing, the injection of live steam to the pickling solution, and as a result of the reaction of Fe oxide scale with sulfuric acid. A dip and spray system can reduce rinse volume. At pickling capacities above 75,000 tons/yr, acid recovery may be the most economical choice unless a disposal problem exists. For capacities below 50,000 tons/yr, special site conditions will determine the most economical choice. Neutralization appears economical only where ample landfill space is available. Neutralization-oxidation systems offer the possibility for magnetite recovery, but are more expensive than neutralization alone. Iron loss from overpickling should be reduced to decrease investment and operating costs. At about 0.75% Fe loss, acid recovery systems and neutralization systems display about equal energy requirements with more favorable energy savings for acid recovery at higher Fe losses.
W85-04933

UNIFIED ANALYSIS OF THICKENING,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
D. E. Baskin, and M. T. Suidan.
Journal of Environmental Engineering, Vol. 111, No. 1, p 10-26, February, 1985. 13 Fig, 2 Tab, 15 Ref.

Descriptors: *Sludge thickening, *Model studies, Mathematical equations, Settling, Velocity, Sludge treatment, Wastewater treatment.

Two simplified models, originating from more complex existing models, were developed for easier analysis of thickener performance. Each relates zone settling velocity to solids concentraton. The first model applies thickener data to a log-log concept, while the second applies the data to a semilogarithmic mode. Further manipulation of the models resulted in nondimensional relationships between solids flux, underflow velocity and underflow solids concentration. When plotted on a log-log scale, the solution to the dimensionless logarithmic equation is described by a family of straight lines, each having a slope (1-n). A graph of the semilogarithmic model presents a single line. The operational lines represent a simple unified method that may be used to aid in the control of transient conditions as well as in the analysis of steady state behavior of sludge thickeners. (Baker-IVI)
W85-04964

5F. Water Treatment and Quality Alteration

SOME CHARACTERISTICS OF CHEMICAL CRYSTALLIZATION IN WATER PURIFICATION PROCESS,
Moscow State Univ. (USSR). Faculty of Chemistry.
I. V. Melikhov, Z. Vukovic, S. Bacic, and S. Lazic.
Chemical Engineering Science, Vol. 39, No. 12, p 1707-1713, 1984. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Water treatment, *Crystallization, *Chemical crystallization, *Chemical precipitation, Chemical reactions, Nucleation, Barium chloride, Sodium bicarbonate.

Coprecipitation of microimpurities with slightly soluble collectors is a widely used process in water purification. Crystallization was carried out at 298 K under conditions of rapid reagent solution mixing. 50 ml of 0.01 mol/l BaCl2 and Na2CO3 solutions were introduced by means of a mixer into an initially empty crystallizer in which the solution was continuously mixed by a stirrer. Samples were taken periodically and separated into phases by centrifugation; the solid phase was examined under an electron microscope. Crystallization proceeded by the formation of microcrystals which bind into aggregates and eventually take the form of psuedomonocrystals. The second phase of crystallization begins by formation of active centers of primary associate aggregation from four microcrystals. Oriented microcrystal binding with such centers occurs more often than in the course of microcrystal collisions so that centers grow by the mechanism of coagulation growth. The binding frequency practically does not depend on the primary aggegrate and microcrystal size and the secondary aggregates in the course on transformation to pseudomonocrystals behave in an analogous fashion. These psuedomonocrystals do not differ by their outer properties from primary particles which have grown from separate crystallization centers exclusively on account of molecular growth. Actually, each pseudomonocrystal is formed from an average of ten primary microcrystals and represents a secondary form. The possibility of the appearance of secondary, regularly developed forms must be taken into account when interpreting chemical crystallization data. (Collier-IVI)
W85-04409

MAINTENANCE OF DRINKING WATER QUALITY: THE ESSENTIAL DECISIONS,
R. J. Kidson, and D. Morgan.
Water Pollution Control, Vol. 83, No. 1, p 23-30, 1984. 2 Fig, 3 Tab.

Descriptors: *Public health, *Bacteria, *Risks, *Drinking water, Water quality control, Assessments, Water treatment, Maintenance.

A conceptual framework is provided for the assessment of bacterial risk. Recommendations are offered on priorities in the management of water supply systems, including environmental surveillance. The danger of bacteriological contamination of public water supplies can be assessed by considering the underlying environment risks (the indirect risks). The potential hazards facing consumers relate not only to the indirect risks, but also to the bacterial purity of the drinking water (the direct risks). Both indices are useful in establishing the type of treatment required to adequately treat the water and in the case of existing sources, the priority of improvements necessary. Clear lines of communication should be defined for the transfer of significant information between scientific and operational departments, particularly when problems have been identified. A thorough and speedy response in dealing with any problems is of great importance. Levels of disinfection, repair of burst mains, regular maintenance of all treatment equipment and stocking of adequate spares are all essential to the safety of public supplies. Since risks to water can change with time, there is a need to consider environmental activities. It may be appropriate to carry out formal surveys from time to time. (Baker-IVI)
W85-04449

ENHANCE COOLING-WATER REUSE WITH SIDESTREAM SOFTENING,
K. F. Spear, and J. V. Matson.
Power, Vol. 128, No. 12, p 35-40, December, 1984. 5 Fig, 7 Ref.

Descriptors: *Water treatment, *Sidestream softening, *Cooling water, Blowdown, Scaling, Costs, Water softening, Water reuse, Makeup water, Computer models.

Sidestream softening can improve the efficiency of closed-cycle cooling and reduce requirements for blowdown and makeup water. The major application for sidestream treatment is to the high-hardness and/or high-silica waters. The medium- and low-hardness areas of the country also have potential application because of the recycling or concentrating of the makeup water by 20 to 50 times. This means that even a water with only 30-40 ppm total hardness would have a potential of 1500-2000 ppm hardness in the cooling tower, making it a prime candidate for sidestream treatment. Alternative treatments applicable to sidestream treatment include reverse osmosis, ion exchange, softening, and electrodialysis. The economics of sidestream softening are influenced by the cost of makeup water, makeup water quality, cooling-water-inhibitor program, and the effluent treatment costs. The raw water cost should be above 20-30 cents/1000 gal to warrant consideration of the technique. Water that is relatively high in hardness is a good candidate. The big dollar saving is usually in the cost of cooling-water-treatment chemicals. The blowdown contribution to the effluent is eliminated. Thus savings are incurred in operating costs or additional capacity availability. A computer model was developed to compare to economics of sidestream softening with a conventional cooling water system featuring blowdown. (Baker-IVI)

W85-04469

COMPARISON OF CURRENT METHODS OF POLIOVIRUS CONCENTRATION FROM TAP WATER,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
N. Guttman-Bass, T. Hostovsky, M. Lugten, and R. Armon.
Water Research, Vol. 19, No. 1, p 85-88, 1985. 3 Tab, 17 Ref. EPA grants CR-806588-03-2 and CR 806416-01.

Descriptors: *Poliovirus, *Filtration, *Flocculation, *Viruses, Water treatment, Water analysis, Drinking water.

The efficiency of concentration of poliovirus from Jerusalem tap water was investigated for several types of 'electronegatively-charged' and 'electropositively-charged' microporous filters. In addition, the efficiency of organic flocculation as a procedure for reconcentrating poliovirus from filter eluates was investigated. The Balston and Cox filters had similar recovery efficiencies from tap water, with recovery of approx. 90% of the input virus, both after filtration and after organic flocculation. Decreasing the concentration of beef extract in the eluent from 3 to 1% did not negatively influence virus recovery. However, recovery of low virus numbers from large volume samples by Cox filters was variable. Balston filters were used in a series of high volume experiments to test the efficacy of the tentative standard method for virus recovery using a proportioner pump with two additive pumps. The method was inefficient without simple modification, the addition of a second mixing chamber, which increased the virus recovery to an acceptable level. The Zeta Plus electropositively-charged type of filter had a high efficiency of virus recovery in the eluate, but approximately half of the virus was lost during organic flocculation. This may indicate the need for modification of the organic flocculation method when used with filters. (Author's abstract)
W85-04492

COPRECIPITATION OF MICROALGAL BIOMASS WITH CALCIUM AND PHOSPHATE IONS,
Technion - Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
A. Sukenik, W. Schroder, J. Lauer, G. Shelef, and C. J. Soeder.
Water Research, Vol. 19, No. 1, p 127-129, 1985. 3 Fig, 9 Ref.

Descriptors: *Algae, *Calcium, *Phosphates, *Precipitation, Flocculation, Alkalinity, Hydrogen ion concentration.

Algal cultures which tended to flocculate under alkaline conditions were investigated in order to define the flocculating agent. Under the electron microscope, cells appeared to be agglomerated by inorganic 'amorphous' precipitates or rod shaped microcrystals. The use of an energy dispersive X-ray analyser showed that the agglomerating substance consisted of calcium and phosphorus and their atomic ratios varied between 1.07 and 1.34. The experiments suggest that in autoflocculation involving chemical coprecipitation with biomass, calcium phosphate constitutes the major binding agent. The Ca:P ratio in the precipitated calcium phosphate is greatly increased by raising alkaline conditions or increasing precipitation period. (Author's abstract)
W85-04498

STUDY OF WATERWORKS IN THE MANNHEIM/HEIDELBERG URBAN AREA USING THE EXAMPLE OF THE RHEINAU RHE WATERWORKS (WASSERWERKSBETRIEBE IM BALLUNGSRAUM MANNHEIM/HEIDELBERG AM BEISPIEL DES RHE-WASSERWERKES RHEINAU),
Rhein-Neckar Energy and Waterworks Corp., Mannheim (Germany, F.R.).
J. Altnoder.
Wasserwirtschaft, Vol. 74, No. 11, p 523-529, November, 1984. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Water treatment facilities, *Mannheim, *Heidelberg, *Germany (Federal Republic), Drinking water, Groundwater, Activated charcoal, Filtration, Chlorinated hydrocarbons, Iron, Manganese.

The Rhein-Neckar Energy and Waterworks Corporation (RHE) supplies 30 cu hm/yr drinking water for 350,000 inhabitants of the Mannheim/Heidelberg area (Federal Republic of Germany) from its four groundwater works - the main facilities at Kafertal (K) and Rheinau, (R) and the Seckenheim (S) and Ilvesheim subsidiary works, which began operating in 1888, 1927, 1962, and 1974, respectively. Ground-water found in Neckar sediments is of prime importance for drinking water since it is iron- and manganese-free. Geohydrological and human influences have made it necessary to treat groundwater at K, R, and S: at K, iron and manganese are removed in an open high-speed filter with surface aeration; and at R and S, chlorinated hydrocarbons (CHC) are removed by activated charcoal. All four waterworks are automated. Since summer 1980, the upper groundwater conductor of the right-Rhine Rhine-Neckar area has been polluted by CHC, and this has affected the R waterworks. This led to the construction of an activated-charcoal filter facility with a capacity of about 3,000 cu m/hr. The filters are in two layers. Water flows through from top to bottom, so that the upper layer is filled with CHC faster; this layer can then be removed and replaced separately from the cleaner lower layer. The facility has reduced CHC content in drinking water to 5 mg/cu m. In 1983, a high-speed decarbonization facility was installed at R for water softening. (Gish-IVI)
W85-04626

FILTER FOAM - PERFECT IN MANY FIELDS (FILTERSCHAUM - PERFEKT IN VIELEN BEREICHEN),
H. J. Ochs.
Wasser, Luft und Betrieb, Vol. 28, No. 10, p 43-46, October, 1984. 5 Fig, 2 Tab, 2 Ref.

Descriptors: *Filters, *Foam filters, Resistance, Flow structure, Permeability, Separation surface, Storage capacity.

Filter layers constructed from foam have been used increasingly in recent years in the water industry. The difference between filters made of foam and those constructed from glass or synthetic fiber is that the latter have heterogenous form and labile structure, while the former have homogeneous form and stable structure. Foam in this sense is defined as a material built of synthetic chains of macromolecules originating from a polyaddition of monomers that is formed into a preconceived three-dimensional shape and solidified. It has closed pores and exhibits irregular pore-web relationships. A special reticulation procedure corrects this by creating open pores of predetermined size that in their spatial relationship with the web approximate ideal conditions. Present technology can produce a foam with optimal permeability, separation surface, flow structure, and frequency of deflection. A second component, in addition to flow, affecting separation is structure; in this case, effectiveness increases with the depth of the permeated filter layer, through increasing the number of particles separated out and through increasing the mass of separated particles up to the saturation point (storage capacity). As filter depth (and density) increases, flow resistance and pressure difference also become greater. The filter layer should be changed when the pressure difference ceases to rise (i.e., when the limit of particle absorption is reached). (Gish-IVI)
W85-04632

GROUND-WATER CONTAMINATION AND WELL CONSTRUCTION IN SOUTHEAST NEBRASKA,
Nebraska Univ., Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 5B.
W85-04637

OPTIMIZATION OF SAND RECYCLE RATE IN MOBILE BED FILTRATION,
Asian Inst. of Tech., Bangkok (Thailand).
S. Vigneswaran, C. Visvanathan, and R. B. Aim.
Effluent and Water Treatment Journal, Vol. 24, No. 12, p 457-460, December, 1984. 4 Fig, 2 Tab, 6 Ref.

Descriptors: *Water treatment, *Sand recycling rate, *Mobile bed filtration, Optimization, Filtration, Sand filters,.

The bed clogging problem during contact flocculation filtration has led to the development of mobile bed filters. This type of filter arrangement is designed so that filter grains from the bottom layer are recycled to the top of the bed using an air-lift system. Here the recycled filter grains are washed continuously. Mobile bed deep filter experiments suggest that the compressed air used to lift the sand also helped in the separation of retained particles in the sand. For each filtration velocity there is an optimum sand recycle rate which gives rise to a high removal efficiency. Experiments performed with two different filtration velocities indicate that the optimum sand recycle rate increases with an increase in the filtration rate. The concentration profile decreases with time in the initial stages of mobile bed filtration and remains constant once it has reached the steady state. In theory, the steady state correponds to one cycle time of sand recycle. The optimum sand recycle rate in mobile bed filters for low filtration velocities can be successfully calculated from the clogging front theory with a limited number of laboratory scale fixed bed experiments. (Baker-IVI)
W85-04663

ACID RAIN: DOUSING COMMUNITY RESOURCES,
K. Anderberg.
American City and County, Vol. 100, No. 2, p 38, 42-44, 49, February, 1985. 2 Fig.

Descriptors: *Acid rain, *Water pollution control, *Corrosivity, *Water conveyance, Emissions, Sulfur, Water pollution sources, Air pollution, Water treatment.

While almost everyone agrees that there is a problem regarding acid rain, the differences occur in whether to implement control measures now, or wait for several more years of study to be completed. Most observers are convinced that coal-burning power plants are the major contributors to the problem. In the West, large smelter operations are also identified as sources. Usually, the areas affected are far removed from the actual source. Northeastern states have perhaps the greatest concern about acid precipitation's effect on water quality, since water distribution systems in this region often have been in place for decades and lead piping is far from uncommon. Combined with the historically corrosive nature of the region's water sources and the low buffering capacity of the soil, acid precipitation is cited by many experts as an added burden impacting water quality. The challenge to water system operators focuses on the corrosive water's effect on the distribution system. Treatment can be very expensive, but must be addressed. Only 25% of the water systems in New England currently treat water for corrosivity. The most effective method of protecting consumers from corrosive water and associated contaminants is through corrosion control at the treatment plant. Large-scale plans for sulfur emission control still seem to be a long way off. (Baker-IVI)
W85-04750

CONTROL OF SUSPENDED SOLIDS IN OPEN COOLING WATER SYSTEMS,
J. A. Buchanan.
Water, Sewage and Effluent (Johannesburg), Vol. 9, p 11-16, 1982.

Descriptors: *South Africa, *Cooling water, *Slipstream filtration, *Suspended solids, Dusts, Water circulation, Water treatment, Filtration, Cooling towers.

The control of suspended matter in the circulating water system of cooling towers is discussed. In South Africa, particularly on the Reef, most open cooling water systems experience solids pick up via the cooling tower from the dry dusty environment and, consequently, most industrial cooling towers have been provided with slipstream filtration units. The three main advantages to be gained by the application of slipstream filtration are: 20-50% saving in the amount of chemicals required to maintain the circulating water in the correct chemical condition; almost eliminates the need to shut down the plant to defoul the heat exchange equipment; and increases the overall efficiency of the plant by maximizing the heat transfer efficiencies of the heat exchange equipment. The objective of the slipstream filtration plant is to remove the suspended solids which accumulate in the circulating cooling water and to maintain these solids at an acceptable value. The sizing of slipstream filters is based on a mass balance rather than a water balance across the water recirculating system. The filter must be designed to remove on a continuous basis the same amount of insoluble solids which are entering the system via the tower and the make up water stream. The selection of the right type of filter is also important to achieve the full benefits of slipstream filtration, the two most important properties required by the filter being a high dirt holding capacity and a non-blinding characteristic. (Baker-IVI)
W85-04820

NITRATE CONTAMINATION: PUBLIC AWARENESS,
New York State Coll. of Human Ecology, Ithaca. Dept. of Design and Environmental Analysis.
A. T. Lemley, J. Fessenden-Raden, C. A. Bisogni, and J. M. Holway.
Journal of the American Water Works Association, Vol. 77, No. 2, p p 34-39, February, 1985. 2 Fig, 7 Tab, 3 Ref.

Descriptors: *Nitrates, *Drinking water, *Clifton Springs, *New York, Public opinion, Water treatment, Surveys, Public participation.

The public water supply of Clifton Springs, New York, has had nitrate levels greater than the state mandated maximum contaminant level of 10 mg/L for some time. In 1978 the customers were notified of the problem by mail and in 1981 a citizen's action committee was formed to secure public cooperation in solving the problem. A survey was instituted to assess the effectiveness of notification in influencing public knowledge of the water problem; the public's concerns about water quality and the extent of the public's willingness to pay to correct the problem. Ninety-nine percent of the repondents said they had read of the nitrate problem - some in the letter mailed to their homes, others in newspapers. While the people in general were positive about the quality of their community water supply, all who were willing to pay at least a substantial increase over the present water rates wanted the water to meet exceedingly high standards. The majority of the respondents had no current concerns about the nitrate situation. It is recommended that, in addition to notification through the mail and the formation of citizens' advisory committees, any groups at special risk should be targeted to receive special information and education for future similar problems. (Baker-IVI)
W85-04828

GIARDIA LAMBLIA AND WATER SUPPLY,
Illinois State Water Survey, Peoria. Water Quality Section.
S. D. Lin.
Journal of the American Water Works Association, Vol. 77, No. 2, p 40-47, February, 1985. 5 Fig, 1 Tab, 71 Ref.

Descriptors: *Public health, *Disinfection, *Giardia, Drinking water, Water pollution effects, Water treatment, Pathogenic protozoa, Water analysis, Chlorination, Filtration, Ultraviolet radiation.

The most common waterborne disease in the United States is giardiasis. The morphology and life cycle of the causative agent, Giardia lamblia, the detection of Giardia and the effectiveness of water treatment processes in removing it, and the epidemiology and clinical aspects of giardiasis are discussed. The method of detecting G. lamblia cysts in water includes concentration, separation, and microscopic examination of the cysts. The water sample is filtered aseptically through a Giardia-sampling device. Outbreaks of giardiasis usually involve small municipal water systems or semi-public water systems in recreational areas. There is no evidence that such outbreaks occur in well operated systems with conventional or adequate treatment processes. Most outbreaks result from consumption of untreated surface water or surface water treated with chlorine disinfection alone. Chlorine disinfection with normal dosage and contact time is insufficient to destroy G. lamblia cysts. High dosages and longer contact times are required in water treatment systems in which sedimentation and filtration cannot be employed. Ultraviolet radiation has been considered as a potential alternative to chlorine for disinfection in small systems. However, this method is not sufficient. Disinfectants which have been studied include water sterilizing tablets, Globaline tablets, EDWGT, 2% tincture of iodine, saturated iodine, and bleach. Results of tests with these chemicals are included. The use of filtration is also discussed. (Baker-IVI)
W85-04829

CAUSES OF A WATERBORNE GIARDIASIS OUTBREAK,
Environmental Protection Agency, Denver, CO. Region VIII.
T. E. Braidech, and R. J. Karlin.
Journal of the American Water Works Association, Vol. 77, No. 2, p 48-51, February, 1985. 2 Fig, 13 Ref.

Descriptors: *Drinking water, *Water treatment, *Public health, *Giardiasis, *Colorado, Maintenance, Filter beds, Contamination, Chlorination, Disinfection.

A waterborne giardiasis outbreak occurred within the Highlands Water and Sanitation District in Colorado in November of 1981. While the immediate cause of the outbreak was reduced chlorine contact time due to a pump failure, numerous design and operational deficiencies existed at the plant. These included lack of chemical pretreatment, improper backwashing procedures, poor application of raw water to the filter, and failure to monitor plant conditions. The best alternative for eliminating the potential for outbreaks of giardiasis is to adhere to the multiple barrier concept in treating water. Specifically, this should include chemical addition for coagulation-flocculation, sedimentation, and filtration followed by disinfection. Systems in which the raw water turbidity is generally less than 1 ntu year round have tended to eliminate chemical additives for coagulation flocculation, which may place those served by the system in jeopardy. Further, operation and maintenance programs are commonly inadequate in small systems, particularly with regard to the condition of the filter bed. (Baker-IVI)
W85-04830

REMOVING GIARDIA CYSTS WITH SLOW SAND FILTRATION,
CH2M Hill, Newport Beach, CA.
W. D. Bellamy, G. P. Silverman, D. W. Hendricks, and G. S. Logsdon.
Journal of the American Water Works Association, Vol. 77, No. 2, p 52-60, February, 1985. 9 Fig, 3 Tab, 24 Ref.

Descriptors: *Water treatment, *Drinking water, *Sand filters, *Giardia, Public health, Coliforms, Bacteria, Filtration,.

Pilot plant studies were undertaken to determine the efficiency of slow rate sand filters in removing Giardia cysts and other substances. Giardia cyst removal exceeded 98% for all operating conditions tested. Once a microbiological population is established within the sand bed, removal will be virtually 100%. Coliform removal exceeded 99% and even with new sand was 85%. Removal of standard plate count bacteria and particles ranged from 88 to 91%. Turbidity removal averaged from 27 to 39%. The removal of Giardia cysts, coliform bacteria, standard plate count bacteria, and turbidity declines as the hydraulic loading rate increases. Even at 0.40 m/h, the removal of Giardia cysts and coliform bacteria was high, 99.98 to 99.01%. There was no discernible change in the effectiveness of the filter during short-term reductions in temperature from 15 to 5 C. The effluent concentrations of coliform bacteria and of standard plate count bacteria increase as influent concentration increases. Slow rate sand filtration appears an effective water treatment technology. It is passive in nature, requires little action on the part of the operator, and therefore should be the ideal method for small systems. (Baker-IVI)
W85-04831

EVALUATING SEDIMENTATION AND VARIOUS FILTER MEDIA FOR REMOVAL OF GIARDIA CYSTS,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
G. S. Logsdon, V. C. Thurman, E. S. Frindt, and J. G. Stoecker.
Journal of the American Water Works Association, Vol. 77, No. 2, p 61-66, February, 1985. 12 Fig, 8 Tab, 11 Ref.

Descriptors: *Sedimentation, *Filtration, *Water treatment, *Drinking water, *Giardia, Turbidity, Pilot plants, Public health, Disinfection, Anthracite filters.

The primary purpose of the pilot study described was to evaluate the efficiency of sedimentation and of coarse anthracite media for removing Giardia cysts. Removal of cysts by sedimentation ranged from 65 to 93% and was generally similar to percentage removals of turbidity. The concentration of Giardia cysts was influenced by relatively small turbidity changes (0.2 to 0.3 ntu), increasing greatly as turbidity increased. The coarse anthracite media generally produced water of inferior quality when the bed depths of all filters were similar. Use of high molecular weight, slightly anionic polymer improved the performance of the anthracite filter but made backwashing more difficult. Because cyst concentrations may be higher than usual during the first portion of a filter run (just after backwashing), operators should consider a filter to waste period when a new run is begun. Effective control of Giardia cysts depends on informed application of the multiple-barrier concept. Adequate disinfection is absolutely essential. (Baker-IVI)
W85-04832

REMOVAL OF NEW INDICATORS BY COAGULATION AND FILTRATION,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, B. F. Severin, D. Roy, R. S. Engelbrecht, and A. Lalchandani.
Journal of the American Water Works Association, Vol. 77, No. 2, p 67-71, February, 1985. 5 Fig, 3 Tab, 12 Ref.

Descriptors: *Coagulation, *Filtration, *Water treatment, *Indicator organisms, Disinfection, Yeasts, Coliforms, Acid-fast organisms, Sand filters, Turbidity.

The removal of yeasts and acid-fast organisms by chemical coagulation and rapid-rate sand filtration was compared in laboratory studies with that of the currently accepted group of indicator organisms, total coliforms. The objective was to ascertain the expected removals of indicator organisms when coagulation-flocculation or filtration, or both, are used prior to disinfection. With few exceptions, removals of all indicator organisms by coagulation-flocculation range from 1-2 log units. Among the three indicator groups, there was generally less than a 1-log unit of difference between the removals for each group at optimum conditions for turbidity removal, and when differences existed, the coliform organisms were generally more

readily removed. With sand filtration, removals of the acid-fast and coliform groups of organisms are essentially identical. The yeast organisms are more readily removed in the filtration column. Except for the case of yeast removal by rapid-rate sand filtration, it appears that coagulation-flocculation and filtration as commonly practiced result in removing acid-fast and yeast organisms at an efficiency that is less than, or equivalent to, the removal of total coliform organisms. (Baker-IVI)
W85-04833

BACTERIAL COLONIZATION OF POINT-OF-USE WATER TREATMENT DEVICES,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
E. E. Geldreich, R. H. Taylor, J. C. Blannon, and D. J. Reasoner.
Journal of the American Water Works Association, Vol. 77, No. 2, p 72-80, February, 1985. 3 Fig, 7 Tab, 26 Ref.

Descriptors: *Drinking water, *Bacteria, *Filtration, Carbon filters, Public health, Coliforms, Water treatment, Pathogenic bacteria.

Point-of-use water treatment devices were investigated to identify organisms that may colonize filters, to determing the magnitude of the postcolonization release of microorganisms into the product water during daily use or after periods of nonuse, and to demonstrate the effect of tap water of marginal bacteriological quality on the quality of the product water. Bacterial colonization occurred in three types of point-of-use carbon filters that are designed to be installed on the cold water line under the sink in the home. Treatment devices that use carbon impregnated paper filters provided favorable habitats for colonization and release of organisms into the product water and bacterial density increases with the length of cartridge service. A changing flora of gram-negative organisms colonized the test units for periods ranging from one to ten months. After a six week period of nonuse, significantly increased bacterial densities were noted in samples taken after an initial flush of a few seconds, with a return to lower densities after several cycles of normal water use. Of the challenge organisms tested, Pseudomonas aeruginosa proved to be the most tenacious, persisting for more than 150 days. While some opportunistic pathogens grew in the carbon filters, the concentration of such organisms released in the product water did not approach the level considered to be infective for a health compromised consumer. The carbon filter treatment devices tested did not provide an effective barrier against Salmonella typhimurium or Escherichia coli, strains of which may be enterotoxigenic. (Baker-IVI)
W85-04834

INFLUENCE OF SUSPENDED PARTICLE SIZE DISTRIBUTION IN DEEP-BED FILTRATION,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
S. Vigneswaran, and R. Ben Aim.
AIChE Journal, Vol. 31, No. 2, p 321-324, February, 1985. 8 Fig, 2 Tab, 4 Ref.

Descriptors: *Suspended solids, *Filtration, *Particle size, *Water treatment, Model studies, Mathematical models, Particle collectors.

Laboratory scale filter experiments were performed using artificial suspension of pollen grains of different sizes. The concentration was measured in terms of number of particles of a particular size per unit volume using a Coulter counter. The first series of experiments was carried out with monodimensional suspensions. The removal efficiency was found to increase with the increase in particle size in the range considered. The role of coarser particles in the removal efficiency of finer particles when they are together in the suspension was studied in a simple case of bidimensional particles in the suspension. As the ratio of coarser particles to finer particles increased, the removal efficiency of finer particles also increased. This effect is more prominent at higher filtration rates. This result confirms the concept of particle collectors. Although this study was performed for a simple case of bidimensional particles in suspension, the experimental observations and the theoretical formulations could be extended to suspensions of particles in a wide range of sizes. (Baker-IVI)
W85-04876

LEACHING OF TETRACHLOROETHYLENE FROM VINYL-LINED PIPE,
Stanford Univ., CA. Dept. of Civil Engineering.
A. H. Demond.
Journal of Environmental Engineering, Vo. 111, No. 1, p 1-9, February, 1985. 3 Fig, 12 Ref.

Descriptors: *Water quality control, *Water distribution, *Pipelines, *Leaching, *Tetrachloroethylene, Drinking water, Water quality.

Tetrachloroethylene (perchloroethylene, or PCE) was used as a solvent for Piccotex, a vinyl-toluene methyl styrene co-polymer, which was then sprayed on the interior of finished asbestos cement pipe. A total of about 1050 miles of pipe were installed before a PCE contamination problem was discovered in water from the pipes. The movement of PCE through Piccotex can be described by the diffusion equation with a concentration dependent diffusion coefficient. Extrapolation of the laboratory drying curves to zero concentration yielded an estimate of the total drying time under idealized laboratory conditions of 1,250 days. Use of this drying time to predict a problem lifetime in the field is difficult. There may exist large differences not only between the laboratory and field environment, but also between individual pipelines in the field. An analysis of some of the differences between the laboratory condition and the field situation supports the conclusion that the leaching of PCE in the field may continue over a longer time period than in the laboratory. (Baker-IVI)
W85-04963

TIME SERIES MODELS FOR TREATMENT OF SURFACE WATERS,
New Hampshire Univ., Durham.
P. J. Ossenbruggen.
Journal of Environmental Engineering, Vol. 111, No. 1, p 27-44, February, 1985. 5 Fig, 6 Tab, 7 Ref, 3 Append.

Descriptors: *Surface waters, *Water treatment, *Model studies, *Time series analysis, Color, Alum, Forecasting, Chemical treatment, Seasonal variation, Probabilistic process.

The use of probability models derived from a long-term (30 yr) color record forms an approach of forecasting raw water color and assigning an alum dose for treatment of surface waters. Three probabilistic models are developed which incorporate the uncertainties associated with forecasting raw water color and alum dose. These forecasts are based upon the risk or probability associated with underdosing. The effect of seasonal and daily color variation is incorporated into one time series model. In the other time series model, daily color variation is considered exclusively. All models are compared for treatment performance. The methods of model identification, parameter estimation, and forecasting are presented for each model. The results indicate that the two time series models are feasible methods because they lead to the judicious use of alum without excessive overdosing. (Author's abstract)
W85-04965

5G. Water Quality Control

DEVELOPMENT AND USE OF A THEORETICAL MATHEMATICAL MODEL FOR THE MEDWAY ESTUARY,
Southampton Water Authority (England).
For primary bibliographic entry see Field 2L.
W85-04450

EVALUATION OF EUTROPHICATION IMPACT IN PUBLIC WATER SUPPLY RESERVOIRS IN EAST ANGLIA,
For primary bibliographic entry see Field 5C.
W85-04451

POLLUTION CONTROL IN THE HUMBER ESTUARY,
Severn-Trent Water Authority (England).
G. M. Woodward.
Water Pollution Control, Vol. 83, No. 1, p 82-90, 1984. 4 Fig, 3 Tab, 2 Ref.

Descriptors: *Humber Estuary, *Water pollution control, *England, Yorkshire, River Trent, River Humber, Estuaries, Suspended solids, Biochemical oxygen demand.

The Humber Estuary is a major estuary extending 62 km from the confluence of the River Ouse and the River Trent to the North Sea. The catchment area draining to the Humber is the largest of any estuary in the United Kingdom with a drainage area covering 27,000 sq km. The estuary is used extensively as a shipping waterway, as a minor commercial fishery and supports some water based amenity, primarily angling and sailing. The most serious pollution problem in the Humber Estuary is the depletion of dissolved oxygen in the area around Trent Falls. The worst conditions occur during periods of low river flow and warm weather when long lengths of the tidal River Ouse may be almost completely deoxygenated. This problem will not be solved until the polluted Yorkshire rivers achieve their river quality objectives and several of the major direct discharges are brought under control following the implementation of the Control of Pollution Act 1974. (Baker-IVI)
W85-04453

HEALTH AND AMENITY ASPECTS OF SURFACE WATERS,
F. Jones, and W. R. White.
Water Pollution Control, Vol. 83, No. 2, p 215-225, 1984. 1 Fig, 2 Tab, 42 Ref.

Descriptors: *Public health, *Water quality control, *Surface waters, *United Kingdom, Wastewater disposal, Bacteria, Fecal coliforms, Disinfection.

The requirements to maintain and improve water quality and to implement European Economic Community directives places considerable responsibility upon the water industry in the United Kingdom. Water quality is generally determined by measuring and interpreting traditional scientific parameters, and by the aquatic life it supports. Monitoring which produces water quality data assists in decisions on suitability for use and determines whether the surface water is conforming to environmental quality standards. Since no inland surface waters have been nominated in Britain for bathing purposes, only those intended for the abstraction and consumption of drinking water will be subject to legally imposed microbiological standards. It is likely that those responsible for medical, veterinary, and environmental health will look to the enumeration of fecal indicator bacteria as a means of assessing health risks posed by polluted surface waters. If, as a result, such officers decide that health risks are unacceptable they have the power to condemn the use of such water for drinking or recreational purposes until remedial measures have been taken. It is possible that Water Authorities will be expected to make improvements to surface water quality, or examine and alter many of their, and industries' activities, where these produce unacceptable conditions. In some circumstances disinfection of unsatisfactory discharges may have to be resorted to. Such developments have obvious implications for Water Authorities. They may be forced to re-examine their capital programs in a new light and reassess their strategies for monitoring, analysis, data collection and interpretation. (Baker-IVI)
W85-04457

LEA MARSTON PURIFICATION LAKE: OPERATIONAL AND RIVER-QUALITY ASPECTS,
Severn-Trent Water Authority (England).

D. R. Woods, M. B. Green, and R. C. Parish.
Water Pollution Control, Vol. 83, No. 2, p 226-242, 1984. 9 Fig, 7 Tab, 6 Ref.

Descriptors: *Tame River, *England, *Lea Marston Purification Lake, *Purification, *Water quality control, Monitoring, Heavy metals, Sludge disposal, Suspended solids, Biochemical oxygen demand.

The problem of high pollution load in the Tame River under normal flow conditions and the grossly polluting effects of heavy rainfall high in the catchment led to plans for a series of purification lakes to improve river quality. The first lake in the system became operational in July 1980. In flood conditions a considerable quantity and variety of waste material dumped along the river banks is picked up and conveyed to the Lea Marston site. The importance of an effective debris barrier on a river draining an urban area is demonstrated. The Mudcat dredger is an effective tool for removal of sludge; however, additional work is needed with different dredging patterns and an investigation of the effects of sludge consolidation and digestion on the lake bottom are needed to determine the most cost-effective mode of operation with least risk of sludge solids being resuspended. It is strongly recommended for systems being planned elsewhere that long term disposal arrangements for the dredged material be secured before a lake is commissioned. The sludge removed is unsuitable for agricultural disposal. The lake has proved capable of removing a large proportion of the suspended solids and associated BOD loads swept forward during the storm conditions, thus protecting the river downstream. (Baker-IVI)
W85-04458

DESIGN AND OPERATION OF THE PURIFICATION LAKES IN THE RUHR VALLEY,
K. R. Imhoff.
Water Pollution Control, Vol. 83, No. 2, p 243-253, 1984. 9 Fig, 5 Tab, 19 Ref.

Descriptors: *Ruhr Valley, *Germany (Federal Republic), *Purification lakes, *Water quality control, Rivers, Water quality control, Costs, Phosphorus, Wastewater treatment, Storm wastewater.

In the Ruhr valley five purification lakes are successfully operated to improve river water quality, to diminish the residual pollution of sewage-treatment plants, storm-sewage overflows and non-point sources at comparatively low cost. The purification capacity of Lake Baldeney is for instance in the order of 100,000 BOD population equivalents. Its operational cost is only one third and, adding the cost of desludging, two thirds, of the cost of one sewage-treatment plant of the same capacity. In reality, perhaps ten tertiary-treatment steps would have to be added to existing biological plants and be operated at a much higher expenditure to reach the same result. The efficiency of the other lakes can be assumed in proportion to their relative size. Because of the high phosphorus content of the water, uncontrolled mass development of algae may endanger the oxygen balance of the river and the treatment capacity of the water works. Purification lakes therefore should be designed with not more than two days' retention time at low flow. The same rule is applied to polishing lagoons but in this case the volume preferably should be split up into several units with a water depth between 1 and 2 m. With regard to phosphorus, a strategy has been developed to lower the phosphorus concentration in the River Ruhr by simultaneous precipitation of phosphates in the activated-sludge tanks of the treatment plants. The purification lakes store a considerable amount of water of good quality which dilutes shock loads like storm-sewage discharges. In the middle and lower Ruhr consequently no fish kill has been caused by such sources. (Baker-IVI)
W85-04459

WATER RECLAMATION AND RIVER MANAGEMENT IN THE TAME BASIN,
Severn-Trent Water Authority (England).
M. H. Box.
Water Pollution Control, Vol. 83, No. 2, p 254-264, 1984. 4 Fig, 11 Ref.

Descriptors: *Tame Basin, *England, *River management, Water quality control, Purification lakes, Flood control, Wastewater treatment facilities, Sewers.

The River Tame has been neglected. The need to reverse the pollution and strangling of the river by industrial development and its attendant population was seen 60 years ago. Far-seeing engineers worked out proposals to correct that state of affairs, but little was done as the political will and organizations necessary to tackle the work had not then been found and national recognition of the importance of clean rivers was needed before finance was made available. The water authorities created in 1974 have the powers to tackle river pollution and management problems as a whole. In the Tame Basin a scheme has been undertaken which shows major benefits and cost savings over the various approaches adopted independently by predecessor authorities. This has only been achieved by constant pressure to ensure that the needs of the West Midlands conurbation were not neglected in the face of all the other diverse calls on the attention of such a large authority. The scheme will involve the improvement of sewage treatment works, the construction of a purification lake, the construction of 45 km of sewers, and flood control measures. (Baker-IVI)
W85-04460

INVESTIGATION INTO THE HYDRAULIC RESOURCES OF A LAGOON IN PORTUGAL,
Consultores de Engenharia Sanitaria Lda., Lisbon (Portugal).
M. C. Bailey, and J. Q. Levy.
Water Pollution Control, Vol. 83, No. 3, p 327-339, 1984. 5 Fig, 6 Tab.

Descriptors: *Lagoons, *Portugal, *Lagoa de Obidos, Water quality control, Water management, Decision making, Planning, Coastal waters, Sedimentation, Eutrophication, Water pollution effects.

The Lagoa de Obidos is a natural lagoon, principally saline, which is located 85 km north of Lisbon on the Atlantic western coast of Portugal. It has a maximum surface area of about 6 sq km and is separated from the sea by a substantial sand bar, containing a gap through which sea water passes on each tide. The lagoon is important as a recreational and holiday retreat for many Portugese people. The lagoon is suffering from problems which are effectively reducing its life and amenity value. These problems include silt, which is being carried by the rivers to the lagoon and is settling and reducing the volume of water in the upper reaches; a net transport of sand from the sea into the lagoon at the downstream end where large sand-banks are being established; and pollution and eutrophication problems. Three master plans are defined for solving or controlling each of the problems. Priorities are addressed and recommendations made for the staged implementation of the solutions. (Baker-IVI)
W85-04461

LARGE-SCALE FIELD EXPERIMENT IN THE CONTROL OF EUTROPHICATION IN THE NORFOLK BROADS,
G. L. Phillips.
Water Pollution Control, Vol. 83, No. 3, p 400-408, 1984. 7 Fig, 2 Tab, 9 Ref.

Descriptors: *Water quality control, *Eutrophication, *Norfolk Broads, *England, River Ant, Barton Broad, Phosphous removal, Wastewater treatment facilities, Industrial wastewater, Phytoplankton.

The installation of phosphorus removal at all significant sewage-treament works and industrial discharges in the River Ant catchment has reduced the phosphorus load to Barton Broad by about 60%. A significant amount of this may be resuspended particulate phosphorus due to boat activity, and it is not known if this is available to algae. Phosphorus concentration in Barton Broad during winter and early spring is about 0.1 mg/l total P, the target established at the onset of the experiment. Phosphorus is released from the sediment in Barton Broad during the summer and this can enable large phytoplankton populations to develop. At present there is no evidence that without further intervention submerged aquatic plant populations will be re-established. (Baker-IVI)
W85-04465

BIOLOGICAL CONSIDERATIONS IN THE SETTING OF QUALITY STANDARDS FOR THE TIDAL THAMES,
Thames Water Authority (England). Northern Div.
M. J. Andrews, J. E. C. Steel, and A. G. Cockburn.
Water Pollution Control, Vol. 82, No. 1, p 52-60, 1983. 1 Fig, 4 Tab, 46 Ref.

Descriptors: *Water quality standards, *Thames River, *England, Estuarine environment, Dissolved oxygen, Fish, Invertebrates, Water quality control, Tidal waters.

Guidelines have been described for setting biological standards of estuary quality applicable to the Thames, which are related to the dissolved oxygen regime that may be present. It should be noted that under conditions of pollution amelioration, fish, being generally much more mobile will recover more quickly than sedentary benthic macroinvertebrates. The mobile invertebrates (for example shrimp, prawns and crabs) will recolonize at a rate intermediate between that of fish and sedentary macroinvertebrates. Care should be taken when assessing dissimilar rivers and geographical distribution of species and natural levels of potential contaminants must be considered. It is up to those with river management responsibility to decide what community structure they consider acceptable in their rivers and they must take into account the cost of bringing rivers to, or maintaining them at, a particular standard. (Baker-IVI)
W85-04509

INDUSTRIAL EFFLUENT CONTROL IN THE NETHERLANDS AND LEGISLATION IN THIS FIELD IN SOME OTHER EUROPEAN COUNTRIES,
Water Authority Hollandse Eilanden en Waarden, The Netherlands.
H. A. Meijer.
Water Pollution Control, Vol. 82, No. 2, p 213-226, 1983. 1 Fig, 6 Tab, 1 Ref.

Descriptors: *Water pollution control, *Industrial wastes, *Legislation, *Netherlands, Water quality control, Regulations, Economic aspects, Pricing.

The Netherlands is one of the most densely inhabited countries in the world with a population of 14 million in an area of 37,000 sq km. The thirty regional water quality agencies are not only in charge of the discharge licensing policy, but are also concerned with building and operating sewage-treatment plants for towns and villages. The Pollution of Surface Water Act features two main points. Every discharge of waste water into a surface water is subject to a discharge license from the manager of the receiving water. The water quality manager may stipulate conditions concerning the quality and quantity of the effluent to be discharged. The Act stipulates that each discharger of waste water into surface water or a sewer has to pay a pollution levy. The decentralized approach to implementation of the Pollution of Surface Waters Act brings some measures of variety in its wake and therefore a sound co-ordination policy is of prime importance. Summaries are given of recommendations concerning restriction of discharges on non-oxygen-consuming and toxic substances from existing processes in the metal industry; recommendations concerning limitation of discharges of non-oxygen-consuming and toxic substances from formulating pesticides; and recommendations concerning limitation of discharges of non-oxygen-consuming and toxic substances from paint, lacquer and printing ink manufacturers. Results of remedial actions undertaken by industries are presented. (Baker-IVI)

W85-04520

POLLUTION CONTROL POLICIES FOR THE TEES ESTUARY,
Northumbrian Water Authority, Gosforth (England).
J. A. Brady, R. G. Stead, and W. O. Ord.
Water Pollution Control, Vol. 82, No. 3, p 367-380, 1983. 3 Fig, 6 Tab, 21 Ref.

Descriptors: *Water pollution control, *Tees Estuary, *England, Public policy, Estuaries, River Tees, Legal aspects, Water quality, Water quality control, Fish migration, Salmonids, Wastewater treatment.

The River Tees rises at Cross Fell in the Pennines, 893 m above sea level, and flows for some 160 km to the North Sea. Tees-side has a population in excess of 400,000 and is a major industrial development area with port facilities. Water quality targets for the Tees Estuary were developed. The first target area was to be the removal of gross nuisance, including odor and visual nuisance. Water quality in the upper Tees catchment was sufficient to support the initial development of young salmonids, but the second target was to upgrade estuarial quality to support the young fish when they migrate to the open sea. The third quality target area was to upgrade estuary quality at all times, not just when migratory fish were passing through. Relevant water quality parameters included water temperature, ammoniacal nitrogen, cyanide and phenols, and heavy metals. Modeling studies and targets considered include the relationship between depth-averaged and near surface concentrations, effluent loads to achieve targets, and fish migration. The construction of the Portrack primary treatment works to be completed will give partial achievement of the first target by removing odor nuisance by 1985. Regular monitoring of the estuary water quality is to begin and continue to enable conditions under which the second target could be achieved to be understood with greater accuracy. (Baker-IVI)
W85-04525

POLLUTION MANAGEMENT AND THE TIDAL THAMES,
Thames Water Authority (England). Northern Div.
P. J. Lloyd, and A. G. Cockburn.
Water Pollution Control, Vol. 82, No. 3, p 392-401, 1983. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Water pollution control, *Environmental effects, *Thames River, *England, *Tidal waters, Estuaries, Nutrients, Dissolved oxygen.

A method of pollution management is demonstrated which allows for the interaction of several discharges. In tidal waters there is a complex interaction between discharges as the to and fro movement of the water can cause discharge to have effects both upstream and downstream of the point of entry to the estuary. There are several critical points along the course of a river where, for either physical conditions or the location of discharges, the river will tend to show the maximum effect of discharges in relation to quality control objectives. Monitoring at these points will ensure correct knowledge of the condition of the river as a whole. Where a critical point is due to the cumulative effect of a number of discharges then the available capacity at this point could be regarded as a pollution budget which could be equitably allocated according to the need of a discharge. In controlling a cumulative critical point a discharge may not be able to utilize available capacity upstream. The maximum effect of a discharge, as measured by dissolved oxygen (DO) deficit produced, occurs close to the point of discharge. The management of the critical point is carried out such that for discharges of the same load but at different locations, those nearer the seaward end will be able to discharge a greater load. The Thames River Estuary is taken as an example of an estuary where a policy for the regulation of DO by the setting of consent standards is in the process of being implemented. (Baker-IVI)
W85-04527

EFFICIENCY OF LIMING IN ACID, HUMUS-INFLUENCED LAKES,
Norwegian Liming Project, Arendal.
D. Hongve, and H. Abrahamsen.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 700-703, October, 1984. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Acid lakes, *Liming, *Humus, Organic matter, Iron, Aluminum, Calcium, Limestone, Lake sediments, Lake restoration.

Experiments were devised to quantify the effects of humus in water using a small mesohumic lake. The dry sediment of the lake is about 50% organic, the other 50% is mainly iron and aluminum compounds. Mean depth is 2.4 m and theoretical residential time is 0.28 year. The lake was dosed with limestone flour in June 1981 at a rate of 60 g/cu m, of which 34% dissolved instantaneously and 10% during the following month. Then a period followed when calcium disappeared from the water. The loss was attributed to loading of the sediment with dissolved calcium. After two water renewals 46% of the lime had benefited the water quality. After 15 months and four water renewals 65% of the lime dose was used. The polyhumic lake studied has a mean depth of 3.5 m and theoretical residence time of 0.76 years. Lime dose in March of 1981 was 1.0 kg/cu m. Less than 10% dissolved during the first two weeks after icebreak. Thirty-six percent have been used during two water renewals. The natural calcium concentration in these lakes is 1-2 mg/l. After liming the concentration has stabilized for long periods at 4-5 mg/l. The final efficiency in these whole scale liming experiments seems to be as good or better than what can be expected for lake liming. It will be necessary to not only investigate water chemistry, but also to measure base saturation and capacity for ionic exchange in the sediments. (Baker-IVI)
W85-04533

SHORT-TERM EFFECTS OF LIMING ON SEDIMENT OXYGEN UPTAKE IN AN ACID LAKE,
Lund Univ. (Sweden). Limnological Inst.
G. Gahnstrom.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 760-764, October, 1984. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Liming, *Acid lakes, *Oxygen, *Lake sediments, *Lake Gardsjon, *Sweden, Bacteria, Lake restoration, Vegetation, Phytoplankton, Environmental effects.

The objectives of this liming program are to restore acidified freshwaters and to prevent further acidification of freshwaters that are of special importance to fishing and nature conservation. The studied area is situated on the Swedish west coast, 50 km northeast of Goteborg. Sediment was sampled in three lakes in the area, Lakes Gardsjon, Stora Hastevatten and Gaffeln. After liming of Lake Gardsjon, the pH of the overlying water and surface sediments was increased by 2-4 pH units. In May of 1982, two weeks after liming, sediment oxygen uptake decreased 10-40% at all sampling sites in the lake and remained at this lower level at the June sampling, 6 weeks after liming. The initial decrease in sediment oxygen uptake in Gardsjon after liming is most probably due to the drastic change in water chemistry brought about by the addition of calcium carbonate. The increase in sediment oxygen uptake in Gardsjon occurring 3-4 months after liming was probably mediated by an increased supply of organic matter to the sediments from decaying benthic vegetation and increased phytoplankton biomass. Much of the Sphagnum-mats and benthic algae occurring over 90% of the lake bottom was killed after liming. The low pH and high metal content of surface sediment after liming may explain why there was no increase in sediment bacterial populations. Changes in the structure of the microbial community due to increased pH may increase the ability of the microbial community to utilize organic matter stored in the sediments, thus increasing sediment oxygen uptake. (Baker-IVI)
W85-04537

ACIDIFIED LAKES: ECOSYSTEM RESPONSE FOLOWING SEDIMENT TREATMENT WITH SODIUM CARBONATE,
Lund Univ. (Sweden). Limnological Inst.
G. K. Lindmark.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 772-779, October, 1984. 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Acid lakes, *Lake sediments, *Liming, *Sodium carbonate, *Lake Lilla Galtsjon, *Sweden, Lake restoration, Acidification, Acid deposition, Neutralization, Environmental effects, Aquatic life.

Lake Lilla Galtsjon is a small forest lake in southeastern Sweden with a water retention time of about 3.5 years. The lake has become acidified due to acid deposition. In October of 1980 a 10% solution of sodium carbonate, formed by dissolving 40 tons of water free sodium carbonate in lake water, was injected into the sediment by a harrow-like device. The treated area was 25% of the total lake area and the addition was 5.1 eq of base/sq m lake surface. Before treatment Lake Lilla Galtsjon was a typical soft-water acid-damaged lake with pH varying between 4.8 and 5.3. After treament no extremely high pH values were recorded in the water, but values were appropriate to lake biota. During summer stratification the deep hypolimnetic water becomes anoxic. The resulting sulfate reduction causes temporarily elevated pH and bicarbonate generation. No oxygen depletion was observed during winter stratification. The improvement of lake water alkalinity after treatment was ideal. During the stratification periods the diffusion of bicarbonate and sodium ions from the sediment becomes obvious; a salinity gradient develops in the hypolimnetic water column. The short-term results were positive. Lake water quality improved to the desired level. Lake biota responded with a recovery in algal species diversity, in fish reproduction and in distribution of isoetides in the littoral zone and other factors. With respect to the sodium base in the sediment, losses to deeper sediment layers were unavoidable in this experiment. (Baker-IVI)
W85-04539

LOOSDRECHT LAKES RESTORATION PROJECT, AN INTRODUCTION,
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2H.
W85-04544

LOOSDRECHT LAKES RESTORATION PROJECT: HYDROLOGY AND PHYSICO-CHEMICAL CHARACTERISTICS OF THE LAKES,
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
For primary bibliographic entry see Field 2H.
W85-04545

LOOSDRECHT LAKES RESTORATION PROJECT: SEDIMENT PHOSPHORUS DISTRIBUTION AND RELEASE FROM THE SEDIMENTS,
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2K.
W85-04546

EFFECTS OF INTERNAL MEASURES IN BALDEGGERSEE: FORCED-CIRCULATION AND OXYGENATION OF THE HYPOLIMNION (DIE AUSWIRKUNGEN VON INTERNEN MASSNAHMEN IM BALDEGGERSEE: ZWANGSZIRRKULATION UND SAUERSTOFFBEGASUNG DES HYPOLIMNIONS),
Luzern Kantolales Amt fuer Gewasserschultz (Switzerland).
P. Stadelmann, T. Joller, and D. Imboden.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1052-1065, October, 1984. 8 Fig, 4 Tab, 12 Ref.

Descriptors: *Baldeggersee, *Switzerland, *Eutrophic lakes, *Lakes, *Oxygenation, *Destratifica-

tion, Meromictic lakes, Aeration, Dissolved oxygen, Ammonium, Sulfur, Methane, Iron.

With phosphorus concentrations of 300 mg P/cu m and primary production rates of about 400 g C/sq m/year the Baldeggersee (Switzerland) is highly eutrophic. The lake is meromictic and shows also during winter time below 40 to 66 m anoxic conditions. In 1976, 11.3 tons phosphorus entered the lake, while the critical P-loading is 2 tons per year. Since the P-loading can be decreased by external measure only to about 6 tons per year, the lake was restored by means of destratification and oxygenation of the hypolimnion. In winter 1982 the lake was destratified by bubbling compressed air in a depth of 60 m (200 m cu m/h). Within two weeks the whole lake circulated and for a first time since 1958, 4 mg O2/l could be measured down to 66 m. In summer 1982 the technical device for oxygenation of the hypolimnion with small bubbles of pure oxygen gas was tested. Starting from May 1983, 4.5 tons O2 per day were successfully brought into the hypolimnion. The reduced substances (NH4(+), S(2-), CH4, Fe(2+)) disappeared and the anoxic conditions changed to aerobic ones. The six oxygen diffusors were placed at depths of 40 to 60 m and no extremely high oxygen concentrations were observed, indicating a good horizontal and vertical transport of oxygen. By means of artificial destratification in winter and oxygenation of the hypolimnion in summer the deep Baldeggersee exhibited again aerobic conditions. Any apparent toxicity for fish could not be detected either through chemical measurements (O2 oversaturation, N2, NO2) or by observation of the biota. (Author's abstract)
W85-04559

LINEAR PROGRAMMING MODEL FOR THE CONTROL OF COMBINED SEWER SYSTEMS WITH OFF-LINE STORAGE FACILITIES,
California Univ., Davis. Dept. of Civil Engineering.
G. G. Patry.
Canadian Water Resources Journal, Vol. 8, No. 1, p 83-105, 1983. 4 Fig, 5 Tab, 17 Ref. Natural Sciences and Engineering Research Council of Canada grant A-1005.

Descriptors: *Computer models, *Combined sewer overflows, *Storm Water, *Water storage, Model studies, Storage, Overflow, Impact assessment.

Effective and economical measures to control the impacts of storm related pollution are difficult to achieve; overflows from combined sewer systems occur at the junction of combined sewer collectors and the sanitary sewer interceptor. Real-time control of these sewer networks is of increasing interest in the overall pollution control management program. Under reactive (or local) control decision variables are evaluated at every time step based solely on the status of the system at that particular time. The adaptive (or predictive) level of control is based on the sequential and systematic updating of storm inflow forecasts as new information on the storm event is being gathered through an automated data aquisition system. While minimizing the impact on receiving waters is the most desirable objective function, it is by far the most difficult to achieve. Three levels of action are involved: forecast, optimization, and impact assessment. A model was developed which relies on runoff predictive capabilities to minimize the impacts on the receiving waters from combined sewer outflows. The model handles time and spatial sensitivity of the receiving waters as well as off-line storage facilities. Variations in the rates of runoff from different storm patterns have a significant influence on the value of the objective function for any specific set of coefficients and available levels for off-line storage. The overflow and storage patterns for each of the events simulated are quite different from each other and can only be predicted through the use of an optimization scheme. Use of the model for real-time applications is presently underway. (Collier-IVI)
W85-04576

METHODOLOGY FOR POLLUTION CONTROL DECISION ANALYSIS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, and G. Zukovs.
Canadian Water Resources Journal, Vol. 8, No. 2, p 64-87, 1983. 3 Fig, 7 Tab, 14 Ref.

Descriptors: *Pollution control, *Decision making, Administrative decisions, Impacts, Financial aspects, Evaluation, Alternative planning.

The implementation of pollution control alternatives results in potentially very diverse impacts. Some of these impacts are quantifiable in monetary terms whereas others are non-commensurate. For many situations, a number of sources may be contributing, different types of contaminants may be exceeding water quality guidelines, and the violations may occur under different circumstances. Many decision-makers, with individual biases, must implement measures to resolve a problem. A two-stage matrix methodology is developed for use in the selection of pollution control strategies. The initial state is a cursory or screening assessment level used to identify whether additional study is needed. The second stage includes the determination of the various alternatives for pollution control on a set of evaluation criteria. Dominance testing is used to select the best alternative. The methodology is relatively straightforward in application with the principal advantages being that it is applicable to a wide array of problems and provides a structure for organizing the information into a logical progression towards alternative selection. (Moore-IVI)
W85-04582

TREATMENT OF FERRUGINOUS GROUND WATER FROM AN ABANDONED COLLIERY,
For primary bibliographic entry see Field 5D.
W85-04596

SYSTEM OF PRACTICES FOR PREVENTING WATER BY AGRICULTURAL CHEMICALS,
Ukrainian Research Inst. of Forestry and Agriculture, Ivanovo-Frankovsk (USSR).
P. S. Pasternak, N. N. Prikhod'ko, Yu. D. Matukhno, and V. P. Landin.
Soviet Soil Science, Vol. 16, No. 2, p 131-136, March-April, 1984. 2 Tab, 13 Ref. Translated from Agrokhimiya, No. 3, p 61-65, 1984.

Descriptors: *Water pollution control, *Agricultural chemicals, *Shelterbreaks, Soil erosion, Agricultural watersheds, Agricultural runoff, Surface runoff, Drainage basins.

The pollution of water by agricultural chemicals and products of soil erosion is a function of surface runoff, which is the principal route by which fertilizers and pesticides reach lakes and streams. The principles for effectively protecting water against pollution are reduced to the following: minimizing the concentrations of agricultural chemicals in runoff; and decreasing the volume of surface runoff from the fields reaching water sources. A leading role in protecting bodies of water is assigned to a system of shelterbelts in drainage basins. A system of shelterbelts in a drainage basin is based on the contour organization of the area and constitutes the framework within which other measures to regulate and purify surface runoff in the drainage basin are coordinated. The result is an agricultural landscape with a contour-strip structure. The introduction of water protection systems into drainage basins is at present the most effective and least expensive technical solution to the problem of preventing the pollution of bodies of water by agricultural chemicals and soil erosion products. (Moore-IVI)
W85-04619

LONG-TERM GROUNDWATER PROTECTION WITH PLASTIC LININGS (LANGFRISTIGER GRUNDWASSERSCHUTZ MIT KUNSTSTOFF-DICHTUNGSBAHNEN),
Beratender Ingenieur fur Kunststofftechnik im Bauwesen. Schwerpunkt: Wasserbau, Grundwasserschutz, Erd- und Grundbau.
F. W. Knipschild.
Wasser, Luft und Betrieb, Vol. 28, No. 10, p 64-69, October, 1984. 1 Tab, 17 Ref.

Descriptors: *Linings, *Landfills, *Water pollution prevention, Groundwater pollution, Plastics, Waste disposal, Plastics, Materials engineering.

The behavior of plastic linings used to protect groundwater from pollution originating in trash and garbage dumps can be influenced over the long term by the passage of time, high temperatures, chemical composition of the dump, and weather. Hard PVC has significantly greater tensile strength than the partially crystalline polyethylene HDPE up to 60 C but is unusable at higher temperatures, whereas HDPE can be used up to 100 C. Tests of mechanical influences over time can take the form of isochronous stress-strain lines, creep graphs, and relaxation graphs; temperature can be incorporated into these charts to provide profiles for up to 50 yr for various materials. Linings must remain functional for the time span of the dump, but assessment of their long-term behavior is difficult because the exact composition of percolating water cannot be predicted, and mechanical influences can only be determined through detailed knowledge of subterranean conditions. For preliminary assessment, tests in which the sealing material is immersed in a fluid resembling the percolating water to determine weight changes and alterations in short-term mechanical characteristics are sufficient. An HDPE sealant may last 30 yr. HDPE is also suitable for use with hydrocarbons, since tests have shown that changes in HDPE caused by these are reversible. Experiments on HDPE-sealants resistance to weathering have led to the estimation of a 20-yr life span in central Europe. (Gish-IVI)
W85-04633

BIOMANIPULATION EXPERIMENT IN GREEN LAKE, SEATTLE, WASHINGTON,
Washington Univ., Seattle. Dept. of Civil Engineering.
J. A. Goad.
Archiv fur Hydrobiologie, Vol. 102, No. 2, p 137-153, December, 1984. 5 Fig, 2 Tab, 29 Ref.

Descriptors: *Biomanipulation, *Green Lake, *Seattle, *Washington, *Algae control, *Water quality, Fish, Algae growth, Planktivors, Cyanophyta, Trout, Perch, Phytoplankton, Zooplankton.

Biomanipulation was investigated as a method for reduction of algal blooms in Green Lake. Water quality problems occur during the summer when blooms of blue-green algae (Gloeotrichia, Anabaena, and Aphanizomenon) form in the lake; this period coincides with the greatest recreational use of the lake. The effects of two types of planktivorous fish, young-of-the-year perch and 120 mm long rainbow trout, on the zooplankton and phytoplankton communities were examined using three enclosures containing fish and one enclosure without fish. The enclosures containing fish had less zooplankton (as much as an 80% reduction), greater concentrations of chlorophyll (as much as a 160% increase), and alterations in the composition of both zooplankton and phytoplankton populations. The enclosure without fish had a higher abundance of zooplankton and generally a lower phytoplankton biomass. The results of the manipulations varied according to the stocking rate and the type of fish in the enclosures. The highest density of perch (1500 kg/ha) showed the greatest effect. Feeding activity of the trout was probably affected by temperature stress and lack of ability of the hatchery-raised fish to feed in natural conditions. Assuming the conditions in the enclosures were somewhat representative of conditions in the lake, biomanipulation is a feasible approach to the restoration of Green Lake if conducted with discretion. (Collier-IVI)
W85-04671

GROUNDWATER QUALITY PROTECTION: THE ISSUE IN PERSPECTIVE,
Robert S. Kerr Environmental Research Lab., Ada, OK.
C. W. Hall.
Environmental Professional, Vol. 6, No. 1, p 46-51,

1984. 12 Ref.

Descriptors: *Groundwater contamination, *Water quality management, *Environmental protection, Legislation, Research priorities, Fate of pollutants.

An effective program for groundwater protection must include not only a workable legal framework for administration, but also a sound scientific understanding of the occurrence and movement of groundwater and the behavior of contaminants in the subsurface environment. The legislative basis for developing and implementing broad groundwater quality protection programs exists, although it is dispersed in a variety of pieces of legislation. Such programs presuppose the existence of the scientific knowledge necessary to produce viable and effective results from its implementation. The processes that govern the behavior of pollutants in the subsurface can be divided for research purposes into the major areas of hydrologic, abiotic, and biotic. These processes will act to influence: the movement of water; the physical and chemical interactions that will cause pollutants to move at rates different from those of the water; and chemical or microbial alterations that will remove pollutants from the subsurface or render them into insoluble constituents at the surface matrix. The elucidation of the importance and magnitude of the various mechanisms functioning in the three process areas will ultimately provide the knowledge to integrate the influences of these processes into a singular understanding of pollutant behavior in the subsurface. Research under each of these process areas is organized into a series of tasks focusing on methods development, subsurface characterization, pollutant attenuation, process kinetics, field application, and mathematical model development and application. Expanded knowledge of pollutant behavior in the subsurface environment is fundamental if we are to take effective action to prevent or limit groundwater pollution or to rehabilitate already contaminated systems. (Collier-IVI)
W85-04683

IMPORTANCE OF SAMPLE DISCRIMINATION IN USING THE TRAVEL COST METHOD TO ESTIMATE THE BENEFITS OF IMPROVED WATER QUALITY,
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6B.
W85-04753

WATER UTILITY IN THE NUCLEAR AGE,
For primary bibliographic entry see Field 5B.
W85-04773

EUTROPHICATION CONTROL AND THE FALLACY OF NITROGEN REMOVAL,
Maryland Dept. of Health and Mental Hygiene, Baltimore. Office of Environmental Programs.
A. P. Sincero.
Pollution Engineering, Vol. 16, No. 11, p 33-36, November, 1984. 2 Fig.

Descriptors: *Nitrogen removal, *Eutrophication, *Water quality control, Nitrogen cycle, Nutrients, Nitrogen fixation, Microorganisms, Phosphorus.

To better understand the use of nitrogen by microorganisms, the nitrogen cycle and the concept of the limiting nutrient are described. With these ideas in mind, the advisability of removing either phosphorus, nitrogen, or both nutrients in order to combat eutrophication is considered. Literature abounds with proof that organisms fix nitrogen both in salt and fresh waters. In the absence of NH4(+), NO2(-), and NO3(-), which are needed for protein synthesis, N2 from the air can be fixed to produce NH4(+). As a result the removal of nitrogen to control eutrophication would be a wrong approach. Since P is a spare part in the makeup of living bodies, and since its absence will prevent the synthesis of bone, controlling phosphorus is the only sufficient condition to control eutrophication, assuming all other factors remain constant. (Baker-IVI)
W85-04774

ACID DEPOSITION CONTROL, A BENEFIT-COST ANALYSIS: ITS PROSPECTS AND LIMITS,
Wyoming Univ., Laramie. Dept. of Economics.
For primary bibliographic entry see Field 6B.
W85-04798

RESPONSES OF SOCKEYE SALMON (ONCORHYNCHUS NERKA) TO FERTILIZATION OF BRITISH COLUMBIA COASTAL LAKES,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
For primary bibliographic entry see Field 8I.
W85-04847

PHYTOPLANKTON RESPONSES TO REDUCTION AND ELIMINATION OF SUBMERGED VEGETATION BY HERBICIDES AND GRASS CARP IN FOUR FLORIDA LAKES,
Rollins Coll., Winter Park, FL. Dept. of Biology.
D. I. Richard, J. W. Small, Jr., and J. A. Osborne.
Aquatic Botany, Vol. 20, No. 3/4, p 307-319, December, 1984. 1 Fig, 3 Tab, 41 Ref.

Descriptors: *Phytoplankton, *Aquatic weed control, *Florida, Clear Lake, Little Lake Fairview, Lake Orienta, Lake Mann, Submerged plants, Herbicides, Grass carp, Lake restoration, Macrophytes, Aquatic plants, Cyanophyta, Diatoms, Biomass.

Four central Florida lakes were monitored for 3 years to determine the effects of macrophyte reduction and elimination by grass carp and herbicide on phytoplankton populations. Clear Lake, in which grass carp were stocked after a year of baseline studies, had all macrophytes eliminated within 14 months. The density of phytoplankton increased significantly from an initial 24-month mean of 165 000 cells/l to a mean level of 787 900 cells/l in the third year. In Little Lake Fairview, stocked with grass carp in both the first and third years of study, vegetation was not eliminated until the 34th month. Phytoplankton density increased significantly from a 24-month mean of 64 200 cells/l to a mean of 370 200 cells/l in the third year. Lake Orienta, stocked with grass carp in the first year, had all vegetation eliminated within 6 months. Phytoplankton abundance did not change significantly over the course of the study (mean: 2700 000 cells/l). Lake Mann was treated with herbicide alone after an initial year of baseline data collection. Submerged vegetation was reduced in the second year but increased to near initial biomass levels in Year 3, with Nitella sp. replacing Hydrilla verticillata (L.f.) Royle as the dominant macrophyte. No significant yearly changes were noted in density of phytoplankton in this lake. Lake Orienta was the only lake in which the number of phytoplankton species collected differed significantly between years. Cyanophytes (notably species of Anacystis, Microcystis and Anabaena) and the diatom, Fragilaria sp., predominated in all lakes as macrophytes were removed. Most changes observed were in the direction of apparent increased trophic state. Major shifts in the phytoplankton assemblage (e.g., Shannon diversity indices and abundance) coincided with periods of maximal fluctuation in vegetation. Reversals of these tendencies were observed during prolonged stable periods of both high and low macrophyte biomass. (Author's abstract)
W85-04857

CHANGES IN THE OXYGEN BALANCE OF A POLLUTED BROOK-POND SYSTEM DURING AN AERATION EXPERIMENT (VERANDERINGEN IN DE ZUURSTOFBALANS VAN EEN BEVUILD BEEK-VIJVERWATER GEDURENDE EEN AERATIE-EXPERIMENT),
Rijksuniversitair Centrum te Antwerpen (Belgium).
L. Maes.
Natuurwetenschappelijk Tijdschrift, Vol. 65, No. 1-3, p 52-74, January-June, 1983. 3 Fig, 7 Tab, 19 Ref.

Descriptors: *Water quality, *Aeration, *Streams, *Ponds, Biochemical oxygen demand, Chemical oxygen demand, Dissolved oxygen, Water pollution control, Organic matter.

A brook-pond system, polluted with domestic sewage, was aerated by the EVENS technique (previously called Phallus technique). During 3 years the evolution of oxygen concentration, of biochemical oxygen demand (BOD), of chemical oxygen demand (COD) and of oxygen producing capacity (OPP) was studied. In the overall change brought about by the aeration process, a direct and an indirect effect can be distinguished. In the aeration basin a strong reduction of BOD and COD takes place (direct effect). By this rapid removal of the organic load, a gradual recovery of the self-purification can take place. An important factor in self-purification is the increasing oxygen producing capacity of the water downstream (indirect effect). (Author's abstract)
W85-04889

CHANGES OF ORGANIC AND INORGANIC NITROGEN IN A POLLUTED BROOK-POND SYSTEM DURING AN AERATION EXPERIMENT (VERANDERINGEN IN DE ORGANISCHE EN ANORGANISCHE STIKSTOF VAN EEN BEVUILD BEEK-VIJVERWATER GEDURENDE EEN AERATIE-EXPERIMENT),
Rijksuniversitair Centrum te Antwerpen (Belgium).
L. Maes.
Natuurwetenschappelijk Tijdschrift, Vol. 65, No. 5, p 127-144, September-October, 1983. 3 Fig, 5 Tab, 13 Ref.

Descriptors: *Nitrogen, *Aeration, *Brooks, *Ponds, *Water pollution control, Organic nitrogen, Ammonia, Nitrites, Nitrates, Organic matter.

A brook-pond system, polluted with organic waste, was aerated by the EVENS techniques based on the principle of the water jet vacuum pump. During 3 years the evolution of ammonia, nitrite, nitrate and organic nitrogen was studied. In the aeration basin the decrease of ammonia and organic nitrogen was concomitant with the increase of nitrite and nitrate. In the downstream ponds a further decline of ammonia and organic nitrogen content was measured, but the nitrification process remained limited. From the aeration basin through the downstream sampling stations a gradual decrease in total N-concentration (NH4-N + NO2-N + NO3-N + org. N) was found. (Author's abstract)
W85-04890

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

MAINTENANCE OF DRINKING WATER QUALITY: THE ESSENTIAL DECISIONS,
For primary bibliographic entry see Field 5F.
W85-04449

RIVER BASIN PLANNING: PROBLEMS, OPPORTUNITIES AND IMPLICATIONS FOR ONTARIO CONSERVATION AUTHORITIES,
Waterloo Univ. (Ontario). Dept. of Geography.
B. Mitchell.
Canadian Water Resources Journal, Vol. 8, No. 1, p 1-20, 1983. 38 Ref.

Descriptors: *River basins, *Planning, *Ontario, *Watersheds, *Water resources development, River basin development, Mangement planning, Regional planning, Comprehensive planning.

Watershed or river basin planning is falling into disrepute because of a frequent failure to translate plans into action. Two strategic and two operational reasons account for this disenchantment. At a strategic level, it appears that comprehensive plans may not be required for all basins and adequate institutional arrangements do not exist to facilitate coordination of management functions and activities during both planning and implementation. At an operational level, thought is required regarding the implications of both longer and shorter periods

of time for watershed planning and implementation. Also, recommendations often are too numerous, ambiguous or abstract to help implementing agencies and thus frustrate the implementation process. Examples of these problems are presented from river basin management experiences across Canada. Their implications are reviewed for the ongoing development of watershed plans by each of the thirty-nine Ontario Conservation Authorities. While the drainage basin provides a sensible framework for planning, there should be flexibility to plan at other scales, depending upon the nature of the problems to be resolved. (Collier-IVI)
W85-04572

APPLES AND ORANGES: TOWARD A CRITIQUE OF PUBLIC PARTICIPATION IN GREAT LAKES DECISIONS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
A. P. Grima, and R. J. Mason.
Canadian Water Resources Journal, Vol. 8, No. 1, p 22-50, 1983. 2 Fig, 1 Tab, 48 Ref.

Descriptors: *Public participation, *Great Lakes, *Social participation, *Planning, Policy making, Public policy, Water quality management, Water resources development, Land use.

Better monitoring systems and public demands for rehabilitative action are focussing attention on the increasing stresses to the resources of the Great Lakes; consequently, the demand for public involvement in shaping the future of the Great Lakes will increase. Public participation covers a middle ground of all activities by individual citizens or groups attempting to influence public decisions. Effective lobbying and participation are desirable in order to ensure that as many competing views as possible are heard by the few elected or appointed policy makers. Within the strict terms of the 'market' democracy, public participation is justified in order to allow competition by as many interests as possible; biases should be identified and corrected to the extent possible. The state of the art does not permit development of a systematic prescription for evaluating participation programs, but this should not preclude a rigorous approach to the assessment of individual programs. Most attempts to develop a coherent framework for the evaluation of participation programs have incorporated the agency perspective on evaluation. Evaluations should consist of a carefully structured set of questions which have been formulated on the basis of the broad political considerations which are to be addressed. A case study evalution was made of the PLUARG (Pollution from Land Use Activities Group) public involvement program. As part of the PLUARG study, 17 public consultation panels (8 Canadian, 9 American) were established in 1977 to assist the Reference Group in determining practicable management strategies for control of pollution resulting from land use practices. The program was evaluated in terms of effectiveness, representatives of participants, interest of participants, public input to the final report, timing and accountability of the process. The analysis points to the risk of self-serving evaluations and to the need for ongoing and independent evaluations of public involvement programs. (Collier-IVI)
W85-04573

LINEAR PROGRAMMING MODEL FOR THE CONTROL OF COMBINED SEWER SYSTEMS WITH OFF-LINE STORAGE FACILITIES,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W85-04576

CANADIAN WATER MANAGEMENT: A ONE ARMED GIANT,
Canada Centre for Inland Waters, Burlington (Ontario).
D. M. Tate.
Canadian Water Resources Journal, Vol. 9. No. 3, p 1-5, November, 1984. 17 Ref.

Descriptors: *Canada, *Water resources development, *Management planning, *Water policy, *Economic aspects, Water supply development, Water quality management, Irrigation management, Water pollution control, Effluent charges, Planning, Municipal water.

Canada has pursued supply-oriented solutions to water development with uneven success. Often, well-intentioned efforts to increase water supplies have led to increased demands for water, and from there to a cycle of building, redevelopment, more demands and more building. Increased emphasis on water demand management in Canada is needed as a complementary strategy to the traditional water supply management approaches. The general water supply management approaches tend to unvalue or undervalue water resources; water is seen as a limitless resource and water systems are wasteful rather than economically efficient. The economic market is generally the principle resource allocation mechanism in Western societies and it would seem prudent to apply some of these principles to the task of water management. Examples are presented of demand management applications to municipal water supplies, irrigation water use, and industrial water use and effluent control. Economic solutions to pollution problems should be used in concert with other management possibilities. Economic instruments are potent tools for environmental good, and would add greatly to our ability to control environmental quality. It is the entry into the environmental control equation of economic measures, such as marginal cost pricing and other types of incentives, which offers the key to effective demand management. By focussing on rational water use, and socially beneficial reductions in water use or consumption, demand management identifies scarce resources which can be devoted to more economic use. Demand management is a prodevelopment strategy, in contrast to some perceptions that incorporation of demand management strategies would inhibit development; management of water demands is an integral component of a sustainable development strategy of economic advancement. (Collier-IVI)
W85-04685

ROLE OF PRICING IN MANAGING THE DEMAND FOR WATER,
Wilfrid Laurier Univ., Waterloo (Ontario).
F. W. Millerd.
Canadian Water Resources Journal, Vol. 9, No. 3, p 7-16, November, 1984. 2 Fig, 22 Ref.

Descriptors: *Pricing, *Economic aspects, *Water demand, *Management planning, *Public policy, Water policy, Water rationing, Marginal cost, Water rights, Water use.

Water pricing is rarely used to manage the demand for water. Since most water utilities operate on a requirements approach, adjusting supply to meet demand rather than adjusting demand to meet supply, it is probably inevitable that both demand management and pricing are largely ignored. Pricing will efficiently and effectively manage the demand for water. Marginal cost pricing which requires consumers to pay the costs of servicing them finds an ideal application in peak period pricing. Charging those responsible for the system capacity necessary to fulfill their peak demands is both efficient and equitable. Estimates of the price elasticity of demand for water and case studies both show that price increases will reduce the demand for water. Water rights are efficient as a demand management policy and is a possible substitute for pricing. Water use standards, although justified in many cases, may not always efficiently allocate water; standards do not provide incentives to conserve beyond the standard. Prices perform two essential roles in a market system: rationing and production motivation. Rationing is necessary since scarcity precludes both the satisfaction of all needs and the unlimited production of goods and services. Prices provide their production motivation role by indicating what consumers are willing to pay; producers react to this, directing thier production to those products most profitable to them. A perfectly operating market system will not only perform these functions but will achieve, from the viewpoint of society, the optimal level of output of any good or service. (Collier-IVI)
W85-04686

INTEGRATED PLANNING SYSTEM FOR HYDRO DEVELOPMENT IN ECUADOR,
Power and Water Systems Consultants, Oxon (England).
T. C. Muir, and J. Saavedra.
International Water Power and Dam Construction, Vol. 37, No. 1, p 20-24, January, 1985. 3 Fig, 2 Tab, 4 Ref.

Descriptors: *Water resources development, *Planning, *Hydroelectric power, *Ecuador, Economic aspects, Water management, Water resources development, Hydroelectric plants.

In 1979 the government of Ecuador approved a power sector development program which envisaged a reversal, by the late 1980s, of the existing 5%:75% ratio of hydro to thermal generation. An integrated planning system (SIP) was designed to achieve the rational long-term exploitation of the nation's estimated 93,000 MW of hydropower resources. Efforts in hydropower development planning are concentrated in three broad programs: micro hydropower, generally up to 5000 kW; mini hydropower, between 5 MW and 25 MW; and major hydropower projects, greater than 25 MW. A major effort in the implementation of SIP centers on development of a computer based information system containing historical and projected economic and financial data on the national economy and the electricity sector. This data provided economic scenarios for economic evaluation, preparation of demand forecasts and provided a basis for financial analysis of the total plan and the regional power companies. (Baker-IVI)
W85-04780

MATHEMATICAL MODEL FOR RESERVOIR SEDIMENTATION PLANNING,
Tippetts-Abbett-McCarthy-Stratton, New York.
P. C. Chao, and S. Ahmed.
International Water Power and Dam Contruction, Vol. 37, No. 1, p 45-50 and 52, January, 1985. 12 Fig, 2 Tab, 5 Ref.

Descriptors: *Mathematical models, *Reservoir silting, *Sedimentation, *Planning, Multipurpose reservoirs, Reservoir operation, Flood control, Computer models.

After examination of some of the existing well known multi-purpose reservoir projects in the world, it is felt that the general arrangement of their structures such as low level outlet, irrigation and power intake, could have been made differently, resulting in prolonged reservoir life and benefits. With the aid of mathematical modelling of the sediment distribution at the project planning stage, the reservoir capacity, operating rule, selection of the range of generating heads and flood control level can be more efficiently determined. The model would predict the growth of the delta, trap efficiencies, the rate of loss of live storage and the quantities and gradation of sediment that would discharge through the outlets. The benefits to any project can be maximized by varying the factors decribed. It is now possible to conduct such comparative reservoir sediment control studies with the computerized model. This tedious and time consuming computation for sediment distribution is otherwise always simply assumed or usually bypassed by planners, designers and owner/operators of the large water resources projects. (Baker-IVI)
W85-04785

THEORY OF FUZZY SUBSETS AND ITS APPLICATIONS TO WATER-RESOURCES PLANNING (DIE THEORIE UNSCHARFER TEILMENGEN UND IHRE ANWENDUNG IN DER WASSERWIRTSCHAFT),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
C. Rack.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 3, p 79-84, July, 1984. 3 Tab, 8 Ref.

Descriptors: *Planning, *Fuzzy set theory, Algorithms, Uncertainty, Water quality, Decision making, Elbe River.

Fields of application of the fuzzy set theory are discussed. Some basic properties of the young theory are introduced, ranging from the definition of a fuzzy subset through various operators to fuzzy relations. The paper illustrates applications of linguistic variables which are able to manage fuzzy algorithms, as these e.g. occur in the human language. The distinction between uncertainty and fuzziness is explained in a simple example. The examples of applicability are concerned with assessments of water quality, multipurpose decision making, as well as discharge and stage forecasts for the Elbe river. Attention is drawn to a few unsolved problems in applying the fuzzy set theory. (Author's abstract)
W85-04806

NITRATE CONTAMINATION: PUBLIC AWARENESS,
New York State Coll. of Human Ecology, Ithaca. Dept. of Design and Environmental Analysis.
For primary bibliographic entry see Field 5F.
W85-04828

ECONOMIC ANALYSIS OF WATER AND SANITATION ALTERNATIVES FOR COMMUNITIES IN NORTHERN CANADA,
J. J. Cameron.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 77-101, 10 Fig, 7 Tab, 7 Ref.

Descriptors: *Cost analysis, *Economic aspects, Sanitation, Municipal water, Water conveyance, Cold regions, Computer programs, Domestic water, Wastewater, Sewer systems.

An economic analysis of water and sanitation systems for northern communities is presented. A proper theoretical basis for the justification of expenditures on water and sanitation systems is the net present value of all benefits and costs. In the cost-effective approach the social desirability and benefits arising from water and sanitation improvements are left out of the computations. Instead, the analysis focuses on the determination of expenditures for each system alternative and presents these for comparison. The cost-effectiveness analysis should include all the costs associated with water and sanitation systems without regard for who pays for them. The methodology includes: planning horizon, discount rate, inflation, growth, staging, existing facilities, incremental cost, water and sanitation systems and assumptions, trucked systems, pipe systems, partial systems, and garbage service. A water and sanitation computer program was designed which included: program methodology and operation, program output, program assumptions and limitations. An analysis of water and sanitation alternatives for Fort McPherson, a Dene community of about 820 persons, located on the east bank of the Peel River, is presented. The objectives were to deliver a minimum of 90 L/person/day to each home and to remove sewage from the dwelling without handling. A study included: water supply alternatives, sewage treatment and disposal alternatives, water distribution and sewage collection alternatives of trucked system analysis and piped systems analysis. The partial system was seen to be the most cost-effective.
W85-04917

OPERATION AND MAINTENANCE CONSIDERATIONS FOR THE DESIGN OF ARCTIC WATER SYSTEMS,
Alaska Area Native Health Service, Anchorage.
M. W. Mauser.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 180-199, 4 Fig, 2 Tab.

Descriptors: *Design criteria, *Design standards, Municipal water, Costs, Analysis, Maintenance, *Alaska, Maintenance costs, Cold regions, Arctic regions, Operating costs, Reliability, Water treatment facilities, Utilities.

The design of arctic water systems with respect to operation and maintenance considerations is discussed. The design engineer makes decisions that will affect the water plant operator and the community for the life of the plant. In many small communities the job of operator is shared or there is a high turnover rate. The operator is the key to reliable service. The system needs to be easy to operate. Gauges and meters should be adequate and located where they can be easily read. The plant must be easy to maintain. In the event of a failure, it is important that the operator is alerted and instructed. The reliability of a system can be enhanced by using equipment and materials that are readily available or can be serviced locally or regionally. Salaries, heating, and pumping are the biggest expenses in operating a water plant. Designing a reliable, and easily operated and maintained plant automatically keeps salaries at a minimum. Provision should be made for the safe storage and handling of chemicals. An idealized schematic is presented to make plant operation and maintenance easier and reduce piping losses in a circulating water system. After the initial design is completed, it should be reviewed by the operator, sanitarians, and maintenance specialists. Operation and maintenance is for the life of the plant. Shortcuts or oversights in design that may seem minor at first glance can be very important to the operator and the community.
W85-04923

HEATING ENCLOSED WASTEWATER TREATMENT FACILITIES WITH HEAT PUMPS,
Cold Regions Research and Engineering Lab., Hanover, NH.
C. J. Martel, and G. Phetteplace.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 262-280, 7 Fig, 6 Tab, 13 Ref.

Descriptors: *Wastewater facilities, *Heating, Management planning, Construction, Water reuse, Effluents, Fouling, Heat pump.

A simple procedure for evaluating the technical and economic feasibility of installing a heat pump at new or existing wastewater treatment facilities is presented. Existing heat pump installations are in Fairbanks, Alaska; Wilton, Maine; and Madison, Wisconsin. The heat pump in each of these plants is supplied with wastewater of secondary effluent quality or better. A higher strength wastewater is not used because of possible solids accumulation and fouling problems on the interior surfaces of the tube heat exchanger. The preferred location for the intake to the heat pump is just upstream of the overflow weir in the chlorine contact chamber. A heat pump is a cyclic device which transfers heat from a lower temperature source (effluent) to a higher temperature sink (hot water heating system). The coefficient of performance (COP), an important factor in determining the economic feasibility of installing a heat pump, depends mainly on the temperature difference between the heat source (wastewater effluent) and the heat delivery system. The greater the temperature difference, the lower the COP. To maintain a high COP it is better to provide a greater flow through the evaporator and drop the temperature of the effluent only a few degress than to provide a low flow and a large temperature drop. The most important step in sizing a heat pump is to estimate the building heating load resulting from basic conduction losses through walls, windows, ceiling and floor, and air infiltration and ventilation losses. The effluent flow rate needed to supply the evaporator will depend on the heat pump capacity, COP, and the temperature drop across the evaporator.
W85-04924

UNDERGROUND UTILITIES IN BARROW, ALASKA,
Moolin (Frank) and Associates, Anchorage, AL.
J. L. Cerutti, W. L. Zirjacks, C. T. Hwang, and D. E. Bruggers.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 358-382, 19 Fig, 4 Ref.

Descriptors: *Underground structures, *Underground waste disposal, Utilities, Construction, *Alaska, Cold regions, Artic regions, Design criteria, Wastewater treatment.

Barrow, Alaska, the northern-most community in the United States, currently has no area-wide piped water or sewerage facilities. After evaluating the recommendations, design parameters, and risks, the North Slope Borough decided upon a complete below ground utilidor system. The system has the highest capital cost and the lowest maintenance cost of all the systems evaluated. It provides the greatest flexibility for further expansion of the utility system and offers the best aesthetics of all systems investigated. The utilidor is designed to contain water, sewerage, electrical, cable T.V., and telephone transmission systems. The interior will be kept above freezing with heated, circulating water, and space will be provided for man access for maintenance. To evaluate construction techniques and verify the thermal design parameters, part of the utilidor was isolated and instrumented as a test section in May of 1981. All methods of excavation were successful in producing a trench; however the trench portions that were excavated by blasting without the benefit of bordering Roscaw cuts, resulted in an oversize trench. The void space in the dried sands used in the backfill transmitted water much more freely than expected. The ground temperatures adjacent to the heated portion were not significantly affected by the increase of the utilidor temperature. The performance of the test section in obtaining freeze-back after its installation during the start of the seasonal warming cycle indicates that the original design parameters are valid.
W85-04925

CASE STUDY, POTABLE WATER RESERVOIR, TUKTOYAKTUK, NORTHWEST TERRITORIES,
Government of the Northwest Territories, Yellowknife. Water and Sanitation Section.
B. Milburn, D. Clark, N. Jacobsen, B. Smith, and S. Brown.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environment Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 401-419, 2 Fig, 13 Ref.

Descriptors: *Potable water, *Reservoirs, Cost analysis, Environmental effects, Cold regions, Dredging, Water supply, Salinity, Sediment transport, Bathymetry, Pollutants, Benthos, Food chains, Turbidity, Overflow, Case studies.

A case study of potable water reservoir in Tuktoyaktuk, N.W.T. is presented. The predesign study took into account the availability of dredging equipment and subsequently determined that the reservoir site could be established prior to source identification. Three major water supply system concepts, based on the general location of the water source, were identified early in the study: Across the Harbour Concept (i.e., water crossing); Southern Lakes Concept (all overland routes); and Tuktoyaktuk Harbour Concept (direct withdrawal). A cost-effective analysis methodolgy was applied to all alternatives to determine the water supply system that will supply the long term demand for water at the minimum level of service. The concept of drawing water from Tuktoyaktuk Harbour in the winter was rejected because of the basic conflict and resultant pollution potential in harbor utilization, with the shipping due primarily to oil and gas exploration activity in Tuk and in the Beaufort Sea. The geotechnical considerations included: subsurface investigation, reservoir liner, side slopes, liner cover, sub-drainage, and overflow protection. Environmental concerns included: turbidity, temperature and salinity, sediment transportation and deposition, alteration in local bathymetry, potential chemical effects, mobilization of contaminants, dissolved oxygen, potential biological effects, fish entrainment, alterations to migratory

patterns, impact in benthic populations, and impact on food resource chain. The reservoir was sized to meet an annual potable water requirement of 90,000 cu m based on projected populations and water consumption for a 20-year design life.
W85-04927

PRIVATIZATION NEEDS THE PROFESSIONAL APPROACH,
Pirnie (Malcolm), Inc., White Plains, NY.
G. P. Westerhoff.
Water Engineering and Management, Vol. 132, No. 2, p 25-28, February, 1985. 4 Fig.

Descriptors: *Economic aspects, *Wastewater treatment facilities, *Water treatment facilities, *Privatization, Engineering, Education, Training.

As federal support erodes, funding needed for continuing construction of water/wastewater facilities is going to have to be provided by other means. One of these means is privatization which requires an understanding and carefully planned management. Under privatization a facility such as a solid waste, water, or wastewater plant is typically financed using tax exempt industrial development bonds. The largest cost savings are realized when the private service party has access to tax-free financing such as these bonds for financing the project. Four principal reasons why municipal agencies are considering privatization are: inability to raise capital, tax incentive advantages, greater private sector efficiency, and the transfer of risk. A privatization project includes three major technical elements: fiscal, engineering and legal. From a municipal agency's perspective, the key to a successful privatization project is the right combination of ensuring maximum gain from the potential financial benefits and the minimization of the potential disadvantage of loss of control. These can be obtained when the municipal agency fully understands the privatization process, the RFP is carefully prepared and a contract is negotiated which is fair to both parties and clearly defines the service being contracted. (Baker-IVI)
W85-04954

6B. Evaluation Process

ROLE OF WATERSHED MANAGEMENT IN WATER RESOURCES DEVELOPMENT PLANNING - NEED FOR INTEGRATED APPROACH TO DEVELOPMENT OF CATCHMENT AND COMMAND OF IRRIGATION PROJECTS,
Government of Bihar, Patna (India).
B. Sinha.
Water International, Vol. 9, No. 4, p 158-160, December, 1984.

Descriptors: *Watershed management, *Planning, *Water resources development, Reservoirs, Siltation, Decision making, Water management, Erosion.

Deficiencies common in the management of watersheds are identified and the need for dove-tailing watershed management plans and programs with the comprehensive water resources planning framework is highlighted. Observations on many existing reservoirs have shown that the rate of actual siltation is much higher than what was assumed in the design; and sedimentation is not confined to the space below the dead storage level as was assumed and provided for in the design. Variations in the rate of siltation and pattern of distribution in the reservoir may be attributed to inadequacy and inaccuracy of observed data available for use in design; deficient design and planning assumptions and practices; increase in soil erosion in the catchment; faulty and/or inappropriate operation of the reservoir; and slippage in the program of implementation of projects planned for concurrent execution under a unified comprehensive multi-reservoir system. Some of the main causes of the high rate of siltation and its distribution pattern over the depth of reservoirs could substantially, if not wholly, be eliminated by improving the system of silt data collection, collation and analysis; by modifying design and regulation practices; and by drawing up realistic implementation schedules for projects of an interdependent and interacting nature. The lack of a comprehensive approach in the planning of water resources development projects treating a river basin as a unit of planning has been a major problem. (Baker-IVI)
W85-04441

USE OF PERFORMANCE INDICATORS IN SEWAGE TREATMENT APPRAISAL,
Yorkshire Water Authority (England).
For primary bibliographic entry see Field 5D.
W85-04510

COST-EFFECTIVE MANAGEMENT - REVENUE AND TECHNICAL MONITORING,
Anglian Water Authority, Northampton (England). Northampton Sewage Div.
M. J. Johnson, and G. Nunn.
Water Pollution Control, Vol. 82, No. 2, p 203-212, 1983. 1 Fig, 1 Tab, 1 Ref.

Descriptors: *Management, *Cost analysis, Economic aspects, Decision making, Planning, Operation, Monitoring.

Cost-effective management is a management style, a way of thinking, which must permeate through the whole of an organization if it is to be fully cost-effective. Routine revenue and technical monitoring in the form of regular planned collection, processing and production of information for management is only a part of the process. A manager who wishes to be fully cost-effective must be aided by such routine information, but not confined by it. Managers must look for and anticipate change, be prepared to question current methods and indeed the need for the whole or the part of a task. They must be outward looking and attempt to monitor the environment in which the organization functions so that external changes can be anticipated and accommodated. Setting the budget, routine financial and technical control, performance monitoring and performance indicators, the role of the Ad Hoc investigation, and management of change are specifically discussed. (Baker-IVI)
W85-04519

METHODOLOGY FOR POLLUTION CONTROL DECISION ANALYSIS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W85-04582

LOW-HEAD HYDROPOWER FOR LOCAL USE,
Michigan State Univ., East Lansing.
P. Kakela, G. Chilson, and W. Patric.
Environment, Vol. 27, No. 1, p 31-38, January/February, 1985. 5 Fig, 12 Ref.

Descriptors: *Hydroelectric power, *Low-head, *Dam construction, *Michigan, Reconstruction, Regulations, Planning, Water resources development.

Low-head hydropower represents a unique, valuable resource for many local communities. At hydro facilities, the amount of energy that can be generated depends on two factors: the volume of water (flow) and the vertical distance the water falls (head). Many states, such as Michigan, have plenty of water but simply lack mountains. Seasonal fluctuations of rainfall and snowmelt are also important factors. The holding capacity of most watersheds not yet developed for hydropower is also relatively small and in many cases may have been reduced even more by extensive urban development. It is important to recognize that even a limited hydro potential can provide a valuable, clean, renewable energy source, especially at the local level. Many regulations control the development of dormant water power potential. Hydropower comes under both state and federal regulations because most streams are considered interstate navigable waterways. There are at least 17 laws at the federal level and, in Michigan, there are 10 state statutes that might be involved to directly or indirectly influence hydro developments. (Baker-IVI)
W85-04620

PROPOSED FRAMEWORK FOR DEVELOPING A MULTIDISCIPLINARY WETLANDS VALUATION MODEL,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 2L.
W85-04684

NEW IDEAS RESHAPING TREATMENT TECHNOLOGIES,
Lorenz (William T.) and Co., Boston, MA.
For primary bibliographic entry see Field 5D.
W85-04751

IMPORTANCE OF SAMPLE DISCRIMINATION IN USING THE TRAVEL COST METHOD TO ESTIMATE THE BENEFITS OF IMPROVED WATER QUALITY,
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
M. O. Ribaudo, and D. J. Epp.
Land Economics, Vol. 60, No. 4, p 397-403, November, 1984. 1 Fig, 13 Ref.

Descriptors: *Evaluation, *Recreation, *Travel cost method, *Water quality, *Lake Champlain, Economic aspects, Sampling, Social aspects.

The travel cost method is a widely used technique for the valuation of recreation sites in the absence of organized markets. The problem is to be certain that both current users and former users are included in the survey for the travel cost method. A study was conducted in the northeastern portion of Lake Champlain during the summer of 1982, using personal interviews of randomly selected recreationists at recreation sites. Interviews were conducted at St. Albans Bay, alternative sites, and on the open lake itself. Respondents who had recreational experience with St. Albans Bay were asked to imagine that the bay would become as clean as other parts of the lake with which they were familiar. The improvement of water quality in the Bay appears to be desirable for recreationists. Substantial benefits for both current and former users would be generated. Results tend to support the sampling approach used and the subsequent application of the travel cost model. Statistical tests on the sample population indicate significant differences in most of the relevant socioeconomic and recreation behavior variables tested. The estimated benefits for each group are significantly different from each other. The estimate for aggregate benefits is more accurate than if only current users had been included. (Baker-IVI)
W85-04753

OPPORTUNITY COSTS OF PRESERVING COASTAL WETLANDS: A CASE STUDY OF A RECREATIONAL HOUSING DEVELOPMENT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
S. S. Batie, and C. C. Mabbs-Zeno.
Land Economics, Vol. 61, No. 1, p 1-9, February, 1985. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Wetlands, *Environmental effects, *Land development, *Housing, *Virginia, Evaluation, Coastal areas, Recreation, Economic aspects, Permits.

A case study is presented of the development value of converting coastal wetlands into recreational housing lots at Captain's Cove subdivision on Virginia's Eastern Shore. The development value estimates are valid measures of the opportunity cost of prohibiting recreational development in order to preserve Captain's Cove wetlands. The state of hydrological and biological assessment of natural wetlands frequently is not of sufficient detail nor of proper design for use in economic valuation of specific wetlands sites. In contrast, economists are able to supply estimates of development value. The use of the development valuation framework for the provision of development value estimation appears to have considerable utility when data is

lacking for a complete analysis of all social cost and benefits of natural resource use decisions. The analysis of net marginal returns to wetlands as illustrated at the Captain's Cove site reveals several effects of allowing various levels of wetlands destruction. If is were reasonable to assume that the denial of a permit to develop Captain's Cove would mean no investment would be made, then the total returns foregone because of permit denial could be high. If a wetlands board focused on these returns, it is likely that the permit would be allowed unless very substantial negative externalities from development were identified. (Baker-IVI)
W85-04754

FUTURE OF HYDROPOWER IN BRAZIL,
A. C. T. Holtz.
International Water Power and Dam Construction, Vol. 37, No. 1, p 16-19, January, 1985. 2 Fig, 6 Tab, 6 Ref.

Descriptors: *Water resources development, *Brazil, *Hydroelectric power, Water management, Planning, Decision making, Dam construction, Electrical transmission.

Brazil's hydroelectric potential allows for the installation of up to 213000 MW, of which only 24% is currently in operation or under construction. The promising outlook for developing this potential is examined. Brazilian hydroelectric potential exceeds by 80% the total consumption of primary energy of all types recorded in Brazil in 1983. The largest portion of the potential still available is located in the North/Central West and South, especially in the North, where roughly 97800 MW remain to be developed. Progress made locally in the technology of long-distance electric energy transmission has made it economically feasible to set up, in the relatively near future, a single interconnected system for all Brazil, which would enable the country to anticipate development of the northern potential to the benefit of other regions. Preserving the environment, or at least minimizing negative ecological effects, has played an increasingly important role in the selection of different sources of power supply and is likely to become a major conditioning factor for the energy model to be adopted in the future. (Baker-IVI)
W85-04779

ACID DEPOSITION CONTROL, A BENEFIT-COST ANALYSIS: ITS PROSPECTS AND LIMITS,
Wyoming Univ., Laramie. Dept. of Economics.
T. D. Crocker, and J. L. Regens.
Environmental Science and Technology, Vol. 19, No. 2, p 112-116, 1985. 2 Tab, 18 Ref.

Descriptors: *Cost-benefit analysis, *Acid deposition, *Water pollotion control, Economic aspects, Precipitation chemistry, Acid rain, Policy making.

Benefit-cost analysis is a potentially useful component of policy evaluation whose utility is constrained by the availability of reliable data. Precipitation chemistry data indicate that the geographic scope of acid deposition covers most of eastern North America. A benefit-cost analysis of acid deposition requires three kinds of information: the differential changes across space and time that acid deposition control causes in people's alternative opportunities to produce and consume, the responses of prices to these changes, and the adaptations emitters and receptors can make to these changes in opportunities and prices. Accounting for the results of the last two facets is the economic analysis portion of benefit-cost analysis. The value of benefit-cost analysis of acid deposition control resides more in its potential contributions to clearer statements of the problem than in its provision of accounts for social and ecological bookkeeping. Such analyses force policy makers to face the inherent tradeoffs of the acid deposition problem and the influences that individuals and institutions choose to exercise on the structure of these tradeoffs. (Baker-IVI)
W85-04798

MEASUREMENTS AND ESTIMATION IN HYDROLOGY - IDEAS AND PROPOSALS FOR THE QUANTIFICATION OF ERRORS AND UNCERTAINTIES (MESSUNGEN UND SCHATZUNGEN IN DER HYDROLOGIE - GEDANKEN UND VORSCHLAGE ZUR QUANTIFIZIERUNG DER FEHLER UND UNSICHERHEITEN),
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W85-04805

STATUS OF SANITATION FACILITIES IN ALASKA - 1982,
OTT Water Engineers, Anchorage, AK.
W. L. Ryan.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 18-24, 1 Tab.

Descriptors: *Utilities, *Cold regions, Sanitation, Polar regions, *Alaska, Domestic water, Domestic wastes, Wastewater.

A complete inventory of the Alaska Native communities in which sanitation facilities have been installed by the federal and/or state governments is presented. If one considers running water with flush toilets in each house as the goal, there are still around 9000 families that need facilities or major improvements and/or expansion of their existing facilities. However, there are about 70 communities where running water in the house will never be feasible because of engineering or construction constraints. Sixty of these would probably be provided with a central facility. The other ten would likely never be provided with any type of facilities other than a central watering point, primarily because of their small size. This equates to an unmet need of some $280 million (U.S.). This need is split among water supply, sewage disposal, and solid waste disposal on the basis of 55, 41, and 4 percent, respectively.
W85-04915

UTILITIES DELIVERY FOR THE INDIAN AND INUIT AFFAIRS PROGRAM,
Department of Indian Affairs and Northern Development, Ottawa (Ontario). Municipal Services Div.
J. R. Benner, and S. Lam.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 25-70, 22 Fig.

Descriptors: *Utilities, *Cold regions, Polar regions, Sanitation, Water delivery, Sewer systems, Indians, Domestic water, Potable water, Wastewater, Capital costs.

An overview of utilities delivery activities within the Indian and Inuit Affairs Program of the Department of Indian Affairs and Northern Development is presented. All domestic water systems shall provide potable water of a quality stated in the Canadian Drinking Water Standards and Objectives, 1968; there are four levels: the individual is responsible for locating, transporting and treating, if necessary, his water supply; a community water system with one or more watering points from which residents can obtain potable water; potable water is delivered by vehicle to individual residences in limited quantities; and pressurized potable water is provided to meet all normal residential requirements. There are three levels for sewage disposal: the individual is responsible for disposal of human wastes and wastewater from his residence; removal and disposal of limited quantities of domestic sewage is provided; and removal and disposal of all domestic sewage from residences is provided. Capital expenditures for utilities infrastructure has increased steadily over the past 15 years. Generally speaking, the southern reserves are better equipped with water supply and sewage disposal facilities than the northern ones due to various factors including availability of good water sources, accessibility and proximity to urban centers. The majority of the northern reserves are without proper water supply and sewage disposal facilities. In planning and designing a water supply and sewage disposal system for an Indian reserve, life style and community must be considered.
W85-04916

WATER CONSERVATION IN BARROW, ALASKA,
Northern Testing Lab., Inc., Fairbanks, AK.
M. R. Pollen, and D. W. Smith.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 102-109, 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Water conservation, *Water costs, Water use, Wastewater collection, Cold regions, *Alaska, Underground structures, Water treatment facilities.

The operation and maintenance history of water conservation systems in use in the community of Barrow, Alaska are described. An underground utilidor system is under construction which will provide community wide water distribution and wastewater collection for the first time. The transition from the water conservation technology to the full service utility system is examined. The primary water supply for the community is a centrally located impounded reservoir comprised of a series of shallow overflow dams. Due to high color, turbidity, iron, and total dissolved solids (TDS) the water is processed through aeration, coagulation, sedimenation, filtration, and reverse osmosis treatment. The present cost of delivered water ranges from 2.6 to 4.0 cents per liter. Future delivered cost is unknown at the present time, but will reflect both the cost of treating the water and the operation and maintenance of the utilidor. A study of the water consumption rates by the residents of Barrow was completed in 1981. Three levels of water consumption were: trucked residential at 34 L/person/day, Browerville Addition at 49 L/person/day, and Hospital/School at 117-220 L/person/day. The systems using different grades of water include: hospital/school complex split raw and potable water system; Browerville addition redux grey water recycling plant; and Top of the World Hotel Met Pro grey water recycling plant. The systems that do not use water include: aqua sans mineral oil flush system, compost toilets, and incinerating toilets. Minimal water use equipment includes low flush toilets and vacuum flush systems. The high cost of water has resulted in the installation of major water conserving systems.
W85-04918

SMALL HYDRO IN CHINA: PROGRESS AND PROSPECTS,
Ministry of Water Resources and Electric Power, Beijing (China). Dept. of Rural Electrification.
B. Deng.
International Water Power and Dam Construction, Vol. 37, No. 2, p 15-17, February, 1985.

Descriptors: *Hydroelectric power, *Small hydropower, *China (Peoples Republic), Construction, Power plants, Planning.

During the 1950s emphasis was placed on hydropower stations as a part of the rural agricultural resources development movement and by 1966, 8983 stations had been built with an installed capacity of 238 MW. This period was characterized by slow construction, small installed capacity per station, and simple construction of not very high quality. In 1969 the first national conference on small hydro power (SHP) was held to develop a national plan and discuss ways of effectively resolving problems in construction. The end of the 1970s and early 1980s saw the most rapid development of SHP in China. By the end of 1983 there were 76,000 SHP stations with an installed capacity of 8500 MW and annual generation of 20000 GWh. The scope of China's SHP includes two components: stations, and small local grids where SHP forms the main source of local electricity supply. With the support of the State, it is planned that SHP electricity generation should rely on the

pooled resources of county, rural districts, villages and individuals. (Baker-IVI)
W85-04947

EXPLOITING SEASONAL ENERGY FROM SMALL HYDROPOWER STATIONS,
Ministry of Water Resources and Electric Power, Beijing (China). Dept. of Rural Electrification.
Y. Li.
International Water Power and Dam Construction, Vol. 37, No. 2, p 17-18, February, 1985. 1 Fig, 3 Tab.

Descriptors: *Hydroelectric power, *Seasonal variation, *China (Peoples Republic), *Small hydropower, Energy, Hydroelectric plants, Industrial production, Agricultural engineering.

Several ways to use seasonal energy fully have been developed in the Peoples Republic of China. These include: seasonal energy for industrial consumers, seasonal energy for agricultural processing, and seasonal energy for rural domestic purposes. In Dehua county, Fujian province, there are 237 small hydro power (SHP) stations with a total installed capacity of 14.6 MW and an annual average design energy output of 5.9 times 10 to the 7th power kWh. The stations are all run of river type and operate in three independent small grids. In Xinchang county, in Zhejiang province, in the agricultural area, 215 SHP stations exist with a total installed capacity of 27 MW. In the area of domestic use, since 1981, electricity for cooking has begun to be supplied experimentally from SH grids. In order to encourage rural households to use electricity, the policy of preferential pricing during the flood season is adopted. Also, in an effort to encourage electricity usage, high efficiency electric cookers are advocated. (Baker-IVI)
W85-04948

ROLE OF SMALL HYDRO IN RURAL ELECTRIFICATION,
Ministry of Water Resources and Electric Power, Beijing (China). Dept. of Rural Electrification.
L. Bai.
International Water Power and Dam Construction, Vol. 37, No. 2, p 19-20, February, 1985.

Descriptors: *Hydroelectric plants, *China (Peoples Republic), *Small hydropower, *Evaluation, Agricultural engineering, Water resources development.

At the beginning of 1984 the government of the Peoples Republic of China issued a directive to make full use of the rich resources in small hydropower (SHP), to build a Chinese style rural electrification system to make electricity available for cooking, boiling, lighting, cooling, processing, culture, education, county-run enterprises and agricultural oriented needs in a number of counties by the end of 1990. Within five years there should be 100 counties using SHP in prototype arrangements. It is estimated that about half of the counties can exploit their own small hydro resources to meet their own needs. Preliminary aims of the current program are that electricity should be available to over 90% of the families in each pilot county. Electricity should be used by more than 20% of the families for more than 6 months yearly for cooking, boiling water and baking, thus replacing the use of wood. More than 90% of the families should be able to use electricity for agricultural processing. Electricity should be used for small scale irrigation and other agricultural needs. Power needs of the enterprises run by counties or townships should be generally met. The economic evaluation of SHP consists of three parts: analysis of the social benefit, the commercial benefit and the local benefit. (Baker-IVI)
W85-04949

LARGE HYDROPOWER STATIONS IN CHINA,
Scientific and Technological Information Inst., Bejing (China).
X. Wu.
International Water Power and Dam Construction, Vol. 37, No. 2, p 37-39, February, 1985. 2 Fig.

Descriptors: *Hydroelectric power, *Yangtze River, *Wujiang River, *China (Peoples Republic), *Water resources development, Planning, Construction, Rivers.

China has numerous rivers with an abundance of hydropower resources. The Yangtze river ranks the first in hydropower resources, having an installable potential of 197 GW with an annual energy output of 1027 TWh, constituting 53.4% of the total. At present 133 hydropower stations with an installed capacity greater than 12 MW have been built, and 43 of such a size are under construction. Of the principal sources of energy in China, coal, hydroelectricity, oil and natural gas, China's richest is hydropower potential. At present the focus is centered on developing further the hydropower resources in the upper reaches of the Yellow river, the upper and middle reaches of the Yangtze river and its tributaries, the Hongshui river and the Lancang river. A tentative planning proposal is that by the year 2000 the newly increased hydropower installed capacity will be 60 GW including small hydro, and the total hydropower installed capacity will rise to 90 GW and the annual hydroelectric energy output would amount to 250 TWh. (Baker-IVI)
W85-04951

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PRIVATE AND SOCIAL COST - BENEFIT PERSPECTIVES AND A CASE APPLICATION ON RESERVOIR SEDIMENTATION MANAGEMENT,
Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 4D.
W85-04447

INCREASING INTEREST OF PUBLIC ELECTRICITY SUPPLIERS IN MICRO POWER PLANTS (AUFLEBEN KLEINER WASSERKRAFTE AUCH BEIM OFFENTLICHEN ELEKTRIZITATSVERSORGUNGSUNTERNEHMEN),
Stadtwerke Pforzheim (Germany, F.R.).
R. Dupont.
Wasserwirtschaft, Vol. 74, No. 12, p 571-574, December, 1984. 3 Fig, 6 Ref.

Descriptors: *Small hydropower, *Hydroelectric plants, Utilities, Hydroelectric power, Economic aspects, Construction.

The interest in hydro power generation is increasing to a high degree. Public electricity suppliers engaged in generating and distributing electric power and running their own water power plants are stimulated to renew and improve old plants or to build new ones. The economical and technical aspects of a recently materialized project demonstrate the measures to be taken and the profit expected of a water plant. The experiences described refer to run-of-river water power stations up to 1 MW. (Author's abstract)
W85-04628

PEAK USE CHARGE: AN EQUITABLE APPROACH TO CHARGING FOR AND/OR REDUCING SUMMER PEAK USE,
Fairfax County Water Authority, Merrifield, VA.
F. P. Griffith, Jr.
Canadian Water Resources Journal, Vol. 9, No. 3, p 17-21, November, 1984. 2 Append.

Descriptors: *Fairfax County, *Virginia, *Pricing, *Water use, *Economic aspects, Peak demand, Water conservation, Water policy, Management policy, Policy, Metropolitan water management.

Fairfax County Water Authority (Authority), serving a population of over 670,000 in the northern Virginia suburbs of Washington, D.C., was one of the first (1974) utilities in the United States to utilize a water rate structure as a significant segment of a water management policy. The Authority has a basic philosophy and objective of obtaining economic equity and practical conservation. The Authority had a multitude of considerations for the design and actual derivation of a new rate structure. The review and analysis of existing standard and conservation rate schedules were a part of those considerations. The Authority eventually adopted a 'peak use charge' rate system whereby each individual customer is assessed a surcharge per 1,000 gallons during the two peak demand quarters for their use that exceeds their winter quarter use by more than 30 percent. The Authority had reasoned that by directing the elasticity of pricing at the special summer usage activities, it could possibly derive the most benefit relative to reducing the peak demands. To date, after nearly 10 years since adopting the peak use charge, the Authority has concluded that it has attained its objectives and can live with this charge despite the obvious problems and controversy. (Author's abstract)
W85-04687

EMPIRICAL BASIS FOR MUNICIPAL WATER RATES MODIFICATION,
Toronto Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 3D.
W85-04688

EFFECTS OF ELECTRICITY RATES AND RATE STRUCTURES ON PUMP IRRIGATION: AN EASTERN COLORADO CASE STUDY,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 3F.
W85-04752

COST SHARING IN A MULTIPURPOSE WATER PROJECT,
Department of the Environment, London (England).
P. T. McIntosh, and M. C. D. La Touche.
International Water Power and Dam Construction, Vol. 37, No. 1, p 13-15, January, 1985. 3 Fig, 1 Tab.

Descriptors: *Cost sharing, *Multipurpose projects, *Mantaro Transfer Project, *Peru, Water resources development, Planning, Water management, Economic aspects, Political aspects.

Cost sharing is a matter for negotiation. Because of this and because political and other factors may influence the outcome, lengthy calculations may not be justified. The simplified analysis described and illustrated in relation to the Mantaro transfer project, while not indicating any final and precise results, indicates the range within which it would be reasonable for the finally agreed division of costs to fall. Two guidelines to consider in deciding how to share the cost of a joint project are: the most any participant would be prepared to pay would be the cost of an equivalent single purpose project; and the least each participant would expect to pay is his separable costs within the joint project (that is, those that are clearly in no way related to the other products). (Baker-IVI)
W85-04778

6D. Water Demand

GARRISON DIVERSION UNIT - AN UPDATE,
Brandon Univ. (Manitoba). Dept. of Geography.
For primary bibliographic entry see Field 4A.
W85-04574

INCREASING INTEREST OF PUBLIC ELECTRICITY SUPPLIERS IN MICRO POWER PLANTS (AUFLEBEN KLEINER WASSERKRAFTE AUCH BEIM OFFENTLICHEN ELEKTRIZITATSVERSORGUNGSUNTERNEHMEN),
Stadtwerke Pforzheim (Germany, F.R.).
For primary bibliographic entry see Field 6C.
W85-04628

ARIZONA WATER ISSUES: CONTRASTING ECONOMIC AND LEGAL PERSPECTIVES,
Streich, Lang, Weeks and Cardon, Tucson, AZ.

For primary bibliographic entry see Field 6E.
W85-04756

ACCEPTANCE OF TREATED WATER BY NORTHERN COMMUNITY RESIDENTS,
Government of the Northwest Territories, Yellowknife. Town Planning and Lands Div.
M. J. Sims.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 140-151, 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Treated water, *Water conveyance, Water storage, Water tanks, Domestic water, *Canada, Water use, Cold regions, Chlorination, Potable water, Reservoirs, Education, Public policy.

The Government of the Northwest Territories, through its Water and Sanitation Program, establishes basic water supply facilities in the Northwest Territories to ensure that all residents have year-round access to water that will meet reasonable health and sanitation standards. The complexity of the facilities varies from community to community with the minimum acceptable water supply structure being considered a pumphouse/truckfill station. In some of the communities where new facilities have been installed, it has been found that the native people use the treated water for general household use only. Although the water supply meets all the the requirements, some people do not like the taste of treated water and still haul and melt ice and snow for drinking water and for making tea. Case examples of taste problems are given for Lake Harbour, N.T.W.; Sanikiluaq, N.W.T.; and Eskimo Point. The possible reasons for complaints include: the relative newness of the facilities, the lack of experience of the operators especially in respect to the quantity of chlorine to be added; the use of aluminum tanks; the sensitivity to taste of the Inuits; and the traditional background of using pristine waters for their water supplies interferes with the use of water from constructed reservoirs. Some approaches to minimize complaints include: a more detailed sampling of water sources during the predesign stage; training of the operator in chlorine dosage control; design of individual storage tanks to minimize corrosion; and the development of a public education and awareness program on water treatment.
W85-04921

6E. Water Law and Institutions

INTERNATIONAL WATER MANAGEMENT IN CANADIAN-AMERICAN RELATIONS, 1894-1907,
Royal Military Coll. of Canada, Kingston (Ontario).
N. F. Dreisziger.
Canadian Water Resources Journal, Vol. 8, No. 3, p 58-76, 1983. 18 Ref.

Descriptors: *Water management, *International law, *Canada, *United States, International agreements, Water resources development, History.

Until the first decade of the twentieth century Canada and the United States did not possess a set of comprehensive regulations for international water management along their common frontier. The need for such regulations arose during the 1890s and the early 1900s when accelerating population growth, industrialization and technological change resulted in new uses of waters along the U.S. - Canada international boundary. The proliferation of such uses threatened water management in the two countries with chaos. The threat was recognized by technical experts and was dealt with by the governments in Washington and Ottawa -- after innumerable delays. In the end comprehensive guidelines were agreed upon for the orderly development and preservation of common water resources. In 1909 they were incorporated into a treaty, providing North America with its first body of international law for international water management. (Author's abstract)
W85-04588

LOW-HEAD HYDROPOWER FOR LOCAL USE,
Michigan State Univ., East Lansing.
For primary bibliographic entry see Field 6B.
W85-04620

ARIZONA WATER ISSUES: CONTRASTING ECONOMIC AND LEGAL PERSPECTIVES,
Streich, Lang, Weeks and Cardon, Tucson, AZ.
M. F. McNulty, and G. C. Woodard.
Arizona Review, Vol. 32, No. 2, p 1-13, Fall, 1984. 2 Fig, 2 Tab.

Descriptors: *Water conservation, *Legal aspects, *Economic aspects, *Arizona, Water management, Water rights, Regulations, Planning, Water demand.

Unsettled water issues in Arizona are reviewed from different perspectives - from the perspective of the resource economist, whose standard of performance usually is maximizing economic efficiency via minimizing constraints upon free trade; and from the perspective of the water law attorney, who is interested in protecting existing property rights and securing future expectations, and who often is more concerned with equity than efficiency. The overall goal of water resource management in Arizona is to assure a stable, long-term water supply adequate to support the demands of the state's burgeoning population and industrial base. Conservation plans promulgated for the state's Active Management Areas are the first in a series of four such plans designed to move the state toward balancing water supply and demand by the year 2025. Before writing the first plans, an inventory was made and certified for all existing uses of water. This process of verifying grandfathered water rights provided a necessary data base for statewide water management and legitimized current uses of water. Nearly 17,000 people applied for certificates of grandfathered rights in September of 1981. The care with which these applications are being processed speaks well for the future administration of the law. Proposed municipal conservation plans set per capita use rates for cities, towns and private water companies. The agricultural conservation program actually sets a limit as to how much water a given farmer may pump to irrigate his land and how much land is governed by the irrigation grandfathered rights. Industrial conservation technologies focus primarily on five water intensive industries: electric power generation, mining, turf irrigation, sand and gravel, and dairies. The current status of Indian water rights in Arizona is summarized. (Baker-IVI)
W85-04756

PROPOSED LEGAL FRAMEWORK FOR THE REGULATION OF DRINKING WATER,
Canadian Environmental Law Association, Toronto (Ontario).
D. G. Edward.
Water and Pollution Control, Vol. 122, No. 3, p 21-22, 24, 27-28, May/June, 1984. 2 Ref.

Descriptors: *Water quality control, *Regulations, *Canada, *Drinking water, Enforcement, Monitoring, Water treatment, Water supply, Legislation.

The existing threat to the supply of drinking water for Canada is reviewed and problems are highlighted in the current system of regulations which are supposed to safeguard this supply. A Safe Drinking Water Act Proposal is discussed which is not intended to deflect attention from pollution abatement and control. Due to the ongoing problem of cleaning up existing sites and enforcement of prohibitions against further injection of contaminants into the air and water, it is necessary to control the quality of drinking water at the point of consumption. The main responsibility for the enforcement of the proposed Safe Drinking Water Act would lie within the provinces. Public water suppliers would be required to periodically sample and test drinking water. Members of public would be given standing to bring civil actions against anyone for damages arising from a breach of regulations. The Act would require public water suppliers to notify customers and the general public when the system was not performing properly or adequately and to provide alternative sources of supply when necessary. Mandatory research into certain critical water quality problems would be provided for. (Baker-IVI)
W85-04766

6F. Nonstructural Alternatives

FLOODPLAIN POLICY AND PRACTICE IN THE CREDIT RIVER WATERSHED, ONTARIO,
Grand River Conservation Authority, Cambridge (Ontario).
B. J. Veale, and B. Mitchell.
Canadian Water Resources Journal, Vol. 8, No. 3, p 39-57, 1983. 3 Fig, 2 Tab, 27 Ref.

Descriptors: *Floodplain management, *Public policy, *Credit River watershed, *Ontario, Nonstructrual alternatives, Flood control, Public opinion, Economic aspects, Jurisdiction, Urban areas, Institutional constraints.

Analysis of floodplain policy and practice in the Credit River watershed in Ontario revealed that although there has been an increase in the use of non-structural adjustments, municipalities and residents favor structural adjustments to reduce flood hazard at the community level. Several factors contribute to discourage wide spread acceptance and adoption of non-structural adjustments. First, available financial arrangements provide an incentive for water managers to select structural solutions rather than non-structural adjustments. Second, enforcement of non-structural floodplain management alternatives is difficult. Third, communication problems among residents and resource agencies often undermine adjustments, such as flood warning systems. Fourth, jurisdictional fragmentation among resource agencies results in overlapping responsibilities and duplication of management activities which mitigate against a systematic and integrated approach to reducing urban flood problems and allows agencies to evade their responsibilities. These findings support results from an earlier study of floodplain policy and practice in the Grand River watershed in Ontario, and suggest that similar trends may predominate in other Ontario watersheds. (Author's abstract)
W85-04587

CANADIAN WATER MANAGEMENT: A ONE ARMED GIANT,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 6A.
W85-04685

ROLE OF PRICING IN MANAGING THE DEMAND FOR WATER,
Wilfrid Laurier Univ., Waterloo (Ontario).
For primary bibliographic entry see Field 6A.
W85-04686

6G. Ecologic Impact Of Water Development

RESERVOIR SEDIMENTATION IN INDIA -- ITS CAUSES, CONTROL, AND FUTURE COURSE OF ACTION,
Land Use Consultants (International), New Delhi (India).
K. G. Tejwani.
Water International, Vol. 9, No. 4, p 150-154, December, 1984. 15 Ref.

Descriptors: *Sedimentation, *Erosion, *Reservoirs, *Policy aspects, *Management planning, Land use, Agricultural watersheds, Watersheds.

Sedimentation studies of 21 major reservoirs in India have shown that the annual rate of siltation from a unit catchment has been 40 to 2166% more

than was assumed at the time of project design, for an average of about 200% more than the design inflow. The high rates of sedimentation in India are due to the gross misuse of, and mismanagement of, land by man and his animals. Due to the high agricultural land use, usually the land which is unsuited for agriculture is also cultivated and the population density on the cultivated land is very high. At present, India has a good research infrastructure focusing on conservation of soil and water, reducing erosion and rates of sedimentation. Soil erosion and sediment generation can be reduced by biological and mechanical measures. At present, a reservoir is treated as a discrete, independent unit without fully appreciating the fact that it is only one part of a land-water management system which includes the catchment area and command area of the reservoir. It is general practice that a reservoir is conceived, surveyed, planned, designed, constructed and operated without ever giving serious thought to the management of the catchment and the command areas. Policy and planning aspects which need greater attention at present include (1) developing the catchment area, reservoir and command area as a package and (2) recognizing and treating sediment as the greatest pollutant in the developing world. A policy for effective water resource and hydropower development, watershed and command area development must take into account the short term, direct and indirect, private and social benefits, and endeavor to involve the people and the employees in such a way that they feel committed to efficient and effective implementation. (Collier-IVI)
W85-04439

EVALUATION OF ECOLOGICAL FORECASTING PREVIOUS TO THE HYDROELECTRIC DEVELOPMENT OF A NATURAL SUBARCTIC RESERVOIR (EVALUATION ET PREVISION ECOLOGIQUE PREALABLE A L'AMENAGEMENT HYDROELECTRIQUE D'UN RESERVOIR NATUREL HEMIARCTIQUE),
Eco-Research Ltd., Pointe Claire (Quebec).
R. Van Coillie, A. Dumouchel, G. Hayeur, and P. Lamothe.
Canadian Water Resources Journal, Vol. 8, No. 1, p 60-82, 1983. 4 Fig, 7 Tab, 15 Ref.

Descriptors: *Water resources development, *Ecological effects, *Hydroelectric plants, *Subarctic zone, *Reservoirs, *Grande Riviere de la Baleine, *Quebec, *Lake Bienville, Wildlife habitats, Planning, Project planning.

The hydroelectric development of La Grande Riviere de la Baleine basin in Hudson Bay Area of Quebec, presupposes that Lake Bienville, a natural reservoir (1474 sq km) in its head waters, will be transformed into a regulated reservoir with a maximum drawdown of 8.25 m and a 530 km sq increase in its total area. In order to determine the ecological impact of this modification, the methodological approach was based on pre-available data, in situ observations and anticipated physical changes taking into account certain limiting factors in such a study (climatic conditions and the size of the study area). A survey of shorelines, vegetation and aquatic conditions was effected with respect to the anticipated changes. Simultaneously, an attempt was made to determine the utilization of these areas by wildlife resources (caribous, fish, wildfowl). The 5-yr (1975-1980) study showed that the loss of 2/3 of shoreline bogs, 6% spruce stands, 300 islands usually having tundra characteristics, 202 peripheral lakes, the discharge of the lake and its ecotones will have limited repercussions on these resources; the repercussions could be mitigated. (Author's abstract)
W85-04575

SEDIMENT BUDGET STUDY OF CLAMSHELL DREDGING AND OCEAN DISPOSAL ACTIVITIES IN THE NEW YORK BIGHT,
Corps of Engineers, New York. New York District.
J. F. Tavolaro.
Environmental Geology and Water Sciences, Vol. 6, No. 3, p 133-140, 1984. 3 Fig, 4 Tab, 19 Ref.

Descriptors: *Dredging, *Ocean dumping, *Sediment budget, *New York Bight, Turbidity, Environmental effects, Plumes, Waste disposal.

The purpose of this study was to quantify the dry mass of dredged material involved in each stage of typical clamshell dredging and ocean disposal activities in order to identify and quantify 'losses' of dredged material. Turbidity plumes generated at dredging sites were also observed. Approximately 2% of the dredged material was lost at the dredging site. Of this quantity 61% was due to the dredging itself and 38% was due to intentional barge overflow. Approximately 3.7% of the dredged material was lost at the Mud Dump Site during disposal. Total loss of dredged material during these clamshell dredging and ocean disposal operations was calculated to be 5.6%. Observations revealed that turbidity plumes were local features which traveled along the bottom for several hundred feet. These plumes only persisted while dredging was occurring, and ambient conditions were established within a relatively short time after dredging ceased. (Author's abstract)
W85-04598

NATURAL FACTORS AND HUMAN MODIFICATIONS CONTRIBUTING TO MARSH LOSS IN LOUISIANA'S MISSISSIPPI RIVER DELTAIC PLAIN,
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
For primary bibliographic entry see Field 2L.
W85-04603

FACTORS INFLUENCING IMPINGEMENT OF FISH BY LAKE ONTARIO POWER PLANTS,
Hartwick Coll., Oneonta, NY. Dept. of Biology.
For primary bibliographic entry see Field 8I.
W85-04713

SIMULATED EFFECTS OF FERTILIZER MANAGEMENT ON NITRATE LOSS WITH TILE DRAINAGE WATER FOR CONTINUOUS CORN,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. S. Kanwar, J. L. Baker, and H. P Johnson.
Transactions of the American Society of Agricultural Engineers, p 1396-1399 and 1404, 1984. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Computer simulation, *Fertilization, *Tile drainage, *Continuous cropping, *Drainage, Agricultural runoff, Nitrogen, Fertilizer management.

A computer simulation model was used to estimate the impact of different fertilizer management practices for continuous corn production on the loss of nitrate-nitrogen with tile drainage water. Simulations using historical weather data were conducted for seven consecutive growing seasons for a location in Iowa. Currently, nitrogen management by most farmers in Iowa can be represented by a single application (usually NH3-N) of about 150 kg/ha. Management schemes tested to improve the efficiency of nitrogen use include fertilizer application rates, and timing and the number of applications. Model results indicate that lower application rates and multiple applications significantly decrease nitrate-nitrogen losses in both wet and dry years. (Author's abstract)
W85-04739

ENVIRONMENTAL CONTROL AND REGIONAL GROWTH,
Clemson Univ., SC. Dept. of Economics.
B. Yandle.
Growth and Change, Vol. 15, No. 3, p 39-42, July, 1984. 1 Fig, 2 Tab.

Descriptors: *Economic aspects, *Environmental control, *Regional development, Community development, Industrial wastes, Water pollution control, Regulations.

Research is reported which focuses on the relationship between economic development across states, as measured by growth in value added in manufacturing, and actions taken to control pollution. A simple theory of that relationship is presented first. Then, based on a proposition from the theory, an empirical model is posited and results of statistical tests are reported. The evidence presented supports the hypothesis that restrictions on pollution and the associated investment in pollution control capital in the 1970s had a significant effect on regional growth patterns. In three different models, the amount of nonurban space present in a region was significantly and positively associated with growth in value added. The percentage of the labor force employed in industries that faced heavy investments in pollution control capital at the beginning of the period examined showed a significant and negative effect on growth in three models. In many cases heavily polluting industries, required to invest heavily in environmental controls, were concentrated regionally, as accounted for by employment statistics, and the states where they were located in many cases suffered relative to other states. (Baker-IVI)
W85-04755

ENVIRONMENTAL MANAGEMENT PLANNING FOR DAMS AND HYDRO SCHEMES.
International Water Power and Dam Construction, Vol. 37, No. 1, p 41-44, January, 1985. 2 Fig, 2 Tab.

Descriptors: *Environmental effects, *Water resources development, *Dam effects, *Hydroelectric plants, Planning, Water management, Hydroelectric power, Tidal power, Developing countries, Regional development.

Discussions on how to minimize the negative impact on the environment of dams, hydro plants and tidal power schemes formed part of a recent conference on environmental management planning in the mining and energy industries. Several small hydro schemes seem preferable to one large project, where conditions are appropriate, and care should be taken to evalute the impact of large dams in tropical regions. Problems encountered in the Nimas basin tidal power scheme are that time scales for engineering designs and environmental studies differed considerably, many of the locations being studied were rather remote and there was therefore a lack of adequate data and there were separate Federal and Provincial jurisdictions which could confict. A stepped matrix technique was explained for identifying the impact of hydro projects. The technique aimed to formalize the integration of the Environmental Impact Assessment (EIA) and to solve some of the problems which could arise between developers and conservationists. An English case study was presented concerning the EIA on a proposed pumped-storage project at Tintwistle near Manchester. Physical changes which would be brought about through the development of tidal power at the Fundy Bay were described. The use of collective benefits over and above mitigation measures to communities to be affected by a water resources development project was described as it relates to mitigation measures at James Bay. Problems of hydro schemes in developing countries were also considered. (Baker-IVI)
W85-04784

NUTRIENT BUDGETS FOR AGRICULTURAL WATERSHEDS IN THE SOUTHEASTERN COASTAL PLAIN,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. R. Lowrance, R. A. Leonard, L. E. Asmussen, and R. L. Todd.
Ecology, Vol. 66, No. 1, p 287-296, February, 1985. 3 Fig, 6 Tab, 28 Ref. NSF grants DEB 78-10841 and DEB 82-07210.

Descriptors: *Agricultural watersheds, *Nutrients, *Georgia, Precipitation, Streamflow, Fertilizers, Land use, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Chlorides, Water pollution sources.

Watershed-level agroecosystem studies are essential to relate land management to the external environmental effects produced by agricultural nutrients and to enhance our understanding of agricultural nutrient cycles. Inputs and outputs of N, P, K, Ca, Mg, and Cl were determined for four subwatersheds of the Little River in the Georgia Coastal Plain from 1979 through 1981. The four watersheds had 40, 36, 54, and 50%, respectively, of their land in agricultural uses (row crop and pasture). Precipitation inputs and streamflow outputs were determined by field sampling of water volumes and nutrient concentrations. Agronomic inputs (from fertilizer and symbiotic N-fixation) and outputs in harvested material were estimated from land use data; countywide averages of fertilizer applications and crop yield; and plot studies on peanuts and soybeans. All elements except Cl had greater inputs than outputs on each watershed each year. The general order of streamflow loads was Cl > Ca > K > Mg > N > P. Fertilizer inputs exceeded precipitation inputs for all elements on all watersheds. Outputs of N, P, and K in harvest generally exceeded streamflow loads, but harvest outputs of Ca, Mg, and Cl were generally lower than streamflow loads. The two watersheds with more agricultural land had consistently higher loads on N, K, Ca, Mg, and Cl in streamflow and had NO3-N loads 1.5 to 4.4 times higher than loads from the less agricultural watersheds. Streamflow loads on the Little River watersheds were similar to those on other Coastal Plain agricultural watersheds with comparable land use and discharge volumes. Budgets for the upland portion of one of the watersheds indicated that large amounts of N, P, K, Ca, and Mg were not accounted for. About 56 kg/ha/yr of N were retained or lost to gaseous emissions from the uplands. Apparently, a large percentage of the nutrients applied to these watersheds was being retained somewhere in the watershed or being lost in some unquantified way. (Author's abstract)
W85-04826

HUMAN MODIFICATION OF MOLLUSCAN HABITATS IN LITTLE CREEK ESTUARY, VIRGINIA,
Northeastern Univ., Boston, MA. Dept. of Earth Sciences.
R. H. Bailey.
Nautilus, Vol. 99, No. 1, p 1-6, January, 1985. 5 Fig, 8 Ref.

Descriptors: *Little Creek Estuary, *Virginia, *Mollusks, *Habitats, Estuarine environment, Population dynamics, Dredging, Environmental effects.

Mollusks of Little Creek estuary in southeastern Virginia may be grouped into five assemblages indicative of the following benthic habitats: fringe and embayed Spartina marsh, solid substrata, intertidal muddy sand, subtidal muddy sand, and black organic mud. Human activities have signifiantly altered the distribution of mollusks in the creek by modifying basin configuration, hydrograph, and substratum distribution. No molluscan habitat appears to have been entirely eliminated, though all have changed. The substratum distribution map successfully delimits the habitats potentially available to molluscan assemblages even though an expected assemblage may not fully occupy areas of preferred substratum at the instant of sampling. Changes in bottom type associated with human activities in and around the estuary can be monitored easily and quickly, and the ultimate effect on molluscan species or assemblages can be predicted. (Baker-IVI)
W85-04859

BIOLOGY OF BRACHYCENTRUS SUBNUBILUS CURTIS (TRICHOPTERA) IN THE RIVER FROME, DORSET,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2H.
W85-04887

7. RESOURCES DATA

7B. Data Acquisition

ESTIMATION OF SULPHATE IONS IN WATER AND INDUSTRIAL WASTES USING A SOLID STATE MEMBRANE ELECTRODE,
Roorkee Univ. (India). Dept. of Chemistry.
S. K. Srivastava, and C. K. Jain.
Water Research, Vol. 19, No. 1, p 53-56, 1985. 4 Fig, 4 Tab, 11 Ref.

Descriptors: *Sulfates, *Electrodes, *Chemical analysis, *Water analysis, Industrial wastewater, Instrumentation.

Previous attempts to construct electrodes selective to sulfate ions have been susceptible to interference by S(-2), SO3(-2), etc., anions and a number of cations. A solid membrane electrode selective to sulfate ions, has been prepared from hydrous thorium oxide gel with polystyrene as binder. Membranes were prepared by mixing 0.225 g polystyrene and 1.275 g THO and heating the homogenous mass in a die of diameter 1.5 cm kept in a metallurgical specimen mount press at 120 C under a pressure of 6500-7000 psi; stable membranes of 1.5 mm were obtained. Although the electrode is non-Nernstian in nature it can be utilized to estimate sulfate ions in the concentration range 0.1 - 0.0001 M. The useful pH range for this assembly is 6 - 10. It can also be used in partially non-aqueous systems. The membrane electrode shows good selectivity to SO4(-2) ions and there is practically no interference of a large number of anions and cations. The electrode can be used for 4 months without showing any drift in slope, while the linear range and slope decreased slowly after continuous use over a long period. If the electrode shows deterioration, regeneration may be attempted by equilibrating it again with 0.1 M potassium sulfate. It has been used to estimate SO4(-2) ions in wastes from Paper and Pulp and Tannery industries. (Collier-IVI)
W85-04488

MEASUREMENT OF THE PERFORMANCE OF SEWERAGE SYSTEMS AND ASSOCIATED HYDRAULIC STRUCTURES - RECENT DEVELOPMENTS,
For primary bibliographic entry see Field 5D.
W85-04511

DIFFERENT APPROACH TO WATER QUALITY SAMPLING,
Wessex Water Authority, Poole (England).
For primary bibliographic entry see Field 5A.
W85-04524

SMALL FORMAT, HAND HELD HELICOPTER BASED PHOTOGRAPHY FOR MONITORING INDUSTRIAL WATER EFFLUENT PLUMES,
Waterloo Univ. (Ontario). Dept. of Geography.
E. F. LeDrew, and S. E. Franklin.
Canadian Water Resources Journal, Vol. 8, No. 3, p 26-38, 1983. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Path of pollutants, *Aerial photography, *Plumes, *Ontario, *Lake Erie, Industrial wastewater, Remote sensing, Dispersion, Effluents, Dye releases, Helicopters.

In the planning and design of water pollution treatment facilities and in the management of water quality, a significant parameter is the dispersion characteristics of the effluent plumes. The geometry and dimensions of the water effluent plume from a steel making facility at Nanticoke, Ontario, on the north shore of Lake Erie were mapped for six cases with different dispersion characteristics. Small format aerial photography with a dye tracer was used to provide cost effective and accurate information on the dispersion configurations. Interpretation of the remote imagery was verified using water quality data collected during ground information missions co-ordinated with three of the aerial photography flights. From the aerial photography, the effluent boundary is clearly evident. An estimate of the mixing zone of about 120 hectares was based upon a fluid dispersion model. In the six cases mapped, the plume, as determined by chroma contrast, was not greater than 3.2 ha and on one occasion shrank to 0.1 ha. This is significantly less than the model prediction. Only for the case of southeast air flow was the major dispersion component offshore. In the other cases, which represent northwest, southwest, south and northeast air flow, the major dispersion axis was parallel to the shore and typically constrained within 200 m of shore. (Moore-IVI)
W85-04586

TREES SCARS TO DETERMINE THE FREQUENCY AND STAGE OF HIGH MAGNITUDE RIVER ICE DRIVES AND JAMS, RED DEER, ALBERTA,
Calgary Univ. (Alberta). Dept. of Geography.
D. G. Smith, and D. M. Reynolds.
Canadian Water Resources Journal, Vol. 8, No. 3, p 77-94, 1983. 6 Fig, 3 Tab, 20 Ref.

Descriptors: *Tree scars, *Ice jams, *Ice drives, *Red Deer River, *Alberta, Floods, Flood frequency, Flood stage, Trees.

An indirect method of using tree scars to determine stage and frequency of ice drives and jams was tested on the Red Deer River at Red Deer, Alberta. The method involves determining the ages and heights of ice scars on river bank tree trunks. Cores, wedges, and slice cross-sections of scarred trunks were sampled to determine scar ages. Heights of the scars above the river surface were also measured. Often scars on a single tree were overlapped and/or located at different heights on the trunk, thus recording multiple ice drive events. The height and age record of ice scarred trees were then compared against the hydrometric and historical record of ice drives and jams. The comparison suggests that by applying a correction factor the indirect method of using tree scars to assess frequency and stage of ice drives and jams is reliable, and shows considerable promise. The method is particularly applicable to rivers which are ungauged or are without a long term hydrometric record. (Author's abstract)
W85-04589

SAMPLING TUBING EFFECTS ON GROUNDWATER SAMPLES,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
M. J. Barcelona, J. A. Helfrich, and E. E. Garske.
Analytical Chemistry, Vol. 57, p 460-464, February, 1985. 3 Fig, 4 Tab, 18 Ref.

Descriptors: *Sampling, *Tubes, *Errors, *Organic compounds, *Groundwater sampling, Teflon, Polyethylene, Polypropylene, Polyvinyl chloride, Silicone rubber, Volatile compounds, Sorption.

Five common flexible tubing materials were investigated under simulated sampling conditions for the recovery of volatile halocarbons (chloroform, trichloroethylene, trichloroethane, and tetrachloroethylene) frequently identified in contaminated groundwater samples. Tubes evaluated were made of Teflon, polyethylene, polypropylene, polyvinyl chloride, and silicone rubber. Each of these was found to sorb the test compounds in short exposure periods. Virgin tubing materials introduce substantial amounts of leachable organic matter in similar exposures. The Teflon tubing showed the least absorption and leaching problems and should be the tubing material of choice for detailed organic sampling purposes. Absorption into the polymer matrix is the likely mechanism for the errors. A comprehensive evaluation of sampling mechanisms, sample transport tubing, and storage precautions should be made a part of the planning of all groundwater sampling protocols. (Baker-IVI)
W85-04655

METHOD TO MEASURE SUSPENDED LOAD TRANSPORTS IN ESTUARIES,
Institut fuer Meeresforschung, Bremerhaven (Ger-

many, F.R.).
For primary bibliographic entry see Field 2L.
W85-04675

NEAR BOTTOM VARIATIONS OF TURBIDITY IN THE ST. LAWRENCE ESTUARY,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
For primary bibliographic entry see Field 2L.
W85-04677

HYDRAULIC CONDUCTIVITY MEASURED ELECTRONICALLY IN AN AUGER HOLE,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W85-04740

MEASUREMENTS AND ESTIMATION IN HYDROLOGY - IDEAS AND PROPOSALS FOR THE QUANTIFICATION OF ERRORS AND UNCERTAINTIES (MESSUNGEN UND SCHATZUNGEN IN DER HYDROLOGIE - GEDANKEN UND VORSCHLAGE ZUR QUANTIFIZIERUNG DER FEHLER UND UNSICHERHEITEN),
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
W. Schilling.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 3, p 75-78, July, 1984. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Estimation, *Hydrology, *Error analysis, *Uncertainty, Data interpretation, Statistical studies, Management.

In an applied science such as water resources management, both the measurements and model simulations are subject to errors. This holds true for quantitative estimations, which are characteristic of applied science and engineering, due to the ever-present lack of time and money. Two approaches are proposed for statistically quantifying measurement errors and uncertainties in quantitative estimations. A case study of discharge measurements and estimations at low water presents a possible approach to a quantitative characterization of uncertainties in measurements and estimations. The case study shows that even carefully executed measurements yield scattered results. Measurement data gain content and evidential value if their reliability is known or may be safely assessed. In cases where measurements and application of data are in different hands, information about data reliability should be transferred to the user. The methodological approach presented might be used to solve this problem, which is common to all water resources management disciplines. (Moore-IVI)
W85-04805

1981 CCOPE PROBE MESONET CALIBRATION AND MAINTENANCE MEASURES,
Montana Dept. of Natural Resources and Conservation, Helena.
L. Holman, and J. NcInerney.
Available from the National Technical Information Service, Springfield, VA 22161. Bureau of Reclamation Technical Report, June 1983. 67 p, 21 Fig, 7 Tab. Contract/Grant No. 1-07-81-V0175.

Descriptors: *Calibrations, *Maintenance, *Monitoring, *Precipitation, *Electronic equipment, *Quality control, Rain gauges, Wind velocity, Air temperature, Relative humidity, Barometric efficiency, Temperature, Meteorological data collection, Remote sensing, Montana, Telemetry.

A preseason and postseason calibration testing of the PROBE (Portable Remote Observation of the Environment) mesonet monitoring equipment has been conducted to assure data quality for the 1981 Cooperative Convective Precipitation Experiment (CCOPE). Testing of equipment used to measure wind speed, wind direction, temperature, pressure tendency, relative humidity, and precipitation began in August 1979 and continued through June 1982. Many of the calibration procedures and techniques had not been thoroughly tested for operations in Montana due to the prototype nature of the PROBE stations. Calibration and maintenance measures showed reasonable consideration for the many constraints encountered. As a result, the data quality for each parameter was generally good and the overall station performances were considered acceptable.
W85-04928

INFLUENCE OF SAMPLING FREQUENCY ON THE ESTIMATES OF RUNOFF WATER QUALITY,
National Board of Waters, Helsinki (Finland). Water Research Inst.
T. Kohonen.
Available from Govt. Printing Center, P.O. Box 516, SF-00101 Helsinki 10, Finland. Publication of the Water Research Inst. No. 27, 1982. 30 p, 9 Fig, 14 Tab, 59 Ref.

Descriptors: *Data collections, *Statistics, *Data acquisition, *Theoretical analysis, *Water quality, *Nonpoint pollution sources, *Sampling frequency, *Water sampling, Hydrologic data collections, On-site data collections, Mathematical studies, Water analysis, Sampling, Nitrogen, Phosphorus, Suspended solids, Runoff.

The effect of sampling frequency on estimates of quality and loading were studied during 1968 and 1974 in a cultivated and forested basin for the parameters of total N, total P and suspended solids. The deviations of mean values calculated from samples of different sizes from the means obtained using all the available water quality data were investigated by varying the sampling frequency. In the cultivated basin the means of concentration data would be within +/- 20% of the mean of the whole data set in spring, if N and P samples were taken at least five times and suspended solids samples at least three times monthly. In the forested basin the corresponding sampling frequencies were two times monthly for N samples, and four times monthly for P and suspended solids samples. In autumn, the concentration means in runoff water would be within +/- 20% of the mean obtained using the whole data set if three samples per month were taken for N and P and five samples for suspended solids. In the forested basin the same deviation of the mean would be obtained with one N sample, five P samples and sixteen solids samples per month. The other method used to specify the necessary sampling frequency was based on obtaining the mean of the data within a given relative confidence interval about the true mean at a given confidence level. However, the reliability of the results obtained with this method was poor for these data sets. It was concluded that the sampling frequencies chosen only on the grounds of personnel and laboratory resources may reduce the reliability of the conclusions and actions.
W85-04930

AIRBORNE MICROWAVE MEASUREMENTS OF THE SOUTHERN GREENLAND ICE SHEET,
Massachusetts Univ., Amherst.
For primary bibliographic entry see Field 2C.
W85-04962

7C. Evaluation, Processing and Publication

BASIC PROGRAM FOR THE INVESTIGATION OF SPECIES DIVERSITY,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Brewing and Biological Sciences.
C. G. Moore.
Water Pollution Control, Vol. 82, No. 1, p 102-106, 1983. 12 Ref, 1 Append.

Descriptors: *Species diversity, *Computers, *Data processing, Data storage and retrieval, Monitoring.

A program is presented which was written for investigation of the behavior of diversity indices and for the routine processing of monitoring and survey data. The program is interactive and accepts data in a variety of formats including matrices containing zero values. The program is designed to be run from a mainframe terminal. All data can be read from the terminal or species counts and names can be read from a disk file. Data on file can be in the form of a regular matix of counts of individuals of each species in each sample, where the rows are samples and the columns, species. When the program is run, an interactive section follows in which a number of options are chosen and the number of species, samples and individual levels are stated. Thus it is possible to avoid certain routines which are relatively expensive in terms of processor time or paper. (Baker-IVI)
W85-04513

DOING A JOB ON DATA,
Beavercreek Wastewater Treatment Facility, OH.
R. L. Hentrich, Jr., R. Baird, and R. R. Himebaugh.
Water Engineering and Management, Vol. 132, No. 1, p 26-28, January, 1985. 3 Fig, 2 Tab.

Descriptors: *Information systems, *Computers, *Data processing, Data management, Monitoring, Wastewater treatment facilities.

Data management is described for a wastewater treatment facility which monitors a large volume of data on a daily basis. A total of 121 parameters are routinely monitored consisting of meter readings operator measurements, analytical determinations and a number of calculated entries. The total time required each month to calculate daily process control parameters, to perform end of the month column totaling/averaging, and to prepare national Pollutant Discharge Elimination System (NPDES) reports was about 54 hr, or about 7 days of work, or more than 80 days per year lost to record keeping. Installation of The Data Handling System, which is a diskette template program used with Multiplan (a spreadsheet application by Microsoft Corp.) was implemented. This package produced the automatic calculation of parameters and the running average, total maximum and minimum of all columns. The system also offered the automatic calculation and generation of state and federal NPDES reports as well as transfer of all monthly averages to an annual report/log. Reports containing only selected information could also be generated. (Baker-IVI)
W85-04651

INTEGRATED WATER-ENERGY MANAGEMENT SYSTEM FOR CENTER PIVOT IRRIGATION: FUNCTIONAL REQUIREMENTS,
Agricultural Research Service, Fort Collins, CO.
G. W. Buchleiter, D. F. Heermann, and H. R. Duke.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1419-1423, September-October, 1984. 4 Fig, 8 Ref.

Descriptors: *Irrigation operation, *Energy management, *Center pivot irrigation, *Computers, Pumping, Water management, Peak load, Irrigation scheduling, Data processing.

Expanded use of center pivot sprinkler irrigation system in the Great Plains has led to significant increases in irrigated acreage, and dramatic increases in peak load for electricity for pumping. Some power suppliers have implemented load control procedures which reduce the peak demand by interruption of large irrigation loads during peak use periods. An integrated water-energy management system is described which utilizes a microcomputer and radio telemetry system for pump monitoring, pump control, irrigation scheduling and electric load control. The system collects, processes and stores pump operation and weather data automatically yet allows the operator real time control of individual pumps. Less time and effort is required to monitor and control the irrigation pumps. The computer software which prioritizes tasks and has the ability to control pumps at predetermined times allows participation in existing load control programs. The ability to fully participate in a load management program can

provide significant economic incentives to the irrigator and help the power supplier reduce the peak demand. (Moore-IVI)
W85-04742

INTEGRATED WATER-ENERGY MANAGEMENT SYSTEM FOR CENTER PIVOT IRRIGATION: IMPLEMENTATION,
Agricultural Research Service, Fort Collins, CO.
D. F. Heermann, G. W. Buchleiter, and H. R. Duke.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1424-1428, September-October, 1984. 5 Fig, 3 Tab, 4 Ref.

Descriptors: *Irrigation operation, *Energy management, *Center pivot irrigation, *Computers, Pumping, Water management, Irrigation scheduling, Data processing.

Increased energy costs to pump dwindling water supplies has reduced the profitability of irrigated agriculture in some areas of the Great Plains in recent years and pointed to the need for better management of water and energy. An integrated water and energy management system is one method of improving management and participating in a load control program to reduce energy costs. An integrated water-energy management system using a microcomputer provided monitoring, pump control, irrigation schedules, and load control for 15 center pivots in a field test. The system operated with minimal failures. Real-time management data enhances the farmers ability to manage both water and energy to obtain maximum yields. The operator used the system extensively. This system has potential adaptability to a large percentage of center pivot irrigation systems. (Moore-IVI)
W85-04743

INFLUENCE OF SAMPLING FREQUENCY ON THE ESTIMATES OF RUNOFF WATER QUALITY,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 7B.
W85-04930

8. ENGINEERING WORKS

8A. Structures

UNLINED HIGH PRESSURE TUNNELS IN AREAS OF COMPLEX TOPOGRAPHY,
Norges Tekniske Hoegskole, Trondheim. Dept. of Geology.
E. Broch.
International Water Power and Dam Construction, Vol. 36, No. 11, p 21-23, November, 1984. 4 Fig, 10 Ref.

Descriptors: *Tunnels, *Topography, High pressure, Design criteria, Mapping, Stress, Leakage.

In regions with complicated topography, care must be exercised when designing unlined high pressure tunnels or shafts. Protruding ridges and noses do not add much to the stresses in the rock masses in a valley side, and should therefore be neglected. Simplified topographic maps with smooth contour lines, drawn inside such protruding features, should be prepared. Based on these maps, revised vertical profiles can be drawn. These revised profiles should be the basis for the design of high pressure tunnels or shafts without steel linings. In an example, leakage from a tunnel with a water head of 310 m may, in part, be caused by an overestimation of the overburden under a protruding ridge in a valley in a tropical environment. Open cracks in the concrete lining indicates that a concrete-lined tunnel should from a design point of view, be treated as a unlined tunnel. (Baker-IVI)
W85-04412

ECONOMIZING THE DIAMETER OF TUNNELS,
Pipe and Canal Services A.G., Zumikon (Switzerland).
W. Stocker.
International Water Power and Dam Construction, Vol. 36, No. 11, p 24-28, November, 1984. 6 Fig, 3 Tab, 5 Ref.

Descriptors: *Economic aspects, *Design criteria, *Tunnels, Friction, Cost analysis, Tunneling, Tunnel linings.

The standard procedures for finding the most economical diameter of tunnels is reviewed. There is a certain range of friction factors where minimal costs will result. The observation of a distinct least cost minimum has obvious consequences in design. Whenever the rock will allow the designer to choose the standard of finish, the type of plant to be built will primarily influence this standard. For a project producing high cost energy such as a storage plant, a higher standard seems to be adequate. Provided the rock is suitable for making such an evaluation, a low standard will always be the most economical for both types of plants. For the lowest limits, which are hardly ever reached for practical reasons, the lowest practical standard will always lead to the most economical solution. Another influence which has become important only during the past 15 years is the difference in finish when using a tunnel boring machine, compared with that obtained by conventional drilling and blasting methods. In a storage scheme project, producing peak demand energy and with good rock conditions, the cost-conscious engineer would tend towards a bored tunnel solution. With the same cost/design standard thinking, a steel-lined tunnel is not economical. In cases where the permeability of the rock is questionable, a solution with a reinforced crack-limiting concrete lining as suggested by modern design techniques should be evaluated against a conventional steel lining. (Baker-IVI)
W85-04413

UNDERWATER PIERCING OF A TUNNEL,
Norwegian Hydrodynamic Labs., Trondheim.
O. Solvik.
International Water Power and Dam Construction, Vol. 36, No. 11, p 33-36, November, 1984. 6 Fig.

Descriptors: *Tunnel construction, *Hydroelectric plants, *Explosions, Norway, Water resources development, Construction, Erosion, Landslides, Reservoirs, Lakes.

Norwegian consultants and contractors have been confronted with the task of blasting a final penetrating passage that will open the way for the water in a reservoir to flow through to the hydropower turbines. Norway has almost certainly led in this area because of its special topographical and geological conditions. The glacial activities have created a number of natural and very deep lakes forming cheap reservoirs. Piercings at depths up to about 100 m have been performed. Problems tend to increase with depth, but unsuccessful penetration can occur at any depth. When planning an underwater piercing there should be an estimated reservoir requirement based on the hydrological conditions and the profitability of the natural reservoir. The most important condition is the bottom topography of the lake which determines the size of the natural reservoir. Secondary effects to consider include the danger of slides when the water level is lowered, wave erosion along the lowered new shoreline, erosion at all streams and rivers flowing into the lake, and groundwater erosion in the newly exposed dry shoreline. Methods of penetration can be roughly divided into two categories: penetration against the open tunnel shaft (open system); and penetration against the closed tunnel shaft (closed system). (Baker-IVI)
W85-04415

HIGH-HEAD SPILLWAY WITH SWIRLING OF THE FLOW IN THE OUTLET SECTION,
E. G. Donchenko, P. E. Lysenko, and G. A. Chepaikin.
Hydrotechnical Construction, Vol. 18, No. 3, p 115-119, March, 1984. 4 Fig. Translated from Gidrotekhnicheskoie Stroitel'stvo, No. 3, p 17-20, March, 1984.

Descriptors: *Spillways, *Hydroelectric plants, *Construction methods, Energy dissipation, Eddies, High-head dams.

A spillway with a regulating device called an eddy gate, which swirls the flow in the outlet section of the spillway, was proposed as an alternative to the ordinary tunnel spillway of the high-head river hydropower work to reduce the construction time, cost, and work involved. Energy dissipation is accomplished inside the proposed spillway and thus, energy dissipators of the flow at the spillway exit are not required. Ordinary, simple vertical-lift and radial gates can be used in the proposed spillway to regulate and discharge the flow. The hydraulic model investigation performed indicates that at all openings of the main gate of the spillway, the gate operated in the same manner as in ordinary tunnel spillways. Swirling of the flow in the outlet section behind the gate did not affect the operation of the gate. The proposed spillway does not require a long shutdown for converting from a diversion regime to a service regime because the gates can be installed during the construction. (Shieh-IVI)
W85-04420

OPTIMIZATION OF DESIGN PARAMETERS OF COMPLEX SURGE TANKS,
N. N. Arshenevskii, V. V. Berloin, and O. A. Murav'ev.
Hydrotechnical Construction, Vol. 18, No. 4, p 145-148, April, 1984. 5 Fig, 1 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 12-14, April, 1984.

Descriptors: *Surge tanks, *Optimization, Design criteria, Hydroelectric plants, Costs, Pressure conduits, Diversion structures, Surge pipes, Water level.

Surge tanks are complicated and costly structures. The problem of optimizing the design of a surge tank is solved in the scope of the more general problem of optimizing the design of the pressure conduits of hydrostations and structures on them. The optimization problem consists of finding, for a given system of pressure conduits and design regimes, a combination of design parameters for the surge tank such that it determines its minimum cost. The initial data of the optimization problem are: the geometric characteristics of the conduits; the design regimes of buildup and drop of the load, the elevations of the upper pool level corresponding to them and the roughness coefficients of the conduit lining; the maximum allowable piezometric head in the diversion and minimum allowable decline of the level in the tank; range of variation of the design parameters being optimized; unit cost of structural elements of the tank. The basic principle of the proposed method is a hierarchical approach to the selection of the optimal combinations of the investigated parameters, the number of which determines the number of levels of calculation. A differential surge tank is considered in which the optimization is concerned with the diameter of the surge pipe, elevation of the overflow of the surge pipe, area of the chamber around the surge pipe, and area of the orifices. The method makes it possible to compare variants of surge tanks of various types with respect to their cost. The diversion is not taken into account, since a unified maximum pressure is assigned as the initial conditions of calculation in it. (Baker-IVI)
W85-04426

EXPERIENCE IN OPERATING THE BRATSK RESERVOIR,
For primary bibliographic entry see Field 4A.
W85-04429

JAMUNA RIVER 230 KV CROSSING - BANGLADESH, I. DESIGN OF FOUNDATIONS,
Rendel, Palmer and Tritton, London (England).
L. W. Hinch, D. M. McDowell, and P. W. Rowe.
Proceedings of the Institution of Civil Engineers, Part 1, Vol. 76, p 927-949, November, 1984. 14 Fig, 3 Tab, 10 Ref, 1 Append.

Field 8—ENGINEERING WORKS

Group 8A—Structures

Descriptors: *River beds, *Bangladesh, *Jamuna River, *Caissons, *Transmission lines, *Foundations, *Design criteria, Streambeds, Earthquakes, Engineering.

A powerline crossing of the Jamuna River (Bangladesh) has been the subject of studies and investigations for some 20 years but the project has hitherto lacked the economic viability needed to proceed. The Jamuna River Crossing is part of the 230 kV East-West Interconnection project which interconnects the East and West networks of the Bangladesh Power Development Board. In 1979 consultants were appointed to update, revise, and develop earlier design information and to carry the project through its conclusion. The best location for the crossing had previously been defined to be at Aricha, 6 km above the confluence of the Ganges and Jamuna Rivers. This location was considered to be less likely to be bypassed by the changing river course than any other location along the river. At this point the river is 12 km wide in the rainy season and gives rise to possibly the longest river crossing of its kind in the world. When the initial design studies were made before 1968, the Ganges was about 10 km from the line of the proposed crossing; by 1979, the Ganges had migrated to within 2 km of the line. Design of the caissons had to allow for all possible future riverbed movements as well as for local scour due to the caissons themselves. The caissons were checked using a computer to check ultimate load design and additional loading conditions were introduced to allow for earthquake effects and ship impacts. Caissons were not designed for the worst combination of all possible forces; with respect to ship impact, a force of 500 t was taken at the top of the caisson which produced a moment at the point of maximum bending which was appreciably less than the moment from wind loads on the tower and only about half of the moment due to earthquake. (Collier-IVI)
W85-04470

MASINGA DAM IN KENYA,
Watermeyer, Legge, Piesold and Uhlmann, Braamfontein (South Africa).
D. D. A. Piesold, J. Tattersfield, and C. W. Hodgson.
Proceedings of the Institution of Civil Engineers, Part 1, Vol. 76, p 999-1025, November, 1984. 15 Fig, 2 Tab, 1 Append.

Descriptors: *Masinga Dam, *Kenya, *Tana River, *Design criteria, *Dams, *Hydroelectric plants, Powerplants, Streamflow, Reservoir capacity, Runoff, Suspended load, Design flow.

Masinga Dam, officially opened in December, 1981 on the Tana River, is one of Kenya's largest development projects. Sited at the head of the Seven Forks reach, the 1560 M cu m of storage provided by the reservoir will increase power output at the vital hydroelectric power stations downstream and secure flows for irrigated agriculture in the lower reaches. The principal elements of the scheme are a 55 m high, 2.4 km long earth/rock dam (4.9 M cu m fill volume), and overflow chute spillway (capacity 2200 cu m/s) and a 40MW power station. A design flood was estimated from daily historical runoff records for durations of 1-60 days; the 100 year flood was estimated as 1745 cu m/s and the 10,000 year inflow to the reservoir was estimated to be 3100 cu m/s before routing. Assuming an average suspended sediment density of 1.4 t/cu m and allowing for bedload in addition to recorded suspended sediment, the estimated mean annual loss of reservoir capacity is 3.0 M cu m, which is relatively small compared to the reservoir gross capacity. The embankment was constructed from locally-won rock and soils. The river bed height of the dam is 55 m and the crest length of the main wall is 2.4 km. Two saddle dams west of the main embankment have an additional crest length of 1 km. The spillway design flow, with a return period of 1 in 10,000 years, was determined to be 2700 cu m/s after flood routing through the reservoir. The best way to accomodate this was to construct a main spillway of 2200 cu m/s capacity supplemented by an erodible fuse-plug capable of passing the remaining flow. (Collier-IVI)
W85-04471

DEVELOPMENTS IN MATERIALS AND DESIGN TECHNIQUES FOR SEWERAGE SYSTEMS,
Binnie and Partners, London (England).
E. W. Flaxman, and N. J. Dawes.
Water Pollution Control, Vol. 82, No. 2, p 164-178, 1983. 4 Fig, 1 Tab, 35 Ref.

Descriptors: *Design criteria, *Construction, *Sewers, Hydraulics, Reviews, Corrosion, Pipes.

During the last 20 years there has been a considerable increase in understanding the forces and processes that affect the design and durability of sewerage systems. Some of the advances have been the result of original research, but probably more important has been the assembly and presentation of existing technologies in forms which engineers can readily apply to design problems. Gaps in current knowledge include the adoption of the Colebrook-White equation for all sewer flow calculations; a reliable system for assessing the roughness values of gravity sewers, taking account of pipe sliming and silted inverts; further studies to verify appropriate roughness values for sewage pumping mains; field investigations to confirm sediment transport theory for sand in sewage; corrosion-resistant pipes capable of being made in remote locations and of being safely installed without specialist supervision, covering the full range of sizes; a review of the economies of pipe bedding and strengths; and an international compendium of current sewerage research projects. (Baker-IVI)
W85-04517

'RENNFELD' SMALL-SCALE HYDROELECTRIC POWER PLANT NEAR PFORZHEIM (KLEINWASSERKRAFTANLAGE 'RENNFELD' BEI PFORZHEIM),
Weber (Werner) G.m.b.H., Pforzheim (Germany, F.R.).
A. Hutarew.
Wasserwirtschaft, Vol. 74, No. 12, p 577-580, December, 1984. 7 Fig.

Descriptors: *Hydroelectric plants, *Pforzheim, *Germany (Federal Republic), Construction, Small hydropower, Trash racks, Automation, Turbines.

Construction of the Rennfeld hydroelectric power plant at Pforzheim, Federal Republic of Germany demonstrated that small-scale plants (1 MW) can be completed economically within a short time (11 months). Application of suitable rates for energy produced by such low-capacity installations allows them to move to within the profit zone. The new Rennfeld plant is located directly in the bed of the Enz river. Head was thereby increased from 3.8 to 5.7 m; cost-effective construction was realized, and profitability was increased. Rennfeld consists of a three-field weir (each 6.9 m wide) with the turbine house forming the downstream face of the left weir field and an access house containing hydraulic and control equipment on the river bank. In order to fully exploit discharges of 4-20 cu m/sec, two Kaplan pipe turbines with bevel gearing were installed. The turbine intakes were equipped with a horizontal rack installed at 45-degree angle and having a rotating cleaning machine. A cleaner for each turbine field removes material from the horizontal rack to a 1-m wide vertical rack, whose cleaning machine takes it into the access house. Automatic control takes the form of four separate modules (water level, gates, machines, trash rack) coordinated through a control module, which also incorporates optical-observation data and communicates with central control in the city. Water regulation by an upstream weir and favorable conditions during the 1984 discharge year facilitated the short construction time. (Gish-IVI)
W85-04629

DETERMINING EXTRANEOUS FLOWS IN WASTE WATER SYSTEMS,
Waterloo Univ. (Ontario).
B. A. Benninger.
Canadian Water Resources Journal, Vol. 9, No. 3, p 40-43, November, 1984. 1 Fig, 7 Ref.

Descriptors: *Sewer inflow, *Sewer infiltration, *Sewer systems, *Maintenance, Infiltration, Costs, Economic aspects, Linings, Grouting.

Inflow and infiltration may exert stress on the hydraulic capacity of a sewage treatment system. Extraneous flow results in increased sewage treatment cost and an accelerated requirement for sewage treatment plant expansion. Such costs can be avoided or possibly deferred if the extraneous flows are detected and rectified. Should it be suspected that a system may be experiencing an inflow/infiltration problem to the extent that the cost of accommodating the additional water may be greater than the cost of detecting and repairing the sources of the problem, then an inspection and costing of a rejuvenation program for the system should be implemented. Methods for conducting evaluation surveys include smoke testing, sewer damming, semi-permanent transducers, and closed circuit television survey. Once the sources of infiltration and inflow have been located and it has been decided that it is economical to rectify the problem the municipality must examine the available modes of system rejuvenation. Available methods include: excavation and replacement; insertion of plastic liners into existing sewers; and injection of adhesive compound and compaction. In high traffic areas where sewer pipes are structurally intact but porous or loosely jointed, the method of plastic relining may supercede actual removal and replacement. Under certain circumstances of cracked pipes, a sleeve packer and an adhesive grouting mixture may be utilized to mend the leaks; this approach allows the interior of the suspect pipe to be lined with a thin layer of concrete adhesive - however, surrounding groundwater pressure may cause failure of the internal repair. (Collier-IVI)
W85-04689

RELINING: THE FEASIBILITY OF INSERTING PIPE INTO EXISTING SEWERS,
Duratron Systems Ltd., Scarborough (Ontario).
H. St. Onge.
Canadian Water Resources Journal, Vol. 9, No. 3, p 58-65, November, 1984. 6 Fig, 2 Tab, 4 Ref.

Descriptors: *Relining, *Sewers, *Maintenance, Pipelines, Polyethylene pipe.

Insertion renewal systems for collecting wastewater are an economical means of environmental protection. Relining involves the insertion of polyethylene pipe through existing sewers and along the existing line of grade. It facilitates the replacement of failing sewers without disrupting vehicle and pedestrian traffic or interrupting consumers' service. The cost of relining is about one half that of replacing sewer lines. The procedure for relining may include video analysis, removal of obstructions, cleaning of sewers, insertion of shafts, insertion of the polyethylene pipe, anchoring and sealing, and reconnection of laterals. Operating benefits include: a smooth interior for improved hydraulic capacity; the sealed system prevents entry of groundwater, roots, and debris; and minimization of sewer backup and flooded basements. More customers can be added to the system in the long term and reduction of extraneous water allows the treatment plant to operate with improved efficiency. (Collier-IVI)
W85-04693

SOLVING THE PROBLEM OF REHABILITATING DECAYED SEWER SYSTEMS,
Water Research Centre, Marlow (England).
B. Odell.
Water and Pollution Control, Vol. 122, No. 4, p 25, 36-37, July/August, 1984.

Descriptors: *Sewer systems, *Rehabilitation, *England, Linings, Maintenance, Computers, Closed circuit television.

Sewer collapses may be caused by long term leakage of sewage from a cracked sewer, insidiously washing away the surrounding soil. The disruptive cost of these sewer collapses is high and can involve major dislocation of transport and com

merce. For coping with flooding problems the main objectives have been to avoid the disruption and cost of replacing old sewers. Duplicate sewers or the installation of new linings are possibilities. Preventive maintenance efforts should initially be concentrated on the 20% of the sewage system which is in critical condition, leaving the remainder alone for the present time. In response to the need, a closed circuit television process has been refined to produce high resolution pictures from inside small diameter pipes and a variety of remotely controlled equipment has been developed. This includes precision machines for internal pipe drilling, water jet cutters to remove branch pipe protrusions and equipment for spray on linings. A number of computer models have been devised to analyze flow and assist the planning of remedial measures. (Baker-IVI)
W85-04768

FLOW BALANCING SYSTEM FOR STORMWATER AND COMBINED SEWER OVERFLOW,
For primary bibliographic entry see Field 5D.
W85-04772

URIBANTE-DORADAS HYDRO DEVELOPMENT IN VENEZUELA,
CEH Ingenieros Consultores, Caracas (Venezuela).
D. F. Fernandez.
International Water Power and Dam Construction, Vol. 37, No. 1, p 35-38, January, 1985. 7 Fig.

Descriptors: *Dam construction, *Uribante-Doradas development, *Venezuela, Water resources development, Geological fractures, Hydroelectric plants, Planning, Water management.

To provide power supply to the western region of Venezuela, the government-owned electrical power company is constructing the Uribante-Caparo hydroelectric project, with a generating capacity of 1276 MW. The project is described with particular emphasis on the first stage, known as the Uribante-Doradas development, where construction is well advanced. The project area contains a system of faults which run parallel to the Andes range. When completed the project will include three reservoirs, four earthfill dams with heights between 115 and 140 m, two power tunnels, three powerhouses and a diversion tunnel. Details are provided on reservoir works and power generation works. (Baker-IVI)
W85-04783

MALAWI - DRIVING A 9 M DIAMETER POWER CONDUIT WITH LOW COVER AT NKULA FALLS,
Watermeyer, Legge, Piesold and Uhlmann, London (England).
F. Legge.
Civil Engineering Contractor (Johannesburg), Vol. 16, No. 10, p 31, 33, 35, 37-41 and 45, 1982. 18 Fig, 4 Tab.

Descriptors: *Design criteria, *Power conduits, *Tunnels, *Malawi, *Nkula Falls, Conduits, Tunnel construction, Geology, Rock properties, Tunnel linings, Weathering.

A case study is offered of the power conduit of the Nkula Falls hydroelectric scheme in Malawi. The geotechnical, design and constructional aspects are described of a tunnel 1.06 km in length with an excavated span of 9 m and 30 m cover in gneiss with significant discontinuity weathering. The scheme operates under a head of 58 m and the power conduit structure is 1.39 km in length, the first 330 m of which, linking the intake structure to the tunnel, are of reinforced concrete cut and cover construction. Jointing of the rock mass and associated weathering created difficult tunnelling conditions in the major part of the tunnel. Extensive use of temporary support measures was necessary for almost half the tunnel length. The tunnel lining sequence is described. (Baker-IVI)
W85-04819

CASE STUDY, POTABLE WATER RESERVOIR, TUKTOYAKTUK, NORTHWEST TERRITORIES,
Government of the Northwest Territories, Yellowknife. Water and Sanitation Section.
For primary bibliographic entry see Field 6A.
W85-04927

STEWART MOUNTAIN DAM CONCRETE CORE ANALYSIS - 1983,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
T. A. Gaeto.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-84-5, May 1984. 33 p, 11 Fig, 3 Tab, 2 Append.

Descriptors: *Concrete dams, *Compressive strength, Dams, Concrete mixes, Strength, Poisson ratio, In situ tests, *Arizona.

The results of testing approximately 280 feet of 6 inch diameter concrete core extracted from Stewart Mountain Dam, Arizona during the spring of 1982 are reported as part of a continuing effort to monitor the quality of the concrete in this structure. Stewart Mountain Dam is located 41 miles northeast of Phoenix, Arizona. The dam creates a reservoir with a capacity of 70,000 acre-feet. The construction records indicate a concrete mix with a high and wide ranged, water to cement ratio. Good concrete quality control and placement practices by today's standards were not employed throughout construction. The average compressive strength for all specimens tested was 5.25 lb/sq in, above average for mass concrete of this age. Average splitting tensile strengths seem high, at almost 500 lb/sq in. Specimens tested under rapid loading conditions, both compressive and splitting tensile, showed the concrete to be of consistently good quality. Modulus of elasticity and Poisson's ratio are normal for mass concrete, averaging 4.0 x 10 to the (6) power lb/sq in and 0.23 respectively. The movement of the dam since 1968 has been less than the potential indicated by laboratory measurements of expansions due to alkali-aggregate reactions. Based upon the continued reaction potential, monitoring of the dam through instrumentation should be continued. The standard method of core extraction and physical properties testing may never show the real problem, if in fact there is one. An alternative may be the use of state-of-the-art in-situ testing.
W85-04938

MEDIUM AND SMALL MASONRY ARCH DAMS IN CHINA,
Hangzhou Regional Center For Small Hydropower (China).
N. Zheng, and J. Lu.
International Water Power and Dam Construction, Vol. 37, No. 2, p 21-25, February, 1985. 10 Fig, 2 Tab.

Descriptors: *Dam construction, *Arch dams, *China (Peoples Republic), *Masonry dams, Construction materials, Concrete, Rocks, Hydroelectric power.

The masonry arch type is the most common type of dam used for small hydro projects (SHP) in China. This type of dam can be built using indigenous materials; it is economical and safe. Only a few machines are needed for construction and Chinese peasants are familiar with the technique of masonry placement. It is easier to pass floods over masonry dams under construction and proceed with construction during the rainy season. The various types of masonry dams seen in China include gravity arch, single curvature arch and double curvature arch dams. Also used are the massive head arch, multiple arch, hollow arch, hinge arch, two-storey arch, assembly arch, arch with multiple curvature and arch dams with peripheral joints. Specifics are given as to construction materials including rock, sands, cement mortar, fine gravel concrete, small-stone mortar, mixed mortar, and the strength of masonry. Spillway and energy dissipation and the control of seepage through the dam are also considered. (Baker-IVI)
W85-04950

8B. Hydraulics

RESERVOIR STORAGE EQUATION EXPERIMENTALLY VERIFIED,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
For primary bibliographic entry see Field 2E.
W85-04416

MATHEMATICAL MODELING OF HYDRAULIC REGIMES IN THE TRANSITION BETWEEN THE SURGE TANK AND CONDUITS OF A HYDROELECTRIC STATION,
N. N. Arshenevskii, V. V. Berlin, and O. A. Murav'ev.
Hydrotechnical Construction, Vol. 18, No. 3, p 105-110, March, 1984. 4 Fig, 2 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 10-14, March, 1984.

Descriptors: *Mathematical modeling, *Hydraulics, *Hydroelectric plants, *Surge tanks, Computer models, Hydraulic design.

A computer model characterizing the hydraulic regimes of the transition between the surge tank and conduits of a hydroelectric station was developed as a design means to facilitate the processing of a large volume of data. This computer model allows analytical determination of the relationship between the specific energies of flows in the fork of a surge tank in the complete range of their hydraulic characteristics. It was established that the resistance coefficient of a transition between the surge tank and conduits is composed of a constant component depending on the geometry of the transition and a variable component depending on the type of discharges in the branches. Good agreement between predicted and observed values of specific energy of the transition between the surge tank and conduits was obtained. (Shieh-IVI)
W85-04419

HIGH-HEAD SPILLWAY WITH SWIRLING OF THE FLOW IN THE OUTLET SECTION,
For primary bibliographic entry see Field 8A.
W85-04420

KINEMATIC STRUCTURE OF FLOW IN A TRAPEZOIDAL CHANNEL,
E. K. Rabkova, V. I. Elfimov, and H. P. Martines.
Hydrotechnical Construction, Vol. 18, No. 3, p 124-128, March, 1984. 3 Fig, 1 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 24-27, March, 1984.

Descriptors: *Channel erosion, *Erosion, *Hydraulics, Cross-sections, Channel shape, Model studies, Chezy equation.

Development of deformations in erodible channels is determined by the velocity characteristics of the flow interacting with the bed soils. In this paper, the results are reported of a study of the kinematic structure of the flow in trapezoidal channels. The objective was the determination of the cause of deformation of the canal slopes at standard (non eroding) mean flow velocity. The laboratory results indicate a considerable role of transverse turbulent eddy flow, i.e., secondary currents, in the formation of the kinematic structure of the flow. Under conditions of designing earth canals for a maximum permissible noneroding velocity, a trapezoidal channel shape is potentially unstable. In such channels, the velocity distribution over the width does not agree with Chezy calculation. To provide slope stability, the actual velocity distribution must be considered, and this leads to a decrease in the design velocity. The authors recommend the rejection of a trapezoidal shape in favor of a parabolic configuration. (Keenan-IVI)
W85-04421

EXPERIENCE IN THE OPERATION OF HYDRAULIC STRUCTURES AND EQUIPMENT OF HYDROELECTRIC STATIONS,
For primary bibliographic entry see Field 8C.
W85-04423

DISCONTINUOUS WAVE ON STRETCHES OF AN ABRUPT EXPANSION OF A CANAL,
A. V. Mishuev, S. I. Levina, A. A. Gusev, and A. A. Seledkin.
Hydrotechnical Construction, Vol. 18, No. 4, p 137-142, April, 1984. 4 Fig, 5 Ref. Translated from Gidrotekhnichesko Stroitel'stvo, No. 4, p 6-9. April, 1984.

Descriptors: *Discontinuous waves, *Unsteady flow, *Canals, *Pumping, Diversion, Free-surface flow, Waves, Reverse bores, Dam failure, Gates, Velocity.

Design studies dealing with the diversion of part of the runoff of rivers to other areas call for the construction of long canals along which pumping stations will be constructed. The pumping stations are to be equipped with the largest modern hydraulic machinery, which will cause waves to be propagated along the canal. To provide trouble-free operation it will be necessary to thoroughly investigate problems related to unsteady flow. Results of studies are presented for one of the forms of the free surface (flow regime) characterized by the formation of a reversed bore on a wide stretch during supercritical flow in a narrow stretch, and also the results of an experimental investigation of wave formation in the case of complete instantaneous failure of a dam for the case of abrupt expansion of the lower pool. Two series of investigations were conducted. In the first series the discontinuous wave was formed in the narrow part of the flume by opening a gate and then propagating in the lower pool the wave interacted with the expansion. In the second series of studies the wave was formed by opening the gate immediately at the site of expansion. The theoretical solutions obtained agree satisfactorily with the results of the experimental investigations and can be used for preliminary estimations of the values of the depths and cross-sectional average velocities at characteristic sites. (Baker-IVI)
W85-04424

COMPARISON OF DYNAMIC FLOW ROUTING METHODS FOR URBAN DRAINAGE SYSTEMS (VERGLEICH HYDRODYNAMISCHER BERECHNUNGSANSATZE ZUR ABFLUBERMITTLUNG IN KANALNETZEN),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
T. G. Schmitt, and H. H. Hahn.
Wasserwirtschaft, Vol. 74, No. 11, p 530-537, November, 1984. 7 Fig, 7 Tab, 20 Ref.

Descriptors: *Flow routing, *Urban drainage, Hydrodynamics, Storm wastewater, Pipes, Sewer systems, Mathematical equations, Hydraulic regime, Slope.

Four different methods of dynamic flow routing are described. They are widely used in sewer network design and in estimating stormwater overflow. The effects of frequently made simplifying assumptions in solving the dynamic flow equation is demonstrated for a single pipe and for three different sewer networks. Comparing the results obtained with simplified methods with those from a complete solution of the flow equations indicates that the acceptability of simplifications mainly depends on mean channel slope and volume and on the occurrence of special hydraulic regimes. This is particularly true if the system is surcharged or if control structures are activated. (Author's abstract)
W85-04627

SIMPLEST APPROXIMATE COMPUTATION OF DAM-BREAK WAVES (DIE EINFACHSTE NAHERUNGSBERECHNUNG VON DAMMBRUCHWELLEN),
Ingenieurburo, Aarau (Switzerland).
M. Herzog.
Wasserwirtschaft, Vol. 74, No. 12, p 583-585, December, 1984. 6 Fig, 2 Tab, 22 Ref.

Descriptors: *Dam failure, *Dam-break waves, *Mathematical equations, Malpasset, France, Waves, Flood waves.

A simple and clear mathematical method of approximation was developed to describe the dam-break wave at Malpasset, France that occurred in 1959. A simple procedure is possible even without consideration of the non-steady nature of the flow. The Malpasset reservoir had a capacity of 48 million cu m, practically all of which flowed out within an hour. The breach area was later calculated to be 3,700 sq m. With an energy level over the lowest point of the breach of 50 m, the first equation calculates a maximal flow of 42,100 cu m/sec, which is 3 times as high as average flow and 1,000 times as high as the bottom-outlet capacity. The new procedure calculated that the flood wave reached the town of Frejus after 22 minutes (21 minutes in reality) and that emptying of the reservoir lasted 59.5 minutes (61 minutes in reality). Accuracy was therefore excellent despite the fact that only one cross-section of the 9.3-km-long Reyran valley between the dam and Frejus was used for the computation. (Gish-IVI)
W85-04630

PRESSURE RISES DUE TO UNSTEADY FLOW, ESPECIALLY IN HIGH-LIFT NAVIGATION LOCKS (DRUCKERHOHUNGEN AUFGRUND INSTATIONARER STROMUNGSVORGANGE, INSBESONDERE IN SCHIFFSSCHLEUSEN MIT GROSSEN STUFENHOHEN),
Am Ruppurrer Schloss 5, 7500 Karlsruhe 51.
P. M. Schmelzle.
Wasserwirtschaft, Vol. 74, No. 12, p 586-591, December, 1984. 9 Fig, 3 Ref.

Descriptors: *Locks, *Unsteady flow, *Pressure, Mathematical equations, Hydraulic structures, Gates, Hydraulics.

A new mathematical procedure is described for calculating maximum pressure rise in navigation locks and similar hydraulic structures. A precondition of the procedure is that the lock is short enough and the closure times are long enough that elasticity influences can be disregarded. The system can then be seen as incompressible, and flow processes can be described with the aid of the Bernoulli equation for unsteady flow. These conditions are met by an emergency stop, in which the lock gate is stopped before it is fully open and is then closed, as was shown through studies of a model lock and experiments conducted at the operating lock. In hydraulic systems without oscillations in mass (no changes in water level within the system), maximal possible pressure rise before closure is independent of the opening process and depends only on the closing movement. Equations are give to calculate pressure rises for both linear closures (ideal closing process) and non-linear closures: in the former calculation, it is assumed that flow through the lock changes proportionally with time; while in the latter, the actual throttle effect of the gate at the end of the closure is determined, this being the deciding factor for the pressure rise. During non-linear procedures, the maximal pressure rise occurs either exactly at the moment of closure or immediately before it. Agreement between calculations using the new procedure and actual measurement was very good. (Gish-IVI)
W85-04631

HYDRAULIC MODELLING AT THE PIEDRA DEL AGUILA DAM,
Ecole Polytechnique Federale de Lausanne (Switzerland).
J. Bruschin.
International Water Power and Dam Construction, Vol. 37, No. 1, p 24-28, January, 1985. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Hydroelectric plants, *Hydraulic models, *Model studies, *Piedra del Aguila Dam, *Argentina, Dam construction, Design criteria, Cavitation.

Piedra del Aguila is a major hydroelectric scheme in Argentina. Extensive tests, aimed to help and check the design of the main hydraulic structures, were run for more than two years on five models at scales from 1:20 to 1:130. High priority problems were identified as: the river diversion and closure; spillway capacity, chute flows, hydraulic jump sweepout, jet impact location and flow aeration; bottom outlet free surface flows, aeration, jet impact location and discharge capacity at various reservoir levels during impoundment; erosion-deposition pattern of alluvium and weathered rocks at jet impact locations, back-water effects and their prevention and/or elimination; and, vibration risks of the very large spillway crest taintergates, specifically suppression of air entraining vortices. Much attention is given to the prevention of cavitation. (Baker-IVI)
W85-04781

8C. Hydraulic Machinery

EXPERIENCE IN THE OPERATION OF HYDRAULIC STRUCTURES AND EQUIPMENT OF HYDROELECTRIC STATIONS,
D. Z. Al'terman, and A. F. Dmitrukhin.
Hydrotechnical Construction, Vol. 18, No. 3, p 133-136, March, 1984. 5 Fig, 1 Tab, 2 Ref. Translated from Gidrotekhnechesko Stroitel'stvo, No. 3, p 34-36, March, 1984.

Descriptors: *Operating policies, *Hydroelectric plants, *Water hammer, Gates, Conduits, Costs.

Water hammer in pressure conduits occurring at hydroelectric stations following rapid unloading of the units can be reduced provided the turbine gate apparatus is closed according to a specially prescribed program. In this paper, an economical design of a programmed closing device is presented. The device can be readily retrofitted at existing installations. At various hydrostations the hammer pressure can be reduced by thirty to fifty percent of its existing value without an additional increase of speed when dropping the load. A decrease of water hammer in the conduits and the resultant reduction of working stresses in the casing will extend the permissible service life, reduce operating costs, and save metal on the repair and replacement of the conduits. (Keenan-IVI)
W85-04423

'RENNFELD' SMALL-SCALE HYDROELECTRIC POWER PLANT NEAR PFORZHEIM (KLEINWASSERKRAFTANLAGE 'RENNFELD' BEI PFORZHEIM),
Weber (Werner) G.m.b.H., Pforzheim (Germany, F.R.).
For primary bibliographic entry see Field 8A.
W85-04629

SPRINKLER DROPLET SIZE DISTRIBUTION ESTIMATION FROM SINGLE LEG TEST DATA,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
R. D. von Bernuth, and J. R. Gilley.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1435-1441, September-October, 1984. 9 Fig, 4 Tab, 26 Ref.

Descriptors: *Fluid drops, *Size distribution, *Sprinklers, Estimation, Ballistics, Nozzles, Pressure.

Droplet size distribution data from agricultural sprinklers are useful for predicting evaporation, wind drift, and droplet effects on the soil. Collecting droplet size distribution data is tedious and expensive, so a method of estimating such data from existing or routinely collected data would be useful. The theory and technique for estimating such data using droplet ballistics are described whereby droplet size data can be estimated from routinely collected single leg data. The model was tested for five sets of conditions including three nozzle sizes and three pressures and proved to fit published droplet size data very well. The distribu-

tions produced by the estimation technique are presented. (Author's abstract)
W85-04745

CONVERT THE BROOK ON YOUR FARM TO ELECTRIC CURRENT,
Pretoria Univ. (South Africa). Dept. of Agricultural Engineering.
J. H. Eckard.
Deciduous Fruit Grower (Cape Town), Vol. 32, No. 1, p 287-289, 1982. 1 Tab.

Descriptors: *South Africa, *Electric power generation, *Farms, *Streams, Hydroelectric power, Centrifugal pumps, Hydroelectric generators, Power requirements.

To determine whether a stream is suitable for generating electricity, three very important requirements must be examined. If the stream is not a perennial the number of months it can be counted on must be determined. The sufficiency of the water flow to convert economically to the generation of electricity must be considered. The pressure head in the stream must be examined. Instructions are supplied on how to build your own generator and the amount of current needed. (Baker-IVI)
W85-04813

HEATING ENCLOSED WASTEWATER TREATMENT FACILITIES WITH HEAT PUMPS,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 6A.
W85-04924

UNDERGROUND UTILITIES IN BARROW, ALASKA,
Moolin (Frank) and Associates, Anchorage, AL.
For primary bibliographic entry see Field 6A.
W85-04925

SEWAGE PUMP STATION DESIGN FOR BARROW, ALASKA,
Moolin (Frank) and Associates, Anchorage, AL.
W. A. Robertson, and R. W. Martin.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 383-400, 6 Fig, 1 Tab.

Descriptors: *Sewer systems, *Utilities, Wastewater treatment, Cold regions, Arctic regions, *Alaska, Pumping plants, Permafrost, Design criteria, Underground structures.

The development of the pump stations to connect the underground utilidor system in Barrow, Alaska is presented. These underground pump stations are the first large scale underground structures in permafrost that are utilized strictly for a community utility system. The geotechnical firms of Harding-Lawson Associates, Woodward-Clyde Consultants and EBA Engineering Consultants, Limited participated in the design of the pump station structure. The systems have been designed to be as redundant as possible and as maintenance free as any mechanical system can be. The designers of the Barrow pump stations, Frank Moolin and Associates and Robertson and Associates, feel that the system as designed is a cost-effective means of meeting the owner's requirements for the underground utilidor system. Excavation for the pump station is in progress; it is estimated that the first pump station foundation will be completed by May 1982.
W85-04926

8D. Soil Mechanics

RISK OF DAMAGE AND FAILURE OF EARTH DAMS,
M. I. Gogoberidze, Yu. N. Mikashvili, G. A. Beruchashvili, and M. E. Gviliya.
Hydrotechnical Construction, Vol. 18, No. 4, p 177-181, April, 1984. 4 Fig, 1 Tab, 6 Ref. Translated from Hydrotechnical Construction, No. 4, p 35-58, April, 1984.

Descriptors: *Earth dams, *Dam failure, Reservoirs, Dam design, Dam construction, Reservoir operation.

An analysis of the data on damages and failures of earth dams shows that the causes of the decrease of their reliability can be divided into the following main groups: survey-research - unsatisfactory quality of surveys at the dam site, mistakes made in selecting the type of dams and in their research; design - errors made when designing individual components or structure as a whole, wrong choice of construction materials and construction technology; construction - low standards of construction works, use of inferior materials, imperfect supervision of construction and assembly works; and operational - insufficient skill of the operating personnel, difficult operating conditions. In view of the fact that the degree of risk is estimated on the basis of a statistical analysis of data on incidents that occurred during construction and operation of dams, it is advisable not to differentiate individual factors influencing the reliability of dams, but rather to examine their joint effect on the structure. (Baker-IVI)
W85-04430

PREDICTION AND CONTROL OF GROUND MOVEMENT ASSOCIATED WITH TRENCH EXCAVATION,
Water Research Centre, Swindon (England). Swindon Engineering Centre.
R. H. Fry, and P. B. Rumsey.
Water Pollution Control, Vol. 82, No. 2, p 151-163, 1983. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Excavation, *Trenches, *Ground movement, Ditches, Earthworks, Soil properties, Design criteria, Pipelines, Sewer systems.

Excavation of trenches for sewers and other deep pielines causes ground movement which can damage adjacent pipelines, road-pavements and buildings. Practical methods of controlling ground movement are discussed, and the role of ground movement prediction and control in the NWX/BGC Model Consultative Procedure for Pipeline Construction involving deep excavation is described. Work is continuing on the analysis and interpretation of field experiments to measure ground movement caused by trenching. It is unrealistic to expect that movement and pipe strain caused by trench excavation will ever be reliably predicted to a high degree of accuracy. Apart from the inherent variability of soil deposits, and therefore soil properties, and the effect of small changes in site construction procedure, unexpected variations in near-surface ground conditions, particularly those occasioned by old backfilled trenches for utilities, and surcharge effects from traffic loading and spoil heaps, can lead to movements which are considerably different from those predicted. It is possible to make meaningful assessment of the range of ground movement to be expected in a given situation. (Baker-IVI)
W85-04516

CLOSED FORMULAE FOR EARTHQUAKE-INDUCED DEFORMATIONS IN DAMS,
Consulting Engineer, Aarau, Switzerland.
A. M. Herzog.
International Water Power and Dam Construction, Vol. 37, No. 1, p 33-34, January, 1985. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Dam stability, *Earthquakes, *Deformation, Mathematical equations, Embankments, Earth dams.

In March of 1979 an earthquake of 7.6 magnitude on the Richter scale affected two embankment dams on the Balsas river in Mexico near the pacific Coast. Both dams were generously equipped with measuring instruments. The records obtained permitted the subsequent calibration of different calculation methods for predicting deformations in dams from earthquakes. Realistic values for the earthquake-induced deformations of dams and embankments are shown to be predictable with simple, closed formulae, based either on the well known shear-beam method, or on a simple earth column. The results obtained from the simple, closed formulae are far more realistic than those rendered by the much more fashionable and expensive finite element methods. (Baker-IVI)
W85-04782

URIBANTE-DORADAS HYDRO DEVELOPMENT IN VENEZUELA,
CEH Ingenieros Consultores, Caracas (Venezuela).
For primary bibliographic entry see Field 8A.
W85-04783

8E. Rock Mechanics and Geology

UNLINED HIGH PRESSURE TUNNELS IN AREAS OF COMPLEX TOPOGRAPHY,
Norges Tekniske Hoegskole, Trondheim. Dept. of Geology.
For primary bibliographic entry see Field 8A.
W85-04412

ECONOMIZING THE DIAMETER OF TUNNELS,
Pipe and Canal Services A.G., Zumikon (Switzerland).
For primary bibliographic entry see Field 8A.
W85-04413

MALAWI - DRIVING A 9 M DIAMETER POWER CONDUIT WITH LOW COVER AT NKULA FALLS,
Watermeyer, Legge, Piesold and Uhlmann, London (England).
For primary bibliographic entry see Field 8A.
W85-04819

8F. Concrete

LONG-TERM PRESTRESS IN CONCRETE-LINED PRESSURE TUNNELS,
Golder Associates, Inc., Bellevue, WA.
L. P. Gonano.
International Water Power and Dam Construction, Vol. 36, No. 11, p 28-33, November, 1984. 5 Fig, 12 Ref.

Descritors: *Tunnel linings, *Creep, *Concretes, Prestressed concrete, Tunnels, Linings, Algorithms, Design criteria.

The limited understanding of the creep behavior of concrete-lined underground structures and the complexities of analysis of material creep have to date effectively deterred rigorous methods of analysis and reliance on creep behavior as a significant and practical design aspect. A simple, accurate and practical analysis algorithm was developed for a symmetrical two-dimensional structure such as a concrete-lined tunnel. It incorporates both the time-dependent creep behavior of the concrete and rock and the structural interaction of the composite structure. It allows all the unknown and complex factors associated with creep to be grouped into a limited number of parameters which can be deduced or checked by back-analysis from the prototype structure. It also allows for simplified methods of design, construction control and design verification to be applied without attendant sacrifices in accuracy. The use of the structural creep model has allowed an explicit consideration of creep in the design of prestressed concrete linings and thereby extended the range of applications for which prestressed linings may be designed. (Baker-IVI)
W85-04414

DETERMINATION OF CERTAIN RHEOLOGICAL CHARACTERISTICS OF CONCRETE MIXES BY SHEAR TESTING,
G. T. Mikeladze.
Hydrotechnical Construction, Vol. 18, No. 4, p 142-145, April, 1984. 3 Fig, 2 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 10-11, April, 1984.

Descriptors: *Concretes, *Rheology, Shear stress, Workability, Strength, Slump test, Stiffness, Concrete additives, Mortar.

One of the main concepts of rheology of concrete mixes is their workability, determined as fluidity according to the slump test (centimeters) or stiffness (seconds). These adopted criteria of workability are only an external manifestation of internal processes occurring in the concrete mix. An attempt was made to determine these internal relations, in which case the shear stresses were taken as objects of rheological measurements, from which the characteristics of internal friction and cohesion were determined. The experiments established that the use of a combined additive retarded the formation of internal bonds and gaining of strength of concrete for a long time. Therefore, mortars and concrete mixes with combined additives have increased workability compared with mixes without additives or with a single additive. (Baker-IVI)
W85-04425

PRESENT TECHNIQUES FOR 'IN-SITU' SEWER RENOVATION,
North West Water Authority, Warrington (England).
R. S. Anderson.
Water Pollution Control, Vol. 82, No. 2, p 179-187, 1983.

Descriptors: *Sewer systems, *Renovation, Hydraulic engineering, Pipes, Linings, Construction, Cement, Plastics, Concrete, Grouting.

Techniques for renovation cannot be developed in isolation. They must be considered as part of a strategic plan encompassing the selection of critical lengths, programmed inspection, an assessment of hydraulic and structural suitability and an examination of the economic and environmental variability of renovation against that of renewal. The ideal renovation system would be one capable of achieving the following objectives: all work capable of being performed through existing manholes without the need for specific excavations; ability to cope with re-making of existing drain connexions without excavation; rapid installation reducing both cost and disruption; substantial cost saving against renewal; extended life comparable with that of renewal; and no loss of hydraulic capacity. Renovation systems described in some detail include slip lining, insituform, lining with segments and panels, glass-reinforced cement, glass-reinforced plastic, precast concrete linings, and polyester-resin concrete. Discussion is also offered of insertion of new pipes, pressure pointing, joint sealing, and grouting of linings. (Baker-IVI)
W85-04518

PARKER DAM CONCRETE CORE INVESTIGATIONS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
E. R. Dunstan.
Available from the National Technical Information Service, Springfield, VA 22161. USBR Report REC-ERC-82-20, August 1983. 40 p, 4 Fig, 4 Tab, 18 Ref, 1 Append. Contract/Grant No. 2-01-DV-00158.

Descriptors: *Compressive strength, *Concrete dams, *Poisson ratio, *Alkali-aggregate reactions, *Modulus of elasticity, Concretes, Strength, Parker Dam, Core data, Arizona, Dam safety, Colorado River.

This report is a review of physical property tests and petrographic examinations of concrete cores from Parker Dam. Cores were taken from the dam in 1938, 1940-41, 1945, 1949, 1956 and 1980, following the onset of visible cracking due to alkali-aggregate reaction. Test data from 1980 cores are reported and compared to earlier core data. The concrete from Parker Dam was, in most cases, stronger in 1980 than when completed in 1938. There were apparent strength reductions in the top portions of the dam from 1938 to 1956, with a rebound in strength since that time. Evidence of alkali-aggregate reaction was found throughout the dam as substantiated by the petrographic analysis. Further evidence was the reduction in modulus of elasticity at all elevations in Parker Dam, although a rebound in modulus of elasticity appears to occur in recent years. The alkali-aggregate reaction is most severe in the upper portions of the dam, resulting in a higher incidence of disbonded construction joints. Assuming that most of the reactive silica and alkalies have been consumed, very little future deterioration will take place as the result of alkali-aggregate reaction.
W85-04935

FLY ASH AND FLY ASH CONCRETE,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
E. R. Dunstan.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-82-1, May 1984. 42 p, 32 Fig, 11 Tab, 45 Ref. Contract/Grant No. 10781 V0195.

Descriptors: *Concrete additives, *Concrete mixes, *Concrete technology, *Concretes, Fly ash, *Cements, Concrete testing, Construction materials, Portland cements, Pozzolans, Abrasion, Backfill, Freeze-thaw tests, Calcium, Elastic properties.

Twenty-one samples of both F and C type fly ashes were examined as replacements for portland cement in concrete. A new cement was also developed that consists of over 90% fly ash and anhydrous CaS04. The nonportland cement concrete showed very good compressive strengths and good resistance to sulfate. Excellent freeze-thaw durability was obtained using 90% fly ash concretes in which proper air entrainment was achieved. High Ca ashes plus CaS04 can be used to produce low-strength backfill and subbase concrete. The concrete produced from 90% or more fly ash displayed low-surface abrasion resistance possibly due to surface carbonation. The elasticity of fly ash concrete is similar to that of ordinary portland cement. The drying shrinkage of fly ash concrete normally is less than that of ordinary cement concrete.
W85-04936

8G. Materials

PRESENT TECHNIQUES FOR 'IN-SITU' SEWER RENOVATION,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 8F.
W85-04518

LONG-TERM GROUNDWATER PROTECTION WITH PLASTIC LININGS (LANGFRISTIGER GRUNDWASSERSCHUTZ MIT KUNSTSTOFF-DICHTUNGSBAHNEN),
Beratender Ingenieur fur Kunststofftechnik im Bauwesen. Schwerpunkt: Wasserbau, Grundwasserschutz, Erd- und Grundbau.
For primary bibliographic entry see Field 5G.
W85-04633

RESPONSES OF LAKE WHITEFISH (COREGONUS CLUPEAFORMIS) TO FERTILIZATION OF LAKE 226, THE EXPERIMENTAL LAKES AREA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 8I.
W85-04840

INVESTIGATION INTO THE FAILURE OF A PRESTRESSED ROCK ANCHOR,
Statens Vattenfallsverk, Vaellingby (Sweden).
G. Jurell.
International Water Power and Dam Construction, Vol. 37, No. 2, p 45-47, February, 1985. 4 Fig, 3 Ref.

Descriptors: *Mechanical failure, *Rock anchors, Sweden, Grundfors hydropower station, Construction, Grouting, Corrosion, Intergranular stress.

During construction of the Grudfors hydropower station in 1955, 118 prestressed rock bolts were installed to support the load from an overhead crane. In 1981, one of these 26 year old bars failed without warning and part of it was ejected at high speed from the hole in which it had been installed. The ejected part of the bar was superficially corroded along its entire length and only traces of grout could be seen. The 2.5 m length of the bar was bent 24 mm out of true. While it was not possible to gain a clear picture of the details of the grouting process used when the bars were installed, one notable fact is the absence of grouting pipes. It is possible that grooves in the anchorage plates had some part to play in the process. Even the original anti-corrosion protection given to the bars can not be proved to have been satisfactory. A further investigation showed that more than half the bars investigated were unsatisfactorily grouted or were damaged in some respect. The material the bars were made of was sensitive to cracking. The primary cause of the failure that occurred was probably inter-granular stress corrosion. The factor of safety against new brittle failure was judged to be low. The load-bearing capacity was restored by installing 232 new unstressed rock bolts in drilled holes followed by grouting. (Baker-IVI)
W85-04952

RECENT DEVELOPMENTS IN LEAK NOISE CORRELATION TECHNIQUES,
J. Oliver.
Water Services, p 512-513, December, 1984. 3 Fig, 1 Ref.

Descriptors: *Pipelines, *Leak detection, *Noise correlation, Water loss, Leakage.

Probably the most significant contribution in recent years to the detection and accurate location of leaks from buried pipelines has been made by the leak noise correlation method. Traditional listening methods seek to locate by identifying the position of maximum leak noise intensity, but often this position does not coincide with the actual leak position. Correlators use not sound intensity but sound similarity involving the properties of noise production, propagation and permanence in time as the basis of their operation. Noise produced by a leak can be said to be random in that the noise is not similar at any time internal. At different points in a uniform pipeline, propagation of noise takes place at the same velocity regardless of the distance of the points from the leak. The permanence in time of leak noises allows the correlator processing period to discriminate against parasitic and transitory noises. Correlators determine the time difference between similar noise patterns reaching two sensors positioned at opposite ends of a section of pipeline in which leakage has been identified. With the input of the measured distance between the sensors and a value for the velocity of sound for the particular pipeline, the correlator computes the leak position from a mathematical equation. (Baker-IVI)
W85-04958

8I. Fisheries Engineering

CONFINEMENT AND WATER QUALITY-INDUCED STRESS IN LARGEMOUTH BASS,
National Fish Hatchery and Technology Center, San Marcos, TX.
For primary bibliographic entry see Field 5C.
W85-04680

EFFECT OF WATER TEMPERATURE ELEVATION ON INCIPIENT AND CUMULATIVE FE-

CUNDITY OF BATCH-SPAWNING TENCH, TINCA TINCA (L.),
Instytut Rybactwa Srodladowego, Warsaw (Poland). Heated Water Lab.
B. Morawska.
Aquaculture, Vol. 42, No. 3/4, p 273-288, December 1, 1984. 3 Fig, 6 Tab, 30 Ref.

Descriptors: *Water temperature, *Fish, *Tench, *Aquaculture, *Fish farming, Spawning, Fish eggs, Fish ponds, Fish hatcheries.

The fecundity of 131 tench (Tinca tinca L.) from heated and control ponds was evaluated in the years 1974, 1975 and 1977. There were differences in the temperature of both types of pond and these varied with the season and also with the year. The reproductive season began 1 month earlier in the heated ponds, but it ended almost simultaneously in the two types of pond. In the control ponds tench deposited 3-4 batches of spawn during the season, and in the heated ones 5-8 batches. There were significant differences in fecundity between successive batches during the season, for the population of the heated ponds. Heating the water did not change mean batch fecundity which varied between 38,000 and 52,000 oocytes. Incipient fecundity (number of oocytes before first spawning) was also similar in both types of pond. The cumulative fecundity (the total number of oocytes deposited by the average female over the reproductive season) of females from the heated ponds was on average higher by 38.6-91.8%. Temperature patterns over the prespawning and spawning period exerted a determining effect on the number and fecundity of the successive batches and on cumulative fecundity during the season. (Author's abstract)
W85-04707

FACTORS INFLUENCING IMPINGEMENT OF FISH BY LAKE ONTARIO POWER PLANTS,
Hartwick Coll., Oneonta, NY. Dept. of Biology.
R. L. Wyman, and R. S. Dischel.
Journal of Great Lakes Research, Vol. 10, No. 4, p 348-357, 1984. 4 Fig, 3 Tab, 25 Ref.

Descriptors: *Lake Ontario, *Powerplant intakes, *Intake gates, *Fish behavior, *Impingement, Thermoclines, Water temperature, Fish populations.

Fish impinged by two Lake Ontario power plants were examined to determine the causal factors. Fish were near shore because they resided there, migrated there to spawn or forage, or because the water mass in which they resided moved near shore. Once near shore, fish abundance in impingement collections was correlated with demersal or pelagic behavior. Periodic increases in diversity and abundance of impinged fish corresponded with times of upwelling and thermocline oscillations. These data suggest that some species were segregated along temperature gradients and were impinged when the thermocline passed near the intake. Comparisons of impingement catch between two power plants, one withdrawing a constant volume of water and the other a varying volume, showed that responses of fish to an intake were of three kinds. Alosa pseudoharengus and Osmerus mordax were apparently attracted to water currents entering the intake. Morone americana, Morone chrysops, Dorosoma cepedianum, and Perca flavescens were not influenced by changes in flow rate, suggesting that their impingement was proportional to their density in nearshore water. Micropterus dolomieui avoided the intake at higher flow rates in part due to rheotactic behavior. (Author's abstract)
W85-04713

RESPONSES OF LAKE WHITEFISH (COREGONUS CLUPEAFORMIS) TO FERTILIZATION OF LAKE 226, THE EXPERIMENTAL LAKES AREA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
K. H. Mills.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 1, p 129-138 January, 1985. 4 Fig, 5 Tab, 53 Ref.

Descriptors: *Whitefish, *Fertilizers, *Lakes, Ontario, Growth, Reproduction, Nitrogen, Phosphorus, Carbon, Nutrients, Fish food organisms.

Intentional fertilization of ponds and lakes to increase fish yield has a long history, but little is known about the responses of a northern fish population, composed largely of older, sexually mature individuals, to nutrient addition. The responses of an unexploited population of lake whitefish (Coregonus clupeaformis) to fertilization of Lake 226 (L226), the Experimental Lakes Area, northwestern Ontario, were measured for 4 yr (1973-77). A vinyl sea curtain separated the lake into a northeast (NE) basin, which received P, N, and and C additions, and a southwest (SW) basin, which received only N and C additions. Six population parameters were monitored throughout the study: growth, condition, abundance, survival, fecundity, and production. Lake whitefish in the NE basin grew faster, had higher coefficients of condition, and had greater recruitment and production than those in the SW basin during the 2nd through 4th yr of fertilization. No differences between basins were detected in annual survival for fish > or = age 1, but survival of age 0 fish was greater in the NE basin. Whitefish production in L226NE averaged twice that in L226SW from the 2nd to the 4th yr of fertilization, though significant variations occurred between years in both the NE and SW populations. The whitefish in L226SW apparently did not respond to nitrogen and carbon fertilization. The increased growth and higher condition of L226NE whitefish was apparently due to an increase in the primary prey items, chironomids and chaoborids, which in turn was related to an increase in their food supply. (Moore-IVI)
W85-04840

RESPONSES OF BENTHIC MACROINVERTEBRATE SPECIES TO MANIPULATION OF INTERSTITIAL DETRITUS IN CARNATION CREEK, BRITISH COLUMBIA,
Calgary Univ. (Alberta). Dept. of Biology.
For primary bibliographic entry see Field 2H. .
W85-04841

RESPONSES OF SOCKEYE SALMON (ONCORHYNCHUS NERKA) TO FERTILIZATION OF BRITISH COLUMBIA COASTAL LAKES,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
K. D. Hyatt, and J. G. Stockner.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 320-331, February, 1985. 9 Fig, 6 Tab, 43 Ref, 1 Append.

Descriptors: *Fertilizers, *Salmon, *Fish management, *British Columbia, Nitrogen, Phosphorus, Zooplankton, Fish food organisms, Smolt.

The coastal lakes of this study have extremely low phosphorus concentrations, short water residence time, and extreme oligotrophic condition. Faunistically the coastal lakes are characterized by low species diversity and low standing crops with respect to both zooplankton and fish communities. Addition of nitrogen and phosphorus fertilizer, using a DC6B aerial tanker, to several British Columbia coastal lakes resulted in increased autotrophic and heterotrophic production and larger standing stocks of zooplankton. These changes at the primary and secondary trophic levels are reflected by increased in-lake growth of juvenile sockeye salmon and larger outmigrant smolts. Smolt size changes in fertilized lakes may lead to increases in the harvestable surplus of sockeye adults by promoting both increases in marine survival and an earlier age-at-return to the fishery. (Moore-IVI)
W85-04847

ATTRACTION OF FISH TO MERCURY VAPOUR LIGHT AND ITS APPLICATION IN A GENERATING STATION FOREBAY,
Ontario Hydro, Toronto. Research Div.
G. T. Haymes, P. H. Patrick, and L. J. Onisto.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 867-876, 1984. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Fish behavior, *Mercury vapor lights, *Fish handling facilities, *Forebays, Thermal powerplants, Cooling water, Alewife, Shad, Smelt, Fish conserving pumps, Strobe lights, Lights.

Many thermal generating stations on the Great Lakes use once-through cooling systems in which water is drawn from the lake into a forebay before passing through the station. In order to reduce fish losses at these generating stations, fish conserving pumps or other means could be used to remove live fish from the forebay to be returned to the lake. Laboratory and field tests were conducted to determine the effectiveness of filtered mercury vapor lights in attracting fish as part of fish conserving schemes. In laboratory tests, alewife demonstrated an attraction to the mercury vapor light which was associated with an increase in swimming activity. This response was maintained over a 48-hour period. When the filtered mercury vapor lights were used in association with a fish pump in a forebay, juvenile gizzard shad and smelt were attracted to the pump area. There was variation with time of day, turbidity and lighting array, but the number of fish passing through the pump increased when the mercury vapor lights alone or when the mercury lights were used in association with a white strobe light. (Moore-IVI)
W85-04914

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SELECTED WATER RESOURCES ABSTRACTS

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 18, NUMBER 10
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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
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01 NATURE OF WATER

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02 WATER CYCLE

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

SIMULATION OF HERBICIDE CONCENTRATIONS IN STORMFLOW FROM FORESTED WATERSHEDS,
Georgia Univ., Athens. School of Forest Resources.
W. L. Nutter, T. Tkacs, P. B. Bush, and D. G. Neary.
Water Resources Bulletin, Vol. 20, No. 6, p 851-857, December, 1984. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Herbicides, *Forest watersheds, *Stormflow, *Runoff, *Path of pollutants, *Watershed models, Model studies, Hexazinone, Bromacil, Picloram, Dicamba, Triclopyr, Erosion.

The breakpoint rainfall hydrology and pesticide options of the field scale model CREAMS (Chemicals, Runoff, and Erosion from Agricultural Managemant Systems) were used to predict average concentrations of hexazinone (3 cyclohexyl-6-(dimethyl-amino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione) in stormflow from four forested watersheds in the upper Piedmont region of Georgia. Predicted concentrations were compared with measured concentrations recorded over a 13-month period. CREAMS accurately predicted hexazinone concentrations in the initial stormflow events which also contained the highest concentrations. The model underestimated the hexazinone concentrations in stormflow two months and greater following pesticide application. In a companion study, the daily rainfall option of the CREAMS model was used to evaluate the relative risk asociated with the maximum expected concentration of hexazinone, bromacil (5-bromo-3 sec-butyl-6 methyuracil), picloram (4-amino-3,5,6 trichloropicolinic acid), dicamba (3,6-dichloro-0-anisic acid), and triclopyr (((3,5,6-trichloro-2-pyridinyl)oxy)acetic acid) in stormflow from small forested watersheds. The model predicted the following order of potential residue appearance in stormflow: bromacil > triclopyr > hexazinone > picloram > dicamba. Subsurface movement of residues via interflow and deep leaching losses are not simulated by the version of CREAMS used in these studies. (Author's abstract)
W85-04991

HYDROLOGY IN TROPICAL AUSTRALIA AND PAPUA NEW GUINEA,
Bureau of Meteorology, Melbourne (Australia). Hydrometeorology Branch.
A. J. Hall.
Hydrological Sciences Journal, Vol. 29, No. 4, p 399- 423, December, 1984. 8 Fig, 56 Ref.

Descriptors: *Australia, *Papua New Guinea, *Hydrology, *Climatology, *Tropic zones, Intertropical convergence zone, Streamflow, Runoff, Rainfall, Seasonal variation.

Australia is a continent of climatologic contrasts with one of the most variable rainfall and runoff regimes in the world. One of the world's wettest and least variable regimes is in Papua New Guinea (PNG) which is well within the equatorial humid tropical region. Australia and PNG provide considerable contrasts hydrologically. PNG lies within the seasonal movement of the intertropical convergence zone and by and large has a comparatively uniform rainfall throughout the year. Convective rainfall in PNG has wide spatial variation under the influence of one of the world's larger cordilleras. The Australian tropical region has one wet season, for about four months of the year, and is subject to extreme variability of rainfall associated with the presence, or absence, of tropical cyclones. This is particularly the case in the northwest where heavy rainfall associated with cyclones occurs less frequently. While annual streamflows in PNG are reliable by world standards and relatively short records can provide reasonable design data for monthly and annual flows, Australia has streams which are considerably more variable than world rivers. Relative to mean annual runoff, Australian mean peak annual floods can be up to an order of magnitude larger than world rivers and the variability of peak annual floods is larger. Flood design in PNG based on streamflow and regional flood frequency methods is preferred to attempts to relate storm rainfall to runoff. Despite the areal variation in storm rainfall, good simulations of daily discharges have been made using conceptual rainfall-runoff models. The status of hydrology in the region has overall reached a reasonable level condidering the sparse settlement of northern Australia and the extreme ruggedness of PNG and its level of development. (Collier-IVI)
W85-05005

PROPOSAL TO CONSTRUCT A COORDINATING MATRIX FOR COMPARATIVE HYDROLOGY,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 7A.
W85-05007

STUDIES ON DROUGHTS OF TAMIL NADU WITH SPECIAL REFERENCE TO THEIR SPREAD AND SEVERITY,
Cochin Univ. (India). Dept. of Marine Sciences.
For primary bibliographic entry see Field 2B.
W85-05073

WGEN: A MODEL FOR GENERATING DAILY WEATHER VARIABLES,
Agricultural Research Service, Washington, DC.
For primary bibliographic entry see Field 7C.
W85-05129

STATISTICAL MODELING OF INTERDEPENDENT ARTIFICIAL HYDROLOGIC SERIES WITH A NONSYMMETRIC GAMMA CORRELATION,
M. A. Velikanov.
Water Resources, Vol. 11, No. 1, p 77-84, January-February, 1984. 2 Tab, 8 Ref. Translated from Vodnye Resursy, No. 1, p 122-130, January-February, 1984.

Descriptors: *Hydrologic models, *Statistical models, Mathematical studies, Water management, Probability, Water managment, Flow discharge, Runoff.

A group of interdependent artificial hydrologic series with given probabilistic characteristics must be obtained when planning water management and water power systems. The accuracy of the hydrologic and water management calculations must be established and the probabilistic limits of variations of the output of the regulating plants determined. The problem of obtaining interdependent artificial series with an autocorrelation, each of which obeys a two-parameter gamma distribution is considered. As an example the results of combined modeling of the mean annual water discharges at three sites are given: Syr Darya at Bejovat city, Irtysh at Ablaketka village, and Ob at Kamen-on-Ob city. A statistical analysis of the data of long term hydrometric observations at these sites showed that each series of mean annual discharges can be described by a two-parameter gamma distribution. A method is proposed which broadens the possibilities of a mathematical description of the process of runoff variations of rivers. When solving particular water management and water power problems, this makes it possible to select those models which best agree with the data from on-site measurements. For this purpose regression relationships reflecting the character and form of intra- and interseries relations of the artificial hydrologic series obtained are presented. This makes is possible, without proceeding to modeling of artificial series, to estimate how the theoretical regressions of these series agree with the available data. If the comparison shows that there is such an agreement, then artificial series obtained by the given algorithms reflect well all regularities of the investigated process of runoff variations at several sites. (Baker-IVI)
W85-05149

MODELING OF TOTAL ACID PRECIPITATION IMPACTS.
For primary bibliographic entry see Field 5C.
W85-05313

NORWEGIAN MODELS FOR SURFACE CHEMISTRY: AN OVERVIEW,
Norsk Inst. for Vannforskning, Oslo.
R. F. Wright.
In: Modeling of Total Acid Precipitation Impacts. 1984. p 73-87, 7 Fig, 2 Tab, 18 Ref.

Descriptors: *Model studies, *Lakes, Hydrologic models, *Acidification, *Chemical properties, *Hydrogen ion concentration, *Acidic water, Reviews, Minerals, Sulfates, Acids, Simulation analysis, Theoretical analysis.

The Henriksen's empirical model for lake acidification and the Birkenes model for streamwater chemistry are reviewed. Henriksen's empirical model for lake acidificaiton is based on the hypothesis that acidification can be described as a large-scale titration in which bicarbonate solution is titrated with a strong acid. This simple model estimates the pH of Norwegian lakes down to levels of 5.0. The Birkenes model simulates the chemical properties of lake water at specific sites on a day-to day basis. It can simulate the pH of stream water given only the precipitation volume, sulfate concentration, dry deposition of S, and temperature. The hydrologic and sulfate parts of the Birkenes model have been successfully applied to the Storgama gauged catchment. Both the Henriksen and Birkenes models are static with respect to long time periods and present some drawbacks when used for prognosis.
W85-05317

MODELING THE REACIDIFICATION RATES OF NEUTRALIZED LAKES NEAR SUDBURY, ONTARIO,
Ontario Ministry of the Environment, Rexdale. Water Resources Branch.
P. J. Dillon, and W. A. Scheider.
In: Modeling of Total Acid Precipitation Impacts. 1984. p 121-154, 6 Fig, 17 Tab, 39 Ref.

Descriptors: *Acidification, *Neutralization, *Model studies, *Hydrologic models, *Lakes, *Acidic water, *Hydrogen ion concentration, Acids, Bases, Watershed models, Chemical properties, Alkalinity, Acid rain, Lake sediments, Nitrogen, Phosphorus, Ontario, Lake Hannah, Lake Middle, Lake Lohi, Lake Clearwater.

The hydrological budgets, input of materials by bulk deposition and the material budgets for the watershed of four lakes near Sudbury, Ontario were combined and used with a mass balance model to predict the reacidification rate of the neutralized lakes. Lake water, sediment, precipitation and stream input samples to Lakes Hannah, Middle, Lohi, and Clearwater were tested regularly from 1973 to 1979. Predictions based on the mass balance model indicated that Lohi Lake would reacidify in late 1976. Reacidification occurred only 6 to 9 months later. The alkalinity of Lohi Lake stabilized at values greater than predicted, indicating that there was an unmeasured internal generation of acid neutralizing capacity (ANC) or that the inputs of mineral acidity were overestimated. The measured ANC in Middle and Hannah lakes was always much greater than ANC predicted by the mass balance model. ANC supplied by nitrate uptake by the biota following fertilization could not account for all the extra ANC generated in these two lakes. It was hypothesized that the remainder of the ANC was released from sediments that had been previously neutralized. The pH of Clearwater Lake will not increase unless the mineral acidity input is reduced.
W85-05319

MODELING IMPACTS OF ACID PRECIPITATION FOR NORTHEASTERN MINNESOTA,
Iowa Univ., Iowa City. Div. of Energy Engineering.
For primary bibliographic entry see Field 2K.
W85-05320

Field 2—WATER CYCLE

Group 2A—General

U. S./ CANADA AQUATIC IMPACTS ASSESSMENT: INTEGRATION OF EXPERIMENTAL STUDIES, MONITORING AND MODELING OF ACIDIC DEPOSITION EFFECTS,
Institute of Ecology, Indianapolis, IN.
O. L. Loucks, and G. E. Glass.
In: Modeling of Total Acid Precipitation Impacts. 1984. p 205-217, 3 Fig, 3 Tab, 30 Ref.

Descriptors: *Model studies, *Acidification, *Acid rain, *Hydrologic models, *Ecosystems, Sulfates, Nitrates, Hydrogen ion concentration, Chemical properties, Air pollution, Soil chemistry, Northeastern United States, Water pollution sources, Water quality, Minerals.

The use of both qualitative comprehensive models and quantitative empirical models as methodologies for the aquatic impact assessment process in Phases I and II of the 1980 U. S./Canada Memorandum of Intent on long-distance pollutants was evaluated. The major components of an applications-oriented systems model are distribution and variability of the input driving variables, processes in the responding system and observed response relations, quantification of biological response relationships, and quantification of predictive/summarative models. The three most suceptible regions for acidification in the eastern half of the U. S., based on the acid-neutralizing constituents of bedrock and soils, are the Northeast, the Appalachian Mountain regions, and the Minnesota-Wisconsin-Michigan highlands. High sulfate concentrations in these regions of low Ca and Mg in soils and waters leads to greatly depressed concentrations of bicarbonate alkalinity. Empirical models have been used to predict sulfate loadings and tolerances of aquatic ecosystems. Mechanistic models for more quantitative evaluations will require more rigorous methodologies such as sequential hypothesis testing.
W85-05322

AGRICULTURAL DROUGHT ASSESSMENTS USING A CROP MODEL.
Texas Agricultural Experiment Station, Temple. Blackland Research Center.
Available from the National Technical Information Service, Springfield, VA 22161. Final Report: October 1, 1980 - July 31, 1983. July 1983. 154 p, 28 Fig, 58 Tab, 44 Ref, 6 Append. Contract/Grant No. 1-07-81-V0159.

Descriptors: *Model studies, *Drought, *Simulation analysis, Wheat, Sorghum, *Soil water, *Mathematical models, Crop yield, Evapotranspiration, Precipitation, Palmer drought index, Texas, Kansas, Plant growth, *Soil-water-plant relationships, Drought prediction, Prediction.

Grain sorghum and winter wheat crop growth simulation models were analyzed to determine the ability to make agricultural drought assessments. Model simulations were run for 30 sorghum seasons and 29 wheat seasons at Temple, Amarillo, and Lubbock, Texas and Manhattan, Kansas. Regression equations were developed at various times in the season between within-season modeled soil water and modeled yield. Early prediction (i.e., before flowering) of yield using the soil water regression equations had errors of approximately 40-60% of mean modeled yield at a location. For sorghum, an additional forecasting technique was developed which involved running-out the model at selected times using weather scenarios to obtain a distribution of simulated yields. Predictive capabilities were not substantially improved with this technique. To further test the validity of the models, modeled yields were compared with USDA county and crop reporting district yields, performance test yields, and monthly Palmer Drought Index values. Correlations were poor between modeled yield and other independent yield data. A methodology using crop models for assessment of status quo crop conditions and forecasting future developments has been developed. The poor results are likely due to inadequacies in the current models and with model improvements, results are likely to improve. (Author's abstract)
W85-05332

HYDROLOGIC AND WATER QUALITY MODELS FOR AGRICULTURE AND FORESTRY.
Virginia Polytechnic Inst. and State Univ., Blacksburg.
Research Bulletin No. 291, Southern Regional Association of State Agricultural Experiment Stations, June 1983. Edited by M. D. Smolen. 104 p. 2 Append. Project S-108.

Descriptors: *Models, *Hydrologic models, *Mathematical models, *Computer models, *Watershed management, *Agricultural watersheds, *Forest watersheds, *Water quality, Model studies, Regression analysis, Rural areas, Mathematical studies, Sediment transport, Crop yield, Erosion, Solute transport, Rainfall-runoff relationships.

This report resulted from the Cooperative Research Project S-108, which was active from 1976 to 1980, and aimed to develop models to simulate the hydrologic transport processes of rural watersheds. The S-108 committee considered models covering a wide range of conceptual and computational approaches and arranged them for easy comparison by potential users. Most of the models considered in this project were from three distinct conceptual types: the regression model, the lumped parameter model, and the distributed parameter model. In presenting each model, the authors have attempted to use examples that relate to a common watershed, Crab Creek Watershed in Montgomery County, Virginia. The models have varying capabilities for simulating water quality. A substantial effort was directed toward the detailed study of components of the hydrologic cycle. Five watershed models and four other models dealing with solute transport, rainfall partitioning, and tillage and erosion effects on crop yield are presented along with hydrologic data on Crab Creek Watershed and a list of publications resulting from Regional Project S-109.
W85-05338

NORTH CAROLINA STREAMFLOW SYNTHESIS AND RESERVOIR REGULATION MODEL,
E. H. Wiser.
In: Research Bulletin No. 291, Southern Regional Association of State Agricultural Experiment Stations, June 1983. Edited by M. D. Smolen, p 7-18, 1 Fig, 9 Tab, 6 Ref. Project No. S-108.

Descriptors: *Hydrologic models, *Model studies, *Streamflow, *Reservoir operation, *Simulation analysis, *Mathematical models, *Computer models, *Streamflow forecasting, Watershed management, Models, Mathematical studies, Watersheds, Precipitation, Cost analysis.

The North Carolina version of the Streamflow Synthesis and Reservoir Regulation model (NCSSARR) is a system that was developed to simulate watershed streamflow in any region of the country. The system is interfaced with the Hydrologic Information Storage and Retrieval System and has been used on large complex river basins. The NCSSARR watershed model uses only daily precipitation data and removes snowmelt subroutines. The NCSSARR watershed model was tested on Crab Creek and Bush Creek in Virginia. A North Carolina watershed was used to provide parameters for simulation of streamflow by adjusting the weight used for the climatological stations to 0.66 for Crab Creek and 1.00 for Bush Creek. Results were suprisingly good for the two simulations, considering that only the mean flow was fitted. Simulation of 10 yr of data for the Crab Creek watershed on an Amdahl 470/V8 computer required 242 K of core memory and took 46 sec of chargeable time at a cost of $1.91. Evaluation of test statistics took an additional 40 sec at a cost of $1.55.
W85-05339

USDAHL HYDROLOGIC MODEL,
K. L. Campbell, Yaramanoglu, and F. R. Crow.
In: Research Bulletin No. 291, Southern Regional Association of State Agricultural Experiment Stations, June 1983. Edited by M. D. Smolen, p 19-32, 1 Fig, 5 Tab, 8 Ref. Project No. S-108.

Descriptors: *Model studies, *Hydrologic models, *Computer models, *Agricultural watersheds, *Water yield, *Watershed management, *Infiltration, *Runoff, *Simulation analysis, Mathematical models, Precipitation, Evapotranspiration, Models, Soil profiles, Cost analysis.

The USDAHL-74 Revised Model of Watershed Hydrology is a deterministic, semiempirical, lumped parameter hydrologic model designed to predict runoff and infiltration in relatively small agricultural watersheds under natural rainfall conditions. The model consists of surface and a subsurface flow component and can predict annual and monthly water yields with a reasonable degree of accuracy. The model requires about 72 different input parameters in addition to meteorological data. This input data is of four types: watershed, soils, land use and hydraulic data. The evapotranspiration parameter plays an important role in model accuracy. The accuracy of soil characteristic parameters also greatly affects model performance. The USDAHL model was used to simulate the hydrology of Crab Creek Watershed, Virginia using meteorological input data from 1965. The storm event from August 21, 1966 was also simulated in detail to compare with the observed hydrograph. Although the runoff volume was simulated accurately, the hydrograph shape and peak runoff rate were greatly different. The USDAHL model assumes uniform spatial distributions of precipitation, an assumption which may not be accurate for larger watersheds. Since the model accepts precipitation input from only one station, inaccuracies may occur. These can be minimized by averaging rainfall records from a number of gages within the watershed. The USDAHL model can readily accomodate water quality model components. Simulation of the hydrology of a 1600-acre watershed for a 3-yr period cost $5.24 including $2.70 for printing with a CPU time of 17.43 sec.
W85-05340

SEDLAB: THE HYDROLOGY/SEDIMENT TRANSPORT MODEL OF THE USDA SEDIMENTATION LABORATORY,
E. H. Seely
In: Research Bulletin, No. 291, Southern Regional Association of State Agricultural Experiment Stations, June 1983. Edited by M. D. Smolen, p 33-45, 3 Fig, 4 Tab, 8 Ref. Project No. S-108.

Descriptors: *Hydrologic models, *Sediment transport, *Surface runoff, *Channel flow, *Overland flow, *Computer models, *Erosion, *Agricultural watersheds, Model studies, Runoff, Watershed management, Mathematical models, Sedimentation, Simulation analysis, Models, Catchment areas, Cost analysis.

SEDLAB is a single event, distributed parameter, mathematical model which simulates surface runoff and sediment transport on small catchments. The model uses the kinematic-wave approximation for routing overland flow and channel flow to a watershed represented by flow planes and channel segments. SEDLAB consists of two linked submodels; one describes the catchment hydrology and the other describes the associated erosion and sedimentation processes. Sediment routing is accomplished by applying a continuity equation for conservation with equations for transport and soil detachment. Measured runoff and sediment data from watershed R-5 near Chickasha, Oklahoma and watershed W-5 near Holly Springs, Mississippi were used to check model accuracy. Costs for running the simulation which took 137 seconds of CPU time for a 4.56 sg km watershed ranged from $2.00 to $4.00. Many improvements in components which have already been made as a part of the small watershed model (SWM) development program can be readily incorporated into the existing model.
W85-05341

ANSWERS MODEL,
D. B. Beasley.
In: Research Bulletin No. 291, Southern Regional Association of State Agricultural Experiment Sta-

tions, June 1983. Edited by M. D. Smolen, p 46-59, 4 Fig, 13 Ref. Project No. S-108.

Descriptors: *Agricultural watersheds, *Computer models, *Sediment transport, *Erosion, *Land management, *Hydrologic models, *Water pollution sources, Watershed management, Models, Model studies, Channel flow, Subsurface drainage, Nonpoint pollution sources, Land use, Simulation anlysis, Cost analysis, Fate of pollutants, Path of pollutants.

The ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) program is an event-oriented, distributed parameter watershed model that has been used since 1976. The updated model includes algorithms for channel flow, subsurface drainage, sediment detachment and transport (erosion and deposition) and land use and management interactions. ANSWERS was designed primarily for use in planning and evaluating strategies for the control of nonpoint source pollution from intensively cropped areas. A watershed to be modeled is assumed to be composed of elements. Elements are areas within which all hydrologically significant parameters are uniform. The input into the ANSWERS model consists of watershed topography, drainage networks, channel flow and infiltration data, precipitation data, soils, land uses and BMPs. Several graphical plotting programs have been designed to provide visual enhancement and better understanding of the ANSWERS model. The ANSWERS model has been used in a number of planning, research and teaching applications. An ANSWER simulation on a 1964 ha watershed took 8 hr and cost about $15.00 on the Purdue University computer.
W85-05342

FINITE ELEMENT STORM HYDROGRAPH MODEL,
M. D. Smolen, B. B. Ross, and V. O. Shanholtz.
In: Research Bulletin No. 291, Southern Regional Association of State Agricultural Experiment Stations, June 1983. Edited by M. D. Smolen, p 60-71, 5 Fig, 2 Tab, 17 Ref. Project No. S-108.

Descriptors: *Models, *Hydrologic models, *Runoff, *Sediment transport, *Streamflow, *Water pollution sources, *Computer models, *Hydrographs, Model studies, Nonpoint pollution sources, Simulation analysis, Watersheds, Mathematical models, Infiltration, Storm runoff, Spatial distribution, Overland flow, Channel flow.

The Finite Element Storm Hydrograph model (FESHM) is a single event, hydrologic model that simulates runoff and streamflow in an ungaged watershed. It is based on physical principles and uses a flexible distributed parameter structure to account for the spatial variability of watershed characteristics. The FESHM uses irregular boundaries typical of soil surveys and land use maps, to define the spatial range of model parameters. The fundamental concept of the FESHM is that the complex watershed system can be subdivided into less complex subsets. FESHM uses two discretization schemes to account for spatial variation; one for variations in infiltration capacity and one for variations in topography. The distributed parameter structure of the model and its high degree of flexibility make it suitable for the simulation of nonpoint pollution. Model components consist of an infiltration model, a depression storage algorithm, a finite element system for routing overland and channel flows and a sediment detachment and transport algorithm. The FESHM was less costly to use than similar simple lumped parameter models.
W85-05343

SIMPLIFIED METHOD FOR APPROXIMATING SUBSURFACE TRAVEL TIMES FOR SOLUTES IN WATERSHEDS,
R. S. Mansell.
In: Research Bulletin No. 291, Southern Regional Association of State Agricultural Experiment Stations, June 1983. Edited by M. D. Smolen, p 74-83, 3 Fig, 14 Ref. Project No. S-108.

Descriptors: *Storm seepage, *Solute transport, *Models, *Agricultural, *Mathematical models, *Surface runoff, *Water quality, *Hydrologic models, Model studies, Watersheds, Runoff, Nonpoint pollution sources, Streamflow, Mathematical studies, Simulation analysis.

A simplified mathematical model is proposed to provide conceptual insight into the major physical processes which control solute transport during subsurface water flow in small watersheds which receive periodic applications of fertilizer of secondary-treated municipal wastewater. The model involves estimating solute travel time when water flow is assumed to be steady so that streamlines can be used to distinguish pathways for solute movement through the soil. The solute molecules are assumed to travel by piston-type displacement along individual stream tubes. The stream tubes are vertical through the water-saturated soil but are curvilinear toward the drain in the saturated groundwater zone. The average concentration of solute in the subsurface flow reaching the stream changes with time due to the distribution of solute travel time in the watershed soil. The model is best suited for the simulation of subsurface flow from low-intensity rain events that do not generate surface runoff. Equations are given for a simplified method to approximate the travel time function for the saturated rectangular zone for use when the distance between the catchment boundary and a stream is greater than about 5 times the depth to the impermeable layer. If a nutrient such as NO3-N is applied uniformly to the watershed, the travel times for subsurface flow become progressively larger with increasing distance from the stream. Such models based on soil physics provide a starting point for the development of a new generation of watershed-scale water quality models.
W85-05344

PARTITIONING VARIABLE STORMS TO RAINFALL EXCESS AND SOIL WATER,
A. W. Thomas, and R. R. Bruce.
In: Research Bulletin No. 291, Southern Regional Association of State Agricultural Experiment Stations, June 1983. Edited by M.D. Smolen, p 85-89, 15 Ref. Project No. S-108.

Descriptors: *Model studies, *Rainfall, *Mathematical models, *Soil water, *Surface runoff, *Soil horizons, *Infiltration, *Hydrologic models, Models, Precipitation, Watersheds, Runoff, Soil profiles, Permeability coefficient, Storm runoff.

Three general modeling approaches for partitioning rainfall are discussed, along with their strengths and limitations. The model developed by Thomas et al. (1981) was a mathematical structure for partitioning rainfall into daily runoff and soil water on a heterogeneous landscape utilizing a retention function driven by rainfall and rescaled pan evaporation between rain events. This approach allowed the description of the state of the watershed in terms of dryness rather than the customary state of wetness. This model was used to simulate 3 yr of measured surface runoff and soil-water data from a 1.3 ha watershed having a cover of common burmudagrass. Annual summaries and seasonal patterns of measured and predicted water qualities indicated that the model could partition rainfall into runoff and soil water. Bruce et al. (1976) used a flow-theory infiltration model to examine the effects of nature and extent of horizons in soil profiles on infiltration and soil-water distribution. It was found with this model that hydraulic conductivity can be satisfactorily calculated from water retention data obtained from core samples of soil horizon material. The flow theory infiltration model used by Bruce et al. (1976) has been modified to increase versatility such as partitioning variable storm patterns. The revised model has been used to describe the effects of variable rainfall patterns and different time increments of rainfall input on rainfall excess and soil water fluxes.
W85-05345

ENVIRONMENTAL DATA SUMMARY FOR THE RHODE RIVER ECOSYSTEM (1970-1978), SECTION A: LONG TERM PHYSICAL/CHEMICAL DATA, PART 1: AIRSHED AND WATERSHED.
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
For primary bibliographic entry see Field 2L.
W85-05353

SEASONAL AND YEARLY VARIATION IN METEOROLOGICAL PARAMETERS AT THE CHESAPEAKE BAY CENTER FOR ENVIRONMENTAL STUDIES,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
D. Higman, and D. L. Correll.
In: Environmental Data Summary for the Rhode River Ecosystem (1970-1978), Section A: Long Term Physical/Chemical Data, Part 1: Airshed and Watershed, 1982. p 1-159, 34 Fig, 8 Tab, 1 Ref.

Descriptors: *Baseline studies, *Maryland, *Meteorological data collections, Data collections, Rainfall, *Precipitation, Seasonal variation, *Chesapeake Bay, *Baltimore harbor, Hydrologic data collections, Relative humidity, Evaporation, Air temperature, Solar radiation.

Readily available macroclimatic data for the Chesapeake Bay Center for Environmental Studies which show the seasonal and yearly variation in meteorological parameters are summarized. A weather station has been maintained at the site since July 1967. Prior to this data was collected from the Baltimore harbor area about 40 km north of the Center's weather station by the Naval Academy. A summary of 7 yr of solar insolation data is given. Mean monthly total insolation varies from 4,646 g cal/sq cm in December to 16,314 g cal/sq cm in July, and mean total yearly insolation was about 127,000 g cal/sq cm. A 10 yr summary of rainfall data is given. No pronounced seasonality of rainfall is apparent from these data. Mean daily maximum relative humidity for the years 1973-1977 ranged from a low 89.8% in January to a high of 97.7% in August. Evaporation rates were highest (0.58 cm/day) in July. For air temperature, the 10-yr monthly mean maxima ranged from 4.7 degrees for January to 29.5 degrees for July while the 10-yr monthly mean minima ranged from -5.4 degrees for January to 18.2 degrees for July. A statistical summary for 160-yr of rainfall data is given by month, season, and entire year. Mean precipitation was highest in August and least in November, but the monthly means and the seasonal means are grouped within a fairly narrow range and the variances are high. A statistical summary of 155 yr of mean daily air temperature and of 88 yr of daily maximum and minimum air temperature is also given.
W85-05354

NUTRIENT COMPOSITION OF THE SOILS OF THREE SINGLE-LAND-USE RHODE RIVER WATERSHEDS,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
D. L. Correll.
In: Environmental Data Summary for the Rhode River Ecosystem (1970-1978), Section A: Long Term Physical/Chemical Data. Part 1: Airshed and Watershed, 1982. p 260-311, 3 Fig, 30 Tab, 8 Ref.

Descriptors: *Watersheds, *Maryland, *Agricultural watersheds, *Forest watersheds, Phosphorus, Nitrogen, *Organic matter, *Elevation, *Soil surveys, Soil properties, Nitrates, Phosphates, *Nutrients, Hydrogen ion concentration, Ammonia, Nitrogen compounds, Soil chemistry.

Soil samples were taken from a forest, pastureland, and cornfield watershed of the Rhode River area during 1976-1978 and were analyzed for nutrient composition. Summary statistics are given for total P, total N and total organic matter and the data are summarized for each elevation contour of each of the three watersheds. No clear-cut elevation gradients are evident for total P, total N, or total organic matter, but all three showed distinct differences at some elevations. In all three watersheds, distinct gradients of declining nutrient content with soil depth were evident for all three parameters. The organic matter gradient was steepest in

the forest, slightly less in the pastureland, and least in the cornfield. The N gradient was steepest in the pastureland, slightly less in the forest and much less in the cornfield. The P gradient was steepest in the forest. The forest soils had the lowest pH, followed by pastureland and then cornfield soils. Soil pH decreased with depth in all three watersheds. The orthophosphate concentration (as a percentage of total-P) was least in forest soils and most in cornfield soils. Water-extractable orthophosphate was highest in the forest and least in the pasture. Total ammonia and total nitrate content of soils showed no clear-cut elevational gradients but declined with soil depth. Seasonal and annual variations in water-extractable orthophosphate, ammonia, nitrate and KCl-extractable ammonia are evident.
W85-05358

SEASONAL AND ANNUAL VARIATION IN RHODE RIVER WATERSHED HYDROLOGY,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
For primary bibliographic entry see Field 2B.
W85-05359

COMPARISON OF RAINFALL-RUNOFF MODELING TECHNIQUES ON SMALL UPLAND CATCHMENTS,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
K. M. Loague, and R. A. Freeze.
Water Resources Research, Vol. 21, No. 2, p 229-248, February, 1985. 8 Fig, 10 Tab, 54 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, Mathematical models, Prediction, Catchment area, Permeability coefficient, Hydrographs, Forecasting.

The use of mathematical models to predict runoff from rainfall is investigated. Modeling efficiencies for three rainfall runoff models on three sets of data from small upland catchments are compared. The models are: a regression model, a unit hydrograph model, and a quasi-physically based model. The assessment of model performance in a forecasting mode requires the calculation of model efficiencies on a sequential event-by-event basis. The results of model efficiency calculations for three rainfall-runoff models on 269 events showed surprisingly poor efficiencies for all models on all catchments. The study does not point to any one modeling approach as being superior to all others for all catchments. The fact that simpler, less data intensive models in the form of regressions and unit hydrographs provided as good or better predictions than a more physically based model is food for thought. The poor performance of the quasi-physically based model is probably due to a combination of model error, input error, and parameter error. The performance of the quasiphysically based model was only slightly improved by calibration against its most sensitive parameter, the saturated hydraulic conductivity. The performance of the unit hydrograph model was probably handicapped by the small size of the catchments studied. (Baker-IVI)
W85-05502

DESIGN DISCHARGES ESTIMATION FOR VARIOUS DESERT SITES NEAR THE DEAD SEA (ISRAEL),
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
E. Simon, and Y. Last.
Journal of Hydrology, Vol. 76, No. 1/2, p 163-181, January, 1985. 6 Fig, 7 Tab, 12 Ref.

Descriptors: *Design discharge, *Estimating, *Deserts, *Israel, *Dead Sea, Hydrographs, Flood frequency, Arid lands, Watersheds, Bridges, Culverts.

A procedure for estimating design hydrographs in areas where no records exist, even for regional flood frequency analysis, is presented. Specifically the study was used to give estimates of design discharges for various recurrence intervals required for the design of bridges and culverts at several sites along the Ein Gedi-Ein Boqeq road. The scarcity of data at the region ruled out the direct application of regional flood frequency analysis and led to the alternative of using a watershed model to simulate design discharges of pattern watersheds. The similarity between the pattern watersheds and the watersheds of the above mentioned sites, later enabled the determination of the required design discharges and also the establishment of regional relationships between design discharges, watershed areas and recurrence intervals. The final results of the study were the presentation of two charts which demonstrated the regional relationships between design discharges, watershed areas and recurrence intervals for future design purposes. These charts differ from the regular regional flood frequency analysis plottings by introducing not only watershed areas, but also some other watershed characteristics, represented by the model parameters. (Baker-IVI)
W85-05539

PETROLEUM REFINERY STORMWATER RUN-OFF STUDY,
Standard Oil Co. (Ohio), Cleveland
R. B. Stalzer, and G. W. McArdle.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 893-902, 14 Fig, 1 Tab, 4 Ref.

Descriptors: *Storm runoff, *Computer models, *Oil refineries, Industrial wastes, Oil industry, Oily water, Flow measurement, Design storms, Diversion, Reservoirs, Management planning, Wastewater treatment, Monitoring, Sewers.

A stormwater run-off study was conducted at a large petroleum refinery to: 1) estimate the peak flow rate and total impounding volume required for design storm events using stormwater run-off computer modeling; 2) install automatic flow recorders to obtain data that can be used for calibrating the computer model and improve simulation of stormwater run-off; 3) develop a conceptual design for an improved diversion and impounding system; and 4) prepare a stormwater management plan that summarizes all aspects of the study. Key elements of the stormwater management plan are outlined, including: identify all areas contributing stormwater run-off to the refinery's oily sewer system; establish the system and subbasin characteristics and hydraulics; determine the maximum flow rate allowable to the wastewater treatment system during a storm event; select the design storm events for estimating peak flow and total required impounding capacity needed for conceptual design purposes; use stormwater run-off computer modeling to develop design hydrographs; calibrate the model with data from a sewer monitoring program using automatic flow recorders; and develop a conceptual plan of an improved diversion and impounding system.
W85-05572

2B. Precipitation

SATELLITE PASSIVE MICROWAVE RAIN RATE MEASUREMENT OVER CROPLANDS DURING SPRING, SUMMER AND FALL,
Wisconsin Univ.-Madison. Space Science and Engineering Center.
R. W. Spencer.
Journal of Climate and Applied Meteorology, Vol. 23, No. 11, p 1553-1562, November, 1984. 8 Fig, 4 Tab, 18 Ref. NOAA/NESDIS contract NA-80-SAC-00742.

Descriptors: *Remote sensing, *Rainfall rate, *Microwaves, *Satellite technology, Precipitation intensity, Nimbus-7, Scanning multichannel microwave radiometer.

Rain rate algorithms for spring, summer and fall that have been developed from comparisons between the brightness temperatures measured by the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) and rain rates derived from operational WSR-57 radars over land are described. Data were utilized from a total of 25 SMMR passes and 234 radars, resulting in approximately 12,000 observations of approximately 1600 sq km areas. Multiple correlation coefficients of 0.63, 0.08 and 0.75 are achieved for the spring, summer and fall algorithms, respectively. Most of this information is in the form of multifrequency contrast in brightness temperature, which is interpreted as a measurement of the degree to which the land-emitted radiation is attenuated by the rain systems. The SMMR 37 GHz channel has more information on rain than any other channel. By combining the lower frequency channels with the 37 GHz observations, variations in land and precipitation thermometric temperatures can be removed, leaving rain attenuation as the major effect on brightness temperature. Polarization screening at 37 GHz is found to be sufficient to screen out cases of wet ground, which is only important when the ground is relatively vegetation free. Heavy rain cases are found to be a significant part of the algorithms' success, because of the strong microwave signatures (low brightness temperature) that result from the presence of precipitation-sized ice in the upper portions of heavily precipitating storms. If IR data are combined with the summer microwave data, an improved (0.85) correlation with radar rain rates is achieved. (Author's abstract)
W85-04984

SPACE TIME ANALYSIS OF HOURLY PRECIPITATION MEASURED IN THE SOUTH EAST OF FRANCE DURING THE ALPEX CAMPAIGN (ANALYSE SPATIO-TEMPORELLE DES PRECIPITATIONS HORAIRES MESUREES DANS LE SUD-EST DE LA FRANCE LORS DE LA CAMPAGNE ALPEX),
Centre d'Etudes de la Neige, Saint-Martin d'Heres (France).
J. P. Navarre, and E. Nicolet.
La Houille Blanche, Vol. 6/7, p 451-458, 1984. 9 Fig, 5 Ref.

Descriptors: *France, *Precipitation monitoring networks, *Rainfall distribution, *French Alps, *Massif Centrale, *Provence, *Jura, Forecasting, Weather forecasting, Hydrologic maps.

In the context of the Alpex programme, CEN has set up an index file of hourly precipitation measurements for the two month period March and April 1982. 124 recording rain gauges were selected from the EDF, SRAE and weather forecasting networks, from the French Alps to the South East of the Massif Centrale, and from Provence to the South of the Jura. This index file was used for a space time study of fine scale precipitation fields, based on meteorological and orographical conditions. The study was particularly concerned with quantifying organized distribution structures by developing and using automatic cartographic methods. (Author's abstract)
W85-05017

STUDIES ON DROUGHTS OF TAMIL NADU WITH SPECIAL REFERENCE TO THEIR SPREAD AND SEVERITY,
Cochin Univ. (India). Dept. of Marine Sciences.
H. S. Ram Mohan.
Mausam, Vol. 35, No. 3, p 253-256, July, 1984. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Droughts, *Tamil Nadu, *India, *Water budget, Rainfall distribution, Soil moisture.

Drought cannot be defined in terms of rainfall deficiency alone, without taking into account the water need of the region and the role of soil moisture. Droughts during the period 1901-1975 over Tamil Nadu, India, and vicinity were analyzed by the application of the water balance approach. Aridity anomaly diagrams on a yearly basis were drawn which show annual fluctuation in aridity presumably caused by large-scale changes in general circulation of the atmosphere. With the annual patterns as a basis, drought spread diagrams on a monthly basis were drawn to identify the 'core' areas and periods. After identifying the drought spells of various intensities and their spread, the cumulative effect of these water deficiencies in dry spells were assessed by employing the cumulative deviation technique. This method

besides giving an objective assessment of drought severity, also indicates the beginning, duration and end of a drought spell. The present investigation has brought forth the utility of the water balance procedure in drought analysis. The study of drought spread and intensification in particular is of great practical importance in agriculture and hydrological planning. (Collier-IVI)
W85-05073

PROBABILITY ANALYSIS OF RAINFALL AND EVOLVING CROPPING SYSTEM FOR COIMBATORE,
Tamil Nadu Agricultural Univ., Coimbatore (India).
R. Kulandaivelu.
Mausam, Vol. 35, No. 3, p 257-258, July, 1984. 1 Tab, 2 Ref.

Descriptors: *Rainfall distribution, *Cropping systems, *Coimbatore, *India, *Agriculture, Crop production, Model studies, Drought, Monsoons, Seasonal variation.

The daily precipitation data of Coimbatore center, India, for a period of 70 years were computed for weekly totals using a computer based incomplete gamma distribution model. The assured weekly rainfall amounts with a 50% probability level were taken as a measure of the adequacy of dependable precipitation and the probability of receiving a given amount of rainfall was worked out. The data indicate the likely commencement of rains, period of drought, length of growing season and end of growing season. In Coimbatore, the highest rainfall peak is noticed in October/November. For the rest of the period there is no high peak of rainfall. The prominent peak is observed in the 42nd week when the lowest assured rainfall amount is 30.8 mm at 50% probability level. The likely commencement of rains is the 40th week and the length of the growing season is the 40th to 49th week without any stress period. Continuous maximum assured rainfall at 50% probability level is received during the northeast monsoon period of October-December; it is the longest wet period during which a successful rainfed crop can be raised. Growing of improved sorghum varieties mixed with pulses is recommended to suit the rainfall pattern of Coimbatore center. (Collier-IVI)
W85-05074

EVALUATION OF AGRICULTURAL DROUGHT USING PROBABILITY DISTRIBUTION OF SOIL MOISTURE INDEX,
Indian Agricultural Research Inst., New Delhi. Div. of Agricultural Physics.
U. S. Victor, and P. S. N. Sastry.
Mausam, Vol. 35, No. 3, p 259-260, July, 1984. 1 Tab, 12 Ref.

Descriptors: *Drought, *Delhi, *India, *Cropping, *Seasonal variation, *Agriculture, Kharif crops, Soil moisture index, Evapotranspiration, Monsoons.

Weekly soil moisture budget was worked out for kharif cropping season July through October for 33 years (1940-1972) for Delhi, India, which has a semi-arid monsoonal climate. For this purpose the step function approach using climatological data suggested by Slatyer (1960) was followed. Soil moisture index (SMI), the ratio of available water to available water capacity in the soil root zone is directly related to the ratio of actual and potential evapotranspiration. Frequency distribution of weekly SMI values were evaluated and compared with the Beta distribution. Kolmogorov-Smirnov test of goodness of fit indicated the Beta distribution to be a suitable statistical model for approximating the frequency distribution of SMI for the monsoon season. For the threshold values corresponding to agricultural drought as well as potential moisture conditions in the root zone in respect of kharif crops, viz., sorghum, pearlmillet, corn, paddy and peanut crops grown in the Delhi region, the frequency of occurrence of agricultural drought during the monsoon season in the different phenological stages was determined. These results are discussed with reference to selection of a cropping pattern tailored to rainfall distribution of the region. (Author's abstract)
W85-05075

AGRICULTURAL DROUGHTS AND CROP PLANNING - A CASE STUDY FOR WESTERN RAJASTHAN,
Central Arid Zone Research Inst., Jodhpur (India).
A. S. R. A. S. Sastri, Y. S. Rama Krishna, G. G. S. N. Rao, and B. V. Ramana Rao.
Mausam, Vol. 35, No. 3, p 261-264, July, 1984. 2 Tab, 11 Ref.

Descriptors: *Drought, *Agriculture, *Cropping, *Rajasthan, *India, Millet, Kharif crops, Evapotranspiration, Rainfall.

The frequencies of occurrence of agricultural droughts with regard to pearlmillet and kharif pulses (the local major rainfed crops) were determined for stations in western Rajasthan, India; the stations represent semi-arid (Sikar), arid (Jodhpur) and extremely arid (Barmer) types of climates. Based on the minimum required values of the actual to potential evapotranspiration ratio for these crops, the intensities of drought during different cropping seasons (1956-1975) were determined. In western Rajasthan, kharif pulses are more susceptible to drought than pearlmillet. Even the pearlmillet crop is vulnerable to drought, with there being a 75% probability of drought during either the main growth or reproductive stages of crop growth when sown early during the 25th standard week. The crop is vulnerable to drought with 70% probability during reproductive stage when sown from the 29th to 31st week. (Collier-IVI)
W85-05076

DROUGHT YEAR OF 1979 - A CRITICAL APPRAISAL WITH REFERENCE TO THE SEMI-ARID REGION OF DELHI,
Indian Agricultural Research Inst., New Delhi. Div. of Agricultural Physics.
C. V. S. Sastri.
Mausam, Vol. 35, No. 3, p 273-276, July, 1984. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Drought, *India, *Delhi, *Agriculture, Seasonal variation, Rainfall, Hydrologic budget.

In the decade 1971-1980, India experienced three severe droughts which affected a major portion of the sub-continent. The failure of the southwest monsoon over India during 1979 resulted in widespread severe drought conditions in most parts of the country; agricultural production in the dryland tracts, especially, decreased considerably during the year. The frequency and severities of droughts that have occurred in the semi-arid region of Delhi were studied through the water balance procedure with emphasis on the year 1979. Monthly water balances for the period 1941-1980 at Delhi were worked out employing a water budgeting procedure. During the Kharif and Rabi seasons, the run off water balance components were studied on a weekly basis so as to determine the impact both individually and collectively on general crop growth in the region. The water balance parameters during 1979 were compared with those of normal, wettest and driest years in the decade as determined from water budgeting procedure and also from cumulative water deficit diagrams. The drought of 1979 was severe during the kharif season and affected the crop production adversely. The mild and moderate droughts of rabi season also had an equally bad effect because of their longer duration. A total of 35 out of 45 weeks were affected by droughts of all intensities. (Collier-IVI)
W85-05077

QUANTIFICATION OF DROUGHT AND CROP POTENTIAL,
Meteorological Office, Poona (India). Agricultural Meteorology Div.
B. C. Biswas, and P. S. Nayar.
Mausam, Vol. 35, No. 3, p 281-286, July, 1984. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Drought, *Climatology, *India, *Agriculture, *Moisture availability index, Climatic zones, Rainfall distribution, Cropping.

An agroclimatic classification based on a moisture availability index (MAI) was developed for demarcating agroclimatic zones of various crop potentials in the dry farming tract in India. That area, where annual rainfall varies from 40 to 100 cm, comprises 105 districts in nine states. In this tract rainfall is the limiting factor for successful raising of crops. In order to stabilize the crop at a certain level even in a low rainfall year, it is essential to know the frequency of drought years so that agricultural planning is drawn up on a rational scientific basis. For the purpose, amongst other things, it is necessary to know the minimum week by week rainfall at different probability levels. The lowest amount of rainfall at different probability levels (10 to 90%) was computed by fitting an incomplete gamma distribution probability model to weekly rainfall totals of 87 stations in the dry farming tract during the Indian monsoon season. The MAI, which is defined as ratio of probabilistic rainfall of a week to potential evapotranspiration, was computed. MAI at a 50% level has been used to map out drought prone areas. The period when MAI $>$ or $=$ 0.3 has been taken as the crop growing period. The mid-season water stress period, i.e., when MAI $<$ or $=$ 0.3 has been found out from 50% probability level and this period has been used to map out drought prone area both in time and space. Severity of drought has been classified by the number of water stress periods as well as their durations. A drought prone area extends from Aurangabad in Maharashtra to Bangalore in Karnataka. Occurrence of drought is frequent in Gujarat and eastern Rajasthan. (Collier-IVI)
W85-05078

STUDY OF ARIDITY AND DROUGHTS IN THE CLIMATIC SPECTRUM OF THE SOUTH INDIAN REGION,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
A. A. L. N. Sarma, and M. Ravindranath.
Mausam, Vol. 35, No. 3, p 287-290, July, 1984. 4 Fig, 2 Ref.

Descriptors: *India, *Drought, *Climatic zones, *Climatology, Rainfall distribution, Seasonal variation, Hydrologic cycle.

The nature of drought depends upon the amount and distribution of rainfall and its matching with the water need. These two aspects were studied in each climatic area of south India employing a water balance procedure. Since the main meteorological source of water supply to the Indian region is the southwest monsoon during the summer season, the moisture regime of the region has a strong seasonal aspect. Proneness of the different climatic types of the south Indian region to droughts was investigated by selecting one station from each zone of the climatic spectrum and plotting the yearly indices of aridity against years of record and categorizing the drought years. Decennial frequency of drought years is then calculated at each station and graphically plotted to get an insight into drought occurrence in the various climatic zones of the south Indian region. Fluctuations in the aridity index from year to year are rather mild at perhumid and arid climates since these climates are at the moist and dry extremes of the hydrologic cycle. (Collier-IVI)
W85-05079

AGROCLIMATIC APPROACH TO THE ASSESSMENT OF TROPICAL DROUGHTS,
Cochin Univ. (India). Dept. of Marine Sciences.
H. S. Ram Mohan, M. J. Stanislaus, and P. Valsala.
Mausam, Vol. 35, No. 3, p 291-294, July, 1984. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *India, *Climatology, *Droughts, *Tropical zone, Water stress, Agriculture, Crop growth, Seasonal variation.

The yearly water balances of two representative stations in Peninsular India - Madurai, which has a

semiarid climate, and Cuddalore, which has a dry sub-humid climate - were worked out for a 75 year period (1901-1975) using a book-keeping procedure. The index of moisture adequacy (Ima) derived from water balance procedures was employed to categorize droughts from the agricultural and ecological point of view. Selected drought spells were analyzed critically by plotting the ratio of the departures of monthly Ima from the climatic normal, to the standard deviation of Ima for that month. This technique was found to be of great value in agricultural and ecological investigations as due weightage is given to the drought resistance and tolerance of crops which are adapted to the region. The same amount of water deficiency during the various seasons of the year and at different stages of crop growth cause varying moisture stress. This is a special interest in tropical regions where it is the moisture factor that inhibits the growth of vegetation to its potential levels. (Collier-IVI)
W85-05080

RAINFALL DISTRIBUTION OVER INDIA DURING THE MONSOON MONTHS IN THE ABSENCE OF DEPRESSIONS AND CYCLONIC STORMS,
Indian Inst. of Tropical Meteorology, Poona.
O. N. Dhar, B. N. Mandal, and P. R. Rakhecha.
Mausam, Vol. 35, No. 3, p 309-314, July, 1984. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *India, *Rainfall distribution, *Monsoons, Seasonal variation, Droughts, Climatology.

It is well known that monsoon depressions and cyclonic storms play an important role in the distribution of rainfall over India. Naturally, their absence from the Indian area during any month of the monsoon season is considered to be responsible for causing deficient rainfall and consequent drought conditions. It is, therefore, of interest to know as to what extent the absence of these synoptic systems cause deficient rainfall during the individual monsoon months. This aspect has been examined by computing the average rainfall of the different meteorological sub-divisions of the Indian plains north of Lat. 15 degrees N for those monsoon months which were free from depression and clyclonic storms. There have been in all 25, 13, 7 and 4 occasions of June, July, August and September respectively, when no depressions or cyclonic storms moved through the Indian land area during the period 1891-1980. Of the 4 monsoon months, the September month is worst affected by the absence of these disturbances and in the case of other monsoon months of June, July and August, rainfall can be abnormally deficient depending upon the presence of any of the following meteorological situations: (a) Late arrival and subsequent weak monsoon conditions over the country, (b) The axis of monsoon trough remains shifted to the north of its normal position, and (c) Non-occurrence of low pressure areas (or land lows) across the country. Rainfall over the country can be normal or even above normal in spite of the absence of these disturbances if the meteorological situations like the above are not there. The absence of monsoon depressions and cyclonic storms are not the main factors which cause deficient rainfall and consequent drought conditions in this country. (Author's abstract)
W85-05081

DROUGHTS OVER PENINSULAR INDIA DURING 1861-1980 AND ASSOCIATED CIRCULATION FEATURES,
Indian Inst. of Tropical Meteorology, Poona.
D. A. Mooley, B. Parthasarathy, and N. A. Sontakke.
Mausam, Vol. 35, No. 3, p 337-342, July, 1984. 2 Fig, 6 Tab, 9 Ref.

Descriptors: *Droughts, *India, *Rainfall distribution, Monsoons, Climatology, Seasonal variation.

Droughts which affected the Peninsular India during the period 1861-1980 have been studied with well distributed rainfall data of 31 raingauge stations. The criterion used for identification of drought is the specific threshold value of rainfall expressed as standard unit, t sub i. If, in any year the t sub i value is less than -1.28, than the station is considered to be affected by drought. A year with 25 per cent of the stations considered suffered from drought is taken as large scale drought year over Peninsular India. There are 10 large-scale drought years during the period, 1876, 1877, 1891, 1899, 1905, 1913, 1918, 1920, 1952 and 1972. Statistical test shows that the time interval between two successive drought years is randomly distributed in time continuum. The worst drought occurred in the years 1899 and 1918 when more than 50% of the stations showed drought conditions. The circulation features, like position of monsoon trough and the depressions and storms, were examined with a view to understand the anomalies in rainfall during the large-scale drought years and the results presented. (Author's abstract)
W85-05082

DROUGHT PREDICTION IN INDIA FROM RADIATION PARAMETERS,
Meteorological Office, Poona (India).
A. Chowdhury, and G. S. Sarwade.
Mausam, Vol. 35, No. 3, p 345-348, July, 1984. 4 Fig, 3 Ref.

Descriptors: *Drought, *India, *Global radiation, *Diffuse radiation, *Solar radiation, Prediction, Radiation, Climatology, Rainfall distribution, Monsoons, Forecasting.

Monthly values of total global (G) and diffuse (D) radiation from January to May, for all available stations for a period 1961-79 have been utilized to predict drought in India. Drought was defined as a situation when over 20% of the area of the country had rainfall deficiency more than 25% of the seasonal (monsoon) normal. Departures from the normal value of total global radiation have been plotted, monthly as well as for the two seasons, viz, winter and pre-monsoon and analyzed to determine if its spatial distribution pattern bears any relationship with the drought occurrence in the succeeding monsoon season. Cumulative totals of G and its cumulative departures for individual stations were also plotted and examined in relation to drought. If during January the departures of the global radiation for the majority of stations among Jodhpur, Ahmedabad, Nagpur, Bangalore, Boa and Bombay are negative and those for Goa, Bangalore, Madras and Visakhapatnam are also negative in February, the year may witness drought conditions. These results have been tested for all stations for which data was available for 1979, the year in which the monsoon failed over large parts of India. At Goa and Ahmedabad, large negative departures prevailed during January. These were also negative for February for Goa and Viakhapatnam. The departures of global radiation during January and February may provide some prior indication of the monsoon activity during succeeding June to September months. (Collier-IVI)
W85-05083

PREDICTION OF DROUGHTS IN THE INDIAN ARID REGION,
Central Arid Zone Research Inst., Jodhpur (India).
Y. S. Rama Krishna, A. S. R. A. S. Sastri, G. G. S. N. Rao, and B. V. Ramana Rao.
Mausam, Vol. 35, No. 3, p 349-354, July, 1984. 4 Fig, 1 Tab, 10 Ref.

Descriptors: *Drought, *Prediction, *India, Arid zones, Seasonal variation, Climatology.

Drought is a recurring feature in the arid regions and prediction of droughts has great relevance to planning for afforestation, sand dune stabilization, establishment of grasslands etc. Some attempts have been made at the Central Arid Zone Research Institute, Jodhpur to develop techniques for prognostication of droughts in the Indian arid region on the basis of climatic fluctuations and variability. The climatic spectrum of the Indian arid region extends from extremely arid to semi-arid conditions. Through application of the theory of conditional probabilities based on first order Markov chain model, the climatic fluctuations during the years 1901-1970 were studied. It was observed that the occurrence of extreme arid conditions in the succeeding year could be predicted with 92 per cent confidence while climatic types can be predicted with 83 per cent confidence. Drought incidence may not be affecting the whole of the region simultaneously and some parts might experience localized droughts. However, in some years the whole region experienced drought conditions and studies reveal that even in such years the drought intensity and its time of occurrence varied from region to region. Studies on the incidence and spread of droughts over western Rajasthan indicate that drought conditions originate first in the northeastern region, during the month of July spread in a southwesterly direction during the month of August and dissipate with an easterly movement in the month of September. This pattern is observed to repeat during the years of severe drought. The applicability of the above techniques were discussed. Long range prediction of droughts is not yet possible with 100 per cent confidence. Therefore, a combination approach using different techniques might provide the necessary confidence in prediction of droughts. (Author's abstract)
W85-05084

ANALYSIS AND PREDICTION OF SHORT PERIOD DROUGHTS DURING SUMMER MONSOON OVER INDIA,
Indian Inst. of Tropical Meteorology, Poona.
S. V. Singh, R. H. Kripalani, P. Saha, and K. D. Prasad.
Mausam, Vol. 35, No. 3, p 361-366, July, 1984. 5 Fig, 3 Tab, 7 Ref.

Descriptors: *Droughts, *Monsoons, *India, *Prediction, Climatology, Spatial distribution, Rainfall distribution.

Climatic characteristics of occurrence of dry spells over 7 meteorological subdivisions lying in semi-arid parts of India were studied using 23 years of spatially averaged subdivisional rainfall data. Five different thresholds were used to decide the occurrence of dry or wet day over the subdivisions Similar characteristics in occurrence of dry spells were studied for 6 stations lying in the same area. The Markov chains of order 1 and 2 were fitted to the frequency of occurrence of dry spells over the stations and on testing, the chain of order 2 are found to fit better. Composite charts of probability of occurrence of rain around depressions located in various geographical areas were prepared by using daily rainfall data of 220 stations for 19 years. With the help of these charts the role of depressions in alleviating drought situation was examined. Multiple linear regression equations were developed by a stepwise screening method to predict the daily rainfall amounts over these subdivisions by using large scale synoptic parameters. When tested on an independent sample of equal size these equations showed skill scores varying from 0.22 to 0.54 in forecasting the terciles of rainfall. (Author's abstract)
W85-05085

SOME CLIMATOLOGICAL ASPECTS OF DROUGHT IN INDIA,
Meteorological Office, Poona (India).
A. Chowdhury, and V. P. Abhyankar
Mausam, Vol. 35, No. 3, p 375-378, July, 1984. 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Drought, *India, *Climatology, *Rainfall distribution, Spatial distribution, Arid zone, Climatic zones.

The drought climatology of India was compiled and collected based on data from 1875 to 1980. Only 'meteorological drought', i.e., rainfall deficiency exceeding 25% of the normal was considered. Frequency of occurrence of drought in different meteorological sub-divisions was obtained which has been used to determine its recurrence period. Drought was classified into moderate and severe categories and the probability of occurrence of these types in different sub-divisions was computed. Depending upon the area of the country affected, drought was further classified into different categories, viz., localized, semi-vast, vast extensive and calamitous, observed frequency of each

type determined. Decadal representation of the drought incidence was obtained and used to predict its occurrence in any 10-year period. The series was also subjected to power spectrum analysis and significant peaks were obtained. Since no rational criteria to define a year as a good or bad monsoon year for the country as a whole exists at present, an objective and pragmatic approach to solve this problem was attempted. The following two categories were separately adopted to consider a year as a drought year, viz., (i) When the percentage area affected exceeds 20%, (ii) When the area exceeds 25%. Sequences of a drought year or a good monsoon year were obtained. This has subsequently been examined to obtain probabilities of a drought year following (a) 3 consecutive good years, (b) 4 good years, and (c) 5 good years. Similarly, chances of two consecutive years of drought after each of 3, 4 and 5 consective good monsoon years were determined. These sequences were utilized to find persistence in occurrence of good or bad (drought) monsoon years and subjected to the chi square test to determine its statistical significance. (Author's abstract)
W85-05086

ANALYSIS OF TRENDS IN THE RAINFALL AND DROUGHTS OCCURRING IN THE SOUTHWEST MONSOON AND NORTHEAST MONSOON SYSTEMS IN THE SOUTHERN PENINSULAR INDIA,
University of Agricultural Sciences, Bangalore (India).
A. Krishnan.
Mausam, Vol. 35, No. 3, p 379-386, July, 1984. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Rainfall distribution, *Droughts, *Karnataka, *Tamil Nadu, *India, *Monsoons, Climatology, Spatial distribution, Seasonal variation.

Previous climatic classification studies of India were based only on the data of meteorlogical observatories for which long period normals were available. A detailed climatic classification of Karnataka and Tamil Nadu States of southern Peninsular India which receive rainfall from both southwest and northeast monsoon has been made by using the data of all provincial raingauge stations in these States for the period 1901-75; a comparison of the same is made with earlier classifications. A comparision of the rainfall normals (1901-1950) with the rainfall amounts recorded at different stations in these States during 1951-1975 indicates that decreases in annual rainfall have occurred in the latter period for many regions in Tamil Nadu which receive rainfall predominently during northeast monsoon, whereas increases have occurred in Malnad area, coastal Karnataka and north Interior Karnataka which receive rainfall mostly during southwest monsoon. The method of time series analysis of rainfall by stochastic processes was described. Use of this approach would shed light on the trends, if any, that occur and would help in a seasonal forecasting of monsoon rainfall. (Collier-IVI)
W85-05087

STOCHASTIC MODEL OF DROUGHT,
Indian Inst. of Tropical Meteorology, Poona.
P. P. Kamte, and S. D. Dahale.
Mausam, Vol. 35, No. 3, p 387-390, July, 1984. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *India, *Drought, *Model studies, Climatology, Rainfall distribution, Seasonal variation.

A stochastic process was applied to daily rainfall series of various meteorological sub-divisions and of different climatic regimes in India. An autoregressive AR(1) model was used to generate m-day minimum rainfall with the auto-correlations estimated through a statistically transformed distribution of minimum rainfall of different durations. The model satisfactorily explains the observed minimum rainfall of different durations; the probabilities of minimum rainfall of different durations are estimated to understand how best one can delineate the areas of droughts. During the month of June, Gujarat, Saurashtra, Kutch, Rajasthan (east and west), Tamilnadu and Rayalaseema show more than 50% of days with no measurable precipitation (2.5 mm is taken as measureable precipitation). During the month of September, except for the regions of Gujarat, Saurashtra, Kutch and Rajasthan (east and west), the rest of the divisions show less than 50% of the days with no measurable precipitation. (Collier-IVI)
W85-05088

STATISTICAL STUDY ON INCIDENCE OF DROUGHT IN RELATION TO AGRICULTURAL PRODUCTION,
Indian Agricultural Statistics Research Inst., New Delhi.
P. Narain, P. N. Bhargava, and A. Saksena.
Mausam, Vol. 35, No. 3, p 391-396, July, 1984. 2 Fig, 6 Tab, 6 Ref.

Descriptors: *India, *Drought, *Statistical analysis, *Agriculture, *Crop production, Rainfall distribution, Climatology, Arid zone, Jowar.

In India about 75 per cent of the cultivated area is rainfed and since about 42 per cent of India's food comes from such areas, there is considerable variation in food production depending upon the amount and distribution of rainfall. The annual rainfall in India's semi-arid areas is usually less than 75 cm and there sometimes occur prolonged dry spells within the rainy season. An agricultural drought is caused by a rainfall deficiency spread over a long duration during the crop season. The intensity of drought is related to the duration of the period during which total rainfall is deficient in relation to that required by the crop for its growth. Conditions for drought for a specific period in relation to a given variety of crop in the region may be determined with the help of rainfall distribution and potential evapotranspiration values. The agricultural drought and its intensity were characterized using data on rainfall and yield of a crop like jowar for certain semi-arid areas of western India. The estimates of the minimum amount of rainfall which is just sufficient for crop growth during a given number of consective weeks were worked out. The occurrence of rainfall below these drought base values gives rise to drought conditions. These values were used to determine the probability estimates of the occurrence of drought of varying durations. In Jamnagar and Surendra Nagar, the occurrence of drought of 9 week duration during early August and end of September is relatively more frequent and is expected to occur once in four and five years respectively. (Collier-IVI)
W85-05089

EXTREME PROBABILITY ANALYSIS OF DROUGHT PERIODS IN MONSOON IN RELATION TO WATER NEED OF CROP STAGES,
Marathwada Agricultural Univ., Parbhani (India). Dept. of Bio-Meteorology.
G. Ramakrishna Rao, and D. G. Phulari.
Mausam, Vol. 35, No. 3, p 397-402, July, 1984. 5 Fig, 5 Tab, 6 Ref.

Descriptors: *Drought, *India, *Crop production, *Agriculture, *Monsoons, Seasonal variation, Rainfall distribution.

Extreme probability analysis of drought periods were conducted on daily rainfall from 1944 to 1976 for frequencies 7, 10, 15, 20 and 25 days to adjust crop phases according to their water need. The study indicated that the first fortnight of June, second fortnight of July, first fortnight of August and second fortnight of September are not suitable for sowing, flowering and pod formation, panicle initiation, earhead emergence and grain filling of kharif crops respectively. If the crop phases are adjusted as per their water need with the available depth of rainfall three years of very successful cropping may be expected, as would five years with success with the crops possibly undergoing severe mositure stress in a two year period. If the proper crop sequence is chosen the crops would have a good harvest in a year particularly where the soil depth exceeds a meter. (Author's abstract)
W85-05090

MARKOV CHAIN MODEL FOR THE PROBABILITY OF DROUGHT INCIDENCE IN INDIA,
Meteorological Office, Poona (India).
A. Chowdhury, and V. P. Abhyankar.
Mausam, Vol. 35, No. 3, p 403-405, July, 1984. 2 Tab, 6 Ref.

Descriptors: *Markov Chain modeling, *Model studies, *Drought, *India, *Climatology, Rainfall distribution, Seasonal variation.

For each sub-division, each year has been classified as a drought year when the seasonal rainfall is less than 75% of the normal and as a non-drought year when the seasonal rainfall is greater than 75% of the normal. This mode of classification yields a sequence of drought and non-drought years which can be regarded as a two-state Markov chain. Seasonal rainfall departures for the period 1875-1974 have been subjected to Markov Chain analysis to determine the conditional probabilities of drought/non-drought years. One meteorological sub-division from each of the climatic type was selected; viz., per-humid, humid, sub-humid (dry and moist), semi-arid and arid regions. Expected length of climatic cycles, that is drought spell followed by a non-drought spell and vice versa, were computed. Considerable variations were observed in the expected lengths of non-drought spells which varies from 23.8 years for Orissa to 5.0 at Telangana. A noteworthy feature is that the expected lengths are greater than the observed lengths at all regions except Telangana where they are equal. Observed lengths of climatic cycles fluctuated from 20.4 years at Orissa to 4.6 years at west Rajasthan, whereas the expected lengths for these two regions were respectively 24.8 years and 4.9 years. Since the non-drought cycles do not confirm to the geometrical model, as such the length of the climatic cycle does not have much significance. (Collier-IVI)
W85-05091

APPLICATION OF MARKOV CHAIN MODEL IN DETERMINING DROUGHT PRONENESS,
Meteorological Office, Poona (India). Agricultural Meteorology Div.
N. N. Khambete, and B. C. Biswas.
Mausam, Vol. 35, No. 3, p 407-410, July, 1984. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Maharashtra, *India, *Drought, *Markov Chain model, *Model studies, Rainfall distribution, Crop production, Agriculture, Climatology.

A first order two state Markov chain model was used to evaluate sequences of dry and wet weeks during a southwest monsoon period over the dry farming tract of Maharashtra, India and an index based on parameters of this model was developed to bring out the degree of drought proneness. A threshold value of 18 mm potential evapotranspiration for the 23-41 week period was chosen for the study area. The dry farming tract of Maharashtra was delineated into five zones of different degrees of drought proneness. In chronic drought-prone areas crop failure is very frequent. In severe drought-prone areas a good crop may be raised in about 35% of the years. In moderately and mild drought prone areas a good crop may be raised in about 40-50% and 50-55% of the years and crop prospect is high in occasional drought prone areas. Better results will emerge if atmospheric demand and soil characteristics of the region are superimposed on these results. (Collier-IVI)
W85-05092

RAINFALL FLUCTUATIONS IN INDIA AND SRI LANKA AND LARGE-SCALE RAINFALL ANOMALIES,
Hanover Univ. (Germany, F.R.). Inst. fuer Meteorologie und Klimatologie.
H. Fleer, B. Schweitzer, and W. Raatz.
Mausam, Vol. 35, No. 2, p 135-144, April, 1984. 9 Fig, 26 Ref.

Descriptors: *Rainfall distribution, *India, *Sri Lanka, *Climatology, El Nino, Monsoons, Walker Circulation, Spatial distribution.

During 1972, world-wide climatic anomalies considerably affected the production of food in tropical countries. Statistical methods were used to investigate the homogeneity, temporal trends, and spatial and temporal distribution of fluctuations in rainfall series for stations in India and Sri Lanka. During 1972 India suffered from a widespread failure of the monsoon rains, upon which the country is so dependent. At some stations in the southwestern part of the subcontinent rainfall was only 50% of normal. During the same year, extraordinary rainfall was registered in the equatorial Pacific. Teleconnections between Indian rainfall and rainfall in the equatorial Pacific dry zone were analyzed. The rainfall series for Indian stations are characterized by pronounced spatial and temporal variations. The temporal fluctuations were investigated using running means, variabilities/auto-correlation and variance spectrum. Significant long-period fluctuations are evident at certain Indian stations but appear not to be a uniform trend in India over the last 100 years. There appears to be a linkage between the recurrent Indian droughts and the El Nino phenomena along the west coast of South America. In all years with rainfall deficits in India, high sea-surface-temperatures and excess rainfall occur in the equatorial Pacific. In El Nino years the Walker-Circulation is either reduced or disrupted by the weak atmospheric pressure gradient between the subtropical Pacific high and the Malayan-Indonesian low and by the decreasing equatorial zonal sea-surface-temperature gradient. A high (low) index that corresponds to a strongly developed (reduced) Walker-Circulation and to an intensified (weakened) upwelling along the equator and off the west coast of South America is connected with high (low) Indian and low (high) Pacific precipitation. (Collier-IVI)
W85-05093

RAINFALL OVER LAKES AROUND BOMBAY,
Meteorological Office, Poona (India).
A. K. Mukherjee, B. Shyamala, and S. G. Apte.
Mausam, Vol. 35, No. 2, p 165-170, April, 1984. 8 Fig, 6 Tab.

Descriptors: *Rainfall distribution, *Bombay, *India, *Seasonal variation, Rainfall intensity, Temporal distribution.

Bombay city and suburbs get their water supplu chiefly from the lakes Tulsi, Tansa, Powai, Vehar and Vaitarna. Mean monthly rainfall for four of the lakes for the period 1901-50 (Vaitarna was not commissioned until 1956) along with the seasonal totals have been calculated for the chief rainy months of June thru September which corresponds to the southwest monsoon period. Many conclusions based on statistical studies have been arrived at by analyzing monthly, seasonal, pentad and daily rainfall normals. Average seasonal rainfall is maximum at Tulsi. Year to year variation of seasonal and monthly rainfall is generally similar for all lakes and Colaba. Average monthly rainfall is less variable in July as compared to other months. During June rainfall is less variable in Colaba, Behar, Powai, but during August and September it is less variable in lakes Tansa and Vaitarna. Coefficient of variation for the seasonal rainfall is low, of the order of 22% for the lakes and Colaba. From analysis of actual daily rainfall data for 50 years, it is seen that the number of occasions with heavy/very heavy rainfall are only about 2%. (Collier-IVI)
W85-05094

TEMPORAL FLUCTUATIONS OF SEASONAL RAINFALL PATTERNS IN EAST AFRICA,
Nairobi Univ. (Kenya). Dept. of Meteorology.
L. Ogallo.
Mausam, Vol. 35, No. 2, p 175-180, April, 1984. 7 Fig, 1 Tab, 22 Ref.

Descriptors: *Rainfall distribution, *Seasonal variation, *Temporal distribution, *Kenya, *Tanzania, *Uganda, Statistical analysis, Mathematical studies, Precipitation.

In order to investigate temporal fluctuations in the seasonal rainfall over East Africa, monthly rainfall records from about 100 stations during the period 1931-75 were subjected to harmonic analysis on the yearly basis. Under this method time series were generated from the yearly amplitude and phase angle values of the dominant harmonics for the period 1931-75. The temporal fluctuations of the generated time were used to describe temporal patterns of seasonal rainfall in East Africa during the period of study. Yearly fluctuations in the pentad rainfall were also investigated during the wet seasons. The results from harmonic analysis indicated the dominance of the first three harmonics over most region of East Africa. Higher harmonics, however, explained substanial variance in some dry regions. The statistical methods employed indicated that at 95% confidence level, no significant seasonal changes or shifts could be detected in the seasonal rainfall patterns. Spectral analysis, however, displayed short period fluctuations within the ranges of 2-3 years and 5-6 years. A weak 10-11 years peak also appeared in some series. (Author's abstract)
W85-05096

STUDY OF MAJOR RAINSTORMS OF THE TEESTA BASIN,
Flood Meteorological Office, Jalpaiguri (India).
B. Biswas, and C. V. V. Bhadram.
Mausam, Vol. 35, No. 2, p 187-190, April, 1984. 6 Fig, 3 Tab, 4 Ref

Descriptors: *India, *Teesta River basin, *Rainstorms, Rainfall distribution, Rainfall intensity, Temporal distritution.

Rainfall distribution based on data from 1960-1981 was studied for the river Teesta catchment extending from its origin in north Sikkim (India) up to the Indo-Bangladesh border. The average monthly and annual rainfall of the Teesta basin were worked out by the isohyetal method. 53 rainstorms occurred during the period of durations of 1 to 3 days were analysed. Out of those storms, 40 are of one-day, 11 are of two-day while only 2 are of three-day duration. One possible cause for the high frequency of one-day storms is the narrow width of the catchment for which the effect of any moving synoptic system lasts for a shorter duration. Rainstorms are most frequent during the month of July. For the period under study, the rainstorm of 3-5 Oct 1968 has made maximum contribution of average depth of rainfall for 1, 2 and 3-day durations. This heavy rainstorm occured in association with a cyclonic storm which originated in the Bay of Bengal and ultimately broke up over the Himalayan region of north Bihar as a low pressure area. (Collier-IVI)
W85-05097

ELECTRONIC DISCRIMINATOR TO ELIMINATE THE PROBLEM OF HORIZONTAL RAINDROP DRIFT,
Missouri Univ.-Columbia. Dept. of Agronomy.
For primary bibliographic entry see Field 7B
W85-05193

CONTINUING DESIGN, REVIEW, AND ANALYSIS WORK FOR THE SIERRA COOPERATIVE PILOT PROJECT,
North American Weather Consultants, Salt Lake City, UT.
For primary bibliographic entry see Field 3B.
W85-05349

SEASONAL AND YEARLY VARIATION IN METEOROLOGICAL PARAMETERS AT THE CHESAPEAKE BAY CENTER FOR ENVIRONMENTAL STUDIES,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
For primary bibliographic entry see Field 2A.
W85-05354

SEASONAL AND ANNUAL VARIATION IN RHODE RIVER WATERSHED HYDROLOGY,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
D. L. Correll.
In: Environmental Data Summary for the Rhode River Ecosystem (1970-1978), Section A: Long Term Physical/Chemical Data, Part 1: Airshed and Watershed, 1982. p 312-343, 3 Fig, 14 Tab, 7 Ref.

Descriptors: *Watersheds, *Maryland, *Precipitation, *Runoff, *Discharge measurement, *Rainfall runoff relationship, *Annual distribution, *Seasonal variation, *Data collections, Statistical analysis, Hydrologic data, Rhode River Watershed, Hydrology.

Seasonal and annual variance in precipitation and runoff was studied in each of 11 basins of the Rhode River watershed. Water discharge was measured with sharp-crested Vee-notch weirs located along stream beds of subbasins and precipitation data was obtained from the CBCES weather station. Long-term (160 yr) mean average annual precipitation is 108 cm. The long-term average precipitation for spring, summer, fall in winter was 28.0 cm, 31.4 cm, 24.5 cm and 24.6 cm, respectively. Discharge data for the watersheds showed mean annual discharges ranging from 9.99 to 49.51 cm. Although precipitation was rather even from season to season, discharge is normally greater in the spring and winter, less in the fall, and least in the summer. Weekly precipitation and discharge data showed periods of increasing or declining discharge rates and periods of drought interrupted by a short period of heavy rain. The periods of increasing and declining discharge were also found to give different patterns if they were within the season of high evapotranspiration. Runoff data show different proportions of runoff between basins for the same storm events.
W85-05359

WATER AVAILABLE FOR RUNOFF FOR 1 TO 15 DAYS DURATION AND RETURN PERIODS OF 2 TO 100 YEARS FOR SELECTED AGRICULTURAL REGIONS IN THE NORTHWEST UNITED STATES,
National Weather Service, Silver Spring, MD.
F. Richards, J. F. Miller, E. A. Zurndorfer, and N. S. Foat.
NOAA Technical Report NWS 36. April 1983. 59 p, 33 Fig, 9 Tab, 16 Ref, 5 Append.

Descriptors: *River forecasting, *Snowmelt, *Runoff, Annual runoff, Cumulative runoff, Storm runoff, Precipitation, Cultivated lands

Through adaptation of the National Weather Service River Forecast System (NWSRFS) snow accumulation and ablation model, this study estimates the frequency of water available for runoff (WAR) from snowmelt and precipitation over selected agricultural areas in the northwest United States. The report outlines the adaptation, testing, and use of the NWSRFS model and presents maps of 1-, 5-, and 15-day, WAR values for 2- and 100-year return periods. Comparison of WAR-frequency estimates with previous precipitation-frequency values shows regions of substantial difference. As a byproduct of the analysis, model-derived water equivalent frequency estimates are also presented.
W85-05363

FIFTEEN YEARS OF AFRICAN DROUGHT,
R. A. Kerr.
Science, Vol. 227, No. 4693, p 1453-1454, March, 1985. 2 Fig, 2 Ref.

Descriptors: *Drought, *Sub-Sahara, *Africa, Lake Chad, Rainfall, Evaporation, History.

The catastrophe of the sub-Saharan drought began toward the end of the 1950s when nearly a decade of unusually wet weather ended and precipitation amounts more typical of the first half of the century returned. But the drop in rainfall continued and a 5 year pulse of dryness peaking in 1972 brought world wide attention to the area. Another, sharper pulse of drought peaked in 1977, equaling the intensity of the 1972 pulse. In 1979, after once again approaching but failing to reach normal, annual precipitation began falling year by year. Records of an earlier drought like this one have been found, making it thus unlikely that the drought was man-made. One measure of sub-Saha-

ran drought intensity is the withdrawal of the edge of Lake Chad as more water evaporates from it than drains into it. The lake was as small in the 1820-1840 drought as it was in 1979. The most pressing question is when will the present crisis ease, but meteorologists can only guess. The 1972 pulse intensified for 2 years before it peaked and took 2 years to approach normal again. The current peak of dryness, if it is a peak, was more than 4 years in the making. An equally long return to normal would not be surprising. (Baker-IVI)
W85-05462

NOTE ON SELECTING AN OPTIMUM RAINGAUGE SUBSET,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley, and B. F. J. Manly.
Journal of Hydrology, Vol. 76, No. 1/2, p 197-201, January, 1985. 1 Fig, 3 Ref.

Descriptors: *Rain gages, *Regression analysis, Catchments, Mathematical studies, Optimization, Rainfall, Measuring instruments, Network design.

All subsets regression is a useful technique for obtaining an optimum raingauge network reduction. With respect to some specified accumulation time T and land area A, the areal mean rainfall depth Y is estimated. It is applicable when real estimation error is negligible for the unreduced raingauge network, for which Y can be written as the weighted mean of recorded rainfall depths. As an illustration of the type of results yielded by this procedure, the method was applied to monthly rainfall data collected from nine gauges over a 7 yr time span from a small catchment. (Baker-IVI)
W85-05541

COMPARISON OF DAILY AND WEEKLY PRECIPITATION SAMPLING EFFICIENCES USING AUTOMATIC COLLECTORS,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 7B.
W85-05694

CONDITIONAL DISTRIBUTIONS OF NEYMAN-SCOTT MODELS FOR STORM ARRIVALS AND THEIR USE IN IRRIGATION SCHEDULING,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
J. A. Ramirez, and R. L. Bras.
Water Resources Research, Vol. 21, No. 3, p 317-330, March, 1985. 7 Fig, 4 Tab, 30 Ref. NSF grants 78-20245 ENG and CEE8211469.

Descriptors: *Rainstorms, *Irrigation scheduling, *Neyman-Scott models, *Rainfall distribution, *Irrigation programs, *Scheduling, Statistical analysis, Model studies, Poisson models, Mathematical studies.

Storm arrivals were modeled with the cluster point process Neyman-Scott (N-S) model. The implied dependence between storms was represented by the conditional distribution of the occurrence of future events given a history of the timing of past events. The deficit irrigation scheduling problem was solved assuming that rainfall arrivals obey a N-S cluster model. This new result was used on a physicostochastic model of the soil moisture history which in turn leads to an optimal control algorithm for making irrigation decisions. The decision of when and how much to irrigate now depends on measured soil moisture, available irrigation water, and time since the last rainfall occurrence. Results of a case study show no important difference between the theoretical net benefits derived from assuming a homogeneous independent Poisson model or a dependent N-S model during the growing season. A nonhomogeneous Poisson model yields higher theoretical benefits. As expected, the conditional N-S model leads to improved irrigation control as compared to the unconditional N-S model. No definite conclusions can be drawn regarding whether the Neyman-Scott model better represents the process of storm arrivals as opposed to the Poisson model. (Collier-IVI)
W85-05795

HYDROGRAPH SENSITIVITY TO STORM KINEMATICS,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
G. G. Ngirane-Katashaya, and H. S. Wheater.
Water Resources Research, Vol. 21, No. 3, p 337-345, March, 1985. 10 Fig, 1 Tab, 10 Ref.

Descriptors: *Hydrographs, *Rainstorms, *Kinematics, *Model studies, *Rainfall-runoff relationships, Runoff, Urban runoff, Rainfall distribution.

The magnitude of the effect of storm field distribution on the hydrograph will depend on catchment response which in turn will vary with catchment size, topography, geology, and land use. Using synthetic urban catchments, represented by a distributed nonlinear rainfall-runoff model, a comprehensive investigation was made of the effects of storm velocity and direction on the runoff hydrograph including variation of catchment area and response and considering alternative definitions of an equivalent stationary storm. The results, although specific to the rainfall-runoff model and catchment drainage configuration adopted, clearly show hydrograph sensitivity to storm speed and direction for each of the areas and response conditions examined. If storms occur with directional bias for a given catchment, as may often be the case, the implications of these results is that depending on the frequency distribution of storm speed, consistent underestimation or overestimation may occur. The results indicate a complex and potentially significant influence of storm kinematics for design practice. (Collier-IVI)
W85-05797

COLLECTION OF FOG DRIP,
San Jose State Univ., CA. Dept. of Meteorology.
J. Goodman.
Water Resources Research, Vol. 21, No. 3, p 392-394, March, 1985. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Fog, *Atmospheric water, *Clouds, *Meteorological data collection, Rainfall, Hydrologic data, Data collection.

Fog and low stratus clouds are the dominant climatic feature along the central California coastline during the summer months. This moisture source is not only a critical feature in the local hydrologic cycle, but may prove to be a valuable source for augmenting the water supplies. During the summer of 1982 an experiment was conducted to examine the relative efficiency of two man-made fog collection systems, the harp and cylinder. The systems were designed to maximize the collection of water droplets on vertically strung wires. The systems collected a rain gauge equivalent of between 25.2 and 80.4 cm/unit vertical area as compared to the mean annual rainfall of 60 cm. (Author's abstract)
W85-05802

2C. Snow, Ice, and Frost

MECHANISMS OF PLASTIC DEFORMATION OF POLYCRYSTALLINE ICE (MECANISMES DE LA DEFORMATION PLASTIQUE DE LA GLACE POLYCRISTALLINE),
Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).
P. Duval.
La Houille Blanche, Vol. 6/7, p 499-503, 1984. 2 Fig, 16 Ref.

Descriptors: *Ice, *Plastic deformation, *Polycrystalline ice, *Deformation, Basal slip, Liquid inclusions.

The microscopic processes that control the plasticity of polycrystalline ice are discussed. Basal slip does not control the plastic flow of the polycrystals. The processes of restoration that enable a static state to be established are analyzed across the temperature range 0 - 5 C. The role of liquid inclusions in the ice of temperate glaciers is discussed in particular. The high level of plastic anisotropy in the ice explains the establishment of an internal stress field with peaks of amplitude several times higher than the stress applied. The initiation of dynamic recrystallization for distortions of less than 1% is explained. For low stresses, a 'superplastic' type behavior may occur if the joints of the particles migrate during distortion. (Author's abstract)
W85-05018

FINDELEN GLACIER; RAPID ADVANCE AND CONSTRUCTION OF A NEW SUBGLACIAL WATER CATCHMENT (GLACIER DE FINDELEN; AVANCE RAPIDE ET CONSTRUCTION D'UN NOUVEAU CAPTAGE SOUS-GLACIAIRE),
Grande Dixence Societe Anonyme, Sion (Switzerland).
A. Bezinge.
La Houille Blanch, Vol. 6/7, p 505-514, 1984. 5 Fig, 25 Ref.

Descriptors: *Findelen Glacier, *Catchment basins, *Glaciohydrology, Glacier surges, Hydrology, Surges.

Following a historical overview of the development of the glacier, and of the characteristics of the sloping basin, there is an analysis of the catchment points, taking account of hypotheses on glacial and hydroglaciological flows. The principle of catchment is then developed for the two banks. A few details of the work are given and a number of special comments are made. (Author's abstract)
W85-05019

USE OF AERIAL PHOTOGRAMMETRY FOR TRADITIONAL SURVEYS OF FLUCTUATIONS IN GLACIAL SPITS (UTILISATION DE LA PHOTOGRAMMETRIE AERIENNE POUR LES RELEVES TRADITIONNELS DE FLUCTUATIONS DES LANGUES GLACIARES),
Centre National de Machinisme Agricole du Genie Rural, des Eaux et des Forets, Saint-Martin-d'Heres (France). Div. Glaciologie.
R. Burnet.
Houille Blanche, No. 6/7, p 515-517, 1984. 2 Tab.

Descriptors: *Glaciers, *Aerial photography, *Photogrammetry, *France, Data collections, Surveys.

An inventory is given of data stored at the Snow Surveying Division of CEMAGREF and made available to researchers. The photogrammetric survey consists of stereopreparation of aerial photographs with a network of visible reference points, and taking of aerial photographs at an altitude of more than 1,500 above the ground. The apparatus is in place for glaciers of three massifs in France: Mont Blanc, Savoie, and Oissans - Grandes Rousses. (Moore-IVI)
W85-05020

MEASUREMENTS OF GLACIAL FLUCTUATIONS IN THE FRENCH ALPS; COLLECTION OF DATA AND RESULTS (MESURES DES FLUCTUATIONS GLACIAIRES DANS LES ALPES FRANCAISES; COLLECTE DES DONNEES ET RESULTATS),
Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).
L. Reyanud.
La Houille Blanche, Vol. 6/7, p 519-528, 1984. 8 Fig, 16 Ref.

Descriptors: *Glaciers, *French Alps, *Mont-Blanc Massif, *Vanoise Massif, *Grandes-Rousses Massif, *Ecrins Massif, Glaciology, Slip speed, Model studies.

A description is given of glaciological measurements made every year on around ten glaciers in the French Alps, located in the Mont-Blanc, Vanoise, Grandes-Rousses and Ecrins massifs. These fluctuation measurements deal with annual variations in surface area, length, altitude, displacement and total amount, or more detailed information on the glacial bed such as slip speeds and water pressure. The use of these measurement results to establish evolution models and study glacial fluctuation is then discussed. The measure-

ments made are particularly interesting, in view of the fact that there has been a period of major glacial development over the past 20 years. (Author's abstract)
W85-05021

RHEOLOGY OF GLACIER ICE,
Cold Regions Research and Engineering Lab., Hanover, NH.
K. C. Jezek, R. B. Alley, and R. H. Thomas.
Science, Vol. 227, No. 4692, 15 March, 1985. 4 Fig, 13 Ref. NSF grant DPP-8306689.

Descriptors: *Antarctica, *Ross Ice Shelf, *Ice, *Rheology, *Stress, Temperature effects, Glaciers, Gravity, Ice shelf.

A new method for calculating the stress field in bounded ice shelves is used to compare strain rate and deviatoric stress on the Ross Ice Shelf, Antarctica. The analysis of the data obtained is in good agreement with a constitutive relation between the power law and creep for glacier ice with exponent equal to 3. The constant in the constitutive relation averaged over depth for central regions of the Ross Ice Shelf is 2.3 x 10 to the minus 23 power/second. Back stresses ranging up to 0.3 MN/sq m or higher, caused by the interaction of the ice shelf with pinning points and with its sides, are an important factor in ice shelf dynamics. (Baker-IVI)
W85-05112

COMPARISON OF FIELD DATA WITH THEORIES ON ICE COVER PROGRESSION IN LARGE RIVERS,
Laval Univ., Quebec. Dept. of Civil Engineering.
B. Michel.
Canadian Journal of Civil Engineering, Vol. 11, No.4, p 798-814, December, 1984. 10 Fig, 5 Tab, 24 Ref.

Descriptors: *Ice cover, *Ice formation, *Rivers, Glaciers, Theories, Hydraulics, Ice packing, Ice shoving, Fluvial processes, Frazil ice.

Existing theories on dynamic ice cover progression are reviewed, an additional one is proposed, and they are classified according to the physical mechanisms that are involved. Finally, they are compared with some existing field data for large rivers. Using the field measurements of ice condition for five cases of long river reaches, with a total of 144 measured sections, it has been possible to distinguish the various meaningful modes of ice cover formation. The mode of quasi-static cover formation has been consistently overlooked in the literature because of the impossibility to simulate it in models, but it is the major ice formation mechanism in rivers of most northerly locations. In temperate climates all means of ice cover formation will occur. To the existing known mechanims the concept of the ice packing criterion is added, which has much similarity with the mechanism of shoving and may be used when the ice cover is packing on a short distance from the edge, during the freeze-up period. The ice Froude number is the main simple analytical tool for determining frontal cover progression or packing. A different number is needed for shoving. Both numbers have been quantified with best fit values from the field data. The velocity of entrainment of frazil to form hanging dam has been confirmed to be between 0.6 and 1.4 m/sec, depending on the states of evolution of frazil. (Baker-IVI)
W85-05458

FLOW RESISTANCE OF ICE-COVERED STREAMS,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W85-05459

ICE JAM PREDICTION MODEL AS A TOOL IN FLOODPLAIN MANAGEMENT,
State Univ. of New York at Binghamton. Dept. of Geological Sciences.
P. L. Barnes-Svarney, and B. E. Montz.
Water Resources Research, Vol. 21, No. 2, p 256-260, February, 1985. 1 Fig, 3 Tab, 12 Ref.

Descriptors: *Ice jams, *Flood plain management, *Conklin, *New York, *Prediction, Flood plains, Water management, Watershed protection, Flood control, Temperature effects, Precipitation, Seasonal variation, Snowfall, Model studies.

The results of a preliminary analysis are presented that incorporates climatic variables into a predictive modeling technique: Wiener Filtering. The analysis is based on the premise that climatic factors have a direct relationship to the occurrence of ice jams. While application of this model will not resolve all problems, it is a tool that may be used in conjunction with other techniques to aid in the prediction of ice jam occurrences and ultimately in more refined floodplain delineation. Ice jam events are postulated to be directly related to seasonal precipitation, snowfall, temperature, and temperature fluctuations. Temperature appeared to have little effect on ice jam events in Conklin, New York. Monthly averages of temperature, precipitation, snowfall, and temperature deviation showed low error, but with a low filter length, there were too few predicted events. While 15 day data on temperature and precipitation showed a large number of predicted points, accuracy could not be checked. The primary result was that ice jam occurrence was predicted in Conklin, New York by using climatic data in certain combinations. The findings suggest that the Wiener Filtering technique may prove to be a useful tool to those concerned with communities that experience irregular ice jam occurrences, such as Conklin. (Baker-IVI)
W85-05504

PHYSICAL PROPERTIES OF SNOW (LES PROPRIETES PHYSIQUES DE LA NEIGE),
Centre d'Etudes de la Neige, Saint-Martin d'Heres (France).
D. Marbouty.
Houille Blanche, p 557-567, August, 1984. 13 Fig, 20 Ref.

Descriptors: *Snow, *Physical properties, *Review, Thermal properties, Optical properties, Electrical properties.

The article reviews composition variables and thermal, optical and electrical properties of snow. Macroscopic properties are examined here. Most of the variables, particularly those of a mechanical nature, vary in different orders of magnitude, since snow is a mixture of 2 to 3 phases (solid, gaseous and perhaps liquid) and the pressures and temperatures found are generally near to the triple point of water. (Author's abstract)
W85-05543

PHYSICAL AND CHEMICAL EVOLUTION OF SNOWPACKS ON THE CANADIAN SHIELD (WINTER 1979-1980),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
H. G. Jones, and M. Bisson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1786-1792, December, 1984. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Canadian Shield, *Snowpacks, *Snowmelt, *Laflamme watershed, *Quebec, Chemical properties, Physical properties, Snow, Crystals, Water quality.

In order to determine any possible relationship between the physical nature of snowpacks and chemical characteristics of meltwaters, an examination was made of the growth and decline of a snowfield in the small watershed of Laflamme Lake north of Quebec city, Canada. The chemistry of the stream waters was also studied. The mesostructure of a typical snowpack at Laflamme Lake is characterized by a succession of strata from previously fallen or redistributed snow in differing stages of metamorphism of snow crystal and grain microstructure and variable chemical composition. The chemical budgets for four snowpacks comprising a part of this snowfield showed that downward migration and rejection of chemical zones by the packs prior to, and during the early melt period, were observed even though snowfield physical dimensions were little changed. The mechanisms for these changes in periods of no meltwater flow are unknown, but may be associated with rejection of aerosols from snow crystals during varying stages of metamorphism. This activity in the snowpacks was reflected by the water quality changes monitored in streamwaters as the spring melt-season progressed. (Baker-IVI)
W85-05659

SUBGLACIAL HYDROLOGY AND SEDIMENT TRANSPORT AT BONDHUSBREEN, SOUTHWEST NORWAY,
Norges Vassdrags- og Elektrisitetsvesen, Oslo. Hydrological Div.
R. LeB. Hooke, B. Wold, and J. O. Hagen.
Geological Society of America Bulletin, Vol. 96, No. 3, p 388-397, March, 1985. 7 Fig, 1 Tab, 28 Ref.

Descriptors: *Glaciohydrology, *Sediment transport, *Bondhusbreen, *Norway, Hydrology, Ice-rock interface, Melting, Suspended sediments, Water pressure, Drainage patterns.

Tunnels driven in rock under the glacier Bondhusbreen in Norway, and thence upward to the ice-rock interface, provide a rare opportunity to study a subglacial drainage system. Early in the melt season, suspended sediment discharges in the subglacial water channels are large, and channels apparently change position. These effects are inferred to be a consequence of increased separation of ice from the bed due to increased water pressure. Water pressures are believed to be high at this time of year because water channels, having closed by plastic deformation during the winter when discharges are low, are too small to handle the increasing spring discharges. Water thus backs up in the channel system. Calculations suggest that further changes in channel position occur as discharges increase, because the potential energy released by the water is able to melt ice in the walls of channels faster than it is replaced by inward flow of ice. Channels can thus trend diagonally across the direction of glacier flow. Although such changes may occur at any time during the melt season in response to variations in discharge, there appears to be a seasonal evolution of the drainage pattern under Bondhusbreen that is repeated each year. These shifting channel patterns make the engineering task of locating and diverting water beneath glaciers more difficult than anticipated. (Author's abstract)
W85-05733

FLOW LAW FOR ICE IN POLAR ICE SHEETS,
British Antarctic Survey, Cambridge (England).
C. S. M. Doake, and E. W. Wolff.
Nature, Vol. 314, No. 6008, p 255-257, March, 1985. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Ice shelves, *Polar regions, *Ice flow, Mathematical equations, Arctic, Antarctic, Boreholes.

Glacier flow theories are commonly based on the assumption that ice is not a Newtonian fluid, but has a non-linear stress-dependent viscosity. A re-examination of the spreading of Antarctic ice shelves suggests that the data cannot define a unique flow law. Analysis of tilt data from four boreholes in the Arctic and Antarctic indicates that a linear law gives overall a more coherent explanation of the data and one which agrees better with ice-shelf data. On evidence available at present it is not necessary to use a non-linear flow law to describe the flow and deformation of polar ice sheets. (Moore-IVI)
W85-05735

EXPLORATION OF A RIGID ICE MODEL OF FROST HEAVE,
Cold Regions Research and Engineering Lab., Hanover, NH.
K. O'Neill, and R. D. Miller.
Water Resources Research, Vol. 21, No. 3, p 281-296, March, 1985. 16 Fig, 29 Ref. NSF grants ENG-77-17004 and CEE-8017422.

Descriptors: *Frost heaving, *Soil water, *Model studies, Frozen ground, Mathematical analysis, Thermodynamics, Pore water.

A numerical model which simulates frost heave in saturated, granular, air-free, solute-free soil was derived based on equations developed from fundamental thermomechanical considerations and previous laboratory investigations. Although adequate data are lacking for strict experimental verification of the model, simulations produce an overall course of events together with significant specific features which are familiar from laboratory experience. Simulated heave histories show proper sensitivities in the shapes and orders of magnitude of output responses and in the relations between crucial factors such as heave rate, freezing rate, and overburden. (Author's abstract)
W85-05791

COMPARISON OF THE THERMAL REGIMES FOR FREEZING AND THAWING OF MOIST SOILS,
Oklahoma Univ., Norman. School of Petroleum and Geological Engineering.
F. Civan, and C. M. Sliepcevich.
Water Resources Research, Vol. 21, No. 3, p 407-410, March, 1985. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Thermal regimes, *Frozen ground, *Soil water, *Thermodynamics, Soil types, Mathematical analysis, Differential equations, Numerical analysis.

The spatial and temporal temperature distributions were compared for freezing or thawing of moist soils undergoing freezing or thawing at a single temperature like coarse-grained gravel or sand or over a temperature interval like fine-grained silts or clays. The principle difference in the thermal physical properties of the soil are affected by the unfrozen water content. For the comparison, an enthalpy formulation in terms of dimensionless variables combined with similarity transformation and coordinate scaling was used to obtain accurate numerical solutions for heat conduction with phase change, irrespective of whether the transition occurs at a single temperature or over a temperature interval. The transformed ordinary differential equation is simpler and can be solved more accurately than the original partial differential equation. The accuracy of the solutions is dependent on the numerical method used. In the case of the finite difference method the accuracy is influenced by the sizes of steps in the spatial and temporal coordinates. (Collier-IVI)
W85-05806

2D. Evaporation and Transpiration

COMPARATIVE STUDY OF THE CLIMATOLOGICAL ESTIMATION OF POTENTIAL EVAPOTRANSPIRATION,
Meteorological Office, Poona (India).
S. Venkataraman, K. Subba Rao, and Y. Jilani.
Mausam, Vol. 35, No. 2, p 171-174, April, 1984. 2 Tab, 13 Ref.

Descriptors: *Evapotranspiration, *Climatic zones, *Pan evaporation, Plant water potential, Water demand, Vegetation, Crops, Agriculture.

A comparative study of potential evapotranspiration (PET) by various methods, viz., Penman, Monteith, and Thom and Oliver, in relation to mesh-covered class A Pan evaporation (EP) was conducted for 9 radiation stations situated in different agroclimatic zones. PET of Monteith is close to PET of Penman and hence Monteith's formula may be preferred as it would also be more convenient for computation. Computation of PET by Monteith's method for a tall crop is recommended for adoption in place of Penman's method. PET short crop would grossly underestimate the peak crop water demands while PET tall crop would give true peak water demand. EP data may by used where PET by modified Penman method is to be preferred. (Collier-IVI)
W85-05095

ESTIMATION OF WEEKLY POTENTIAL EVAPOTRANSPIRATION,
Meteorological Office, Poona (India). Agricultural Meteorology Div.
N. N. Khambete, and B. C. Biswas.
Mausam, Vol. 35, No. 2, p 209-212, April, 1984. 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Potential evapotranspiration, *India, *Pune, *New Delhi, *Nagpur, *Jodhpur, Evaporation, Transpiration, Solar radiation, Seasonal variation.

Weekly potential evapotranspiration at New Delhi, Pune, Nagpur, and Jodhpur (India) were estimated by different methods: (a) interpolation of monthly values estimated by a modified Penman formula; (b) estimation by a modified Penman formula with weekly meteorological normals and measured net solar radiation as input data; (c) computation following the method given by Doorenbos and Pruitt (1975, Crop Water Requirements, Irrigation and Drainage paper, F.A.O. Rome, pp. 28-49.); and (d) estimation by a modified Penman formula with weekly meteorological normals and solar radiation obtained from tables. In all the stations the difference between B and D is always less than the other two methods. Values computed by using actual radiation data is always preferable but for most of the cases net solar radiation data is not available; in those places, method D could be used for estimation of PE values. Ratio of actual evaporation to potential evapotranspiration computed by method D ranges from 0.72 to 0.91. For practical purposes these values may be taken to be 0.75 to 0.90 during the monsoon season; during the post-monsoon season they may be taken to be from 0.75 to 0.80 in the semi-arid zone and from 0.65 to 0.70 in the arid zone. Using method D, PE was computed for 100 stations. (Collier-IVI)
W85-05099

DESERTIFICATION IN THE UNITED STATES, STATUS AND ISSUES,
Bureau of Land Management, Washington, DC.
J. E. Sabadell, E. M. Risley, H. T. Jorgenson, and B. S. Thornton.
Final Report, April 1982. 277 p, 34 Fig, 399 Ref, 15 Append.

Descriptors: *Soil moisture deficiency, *Deserts, *Desertification, Dynamics, Physical events, Soil water, Semi-arid land, Technology, *Climates, Social aspects.

This report is a one-time survey and assessment of important ongoing physical and social events which are affecting the quality of land resources in the extensive water-deficient areas of the Western States. Emphasis is placed on identification and description of dynamic processes set in motion or accelerated by man's actions which change the character of the land positively or negatively; of the technologies and institutional arrangements which have arisen to monitor the effects of man's actions in the more fragile parts of the country; of the mitigating and preventive actions available to land managers and the progress made in the combating desertification. The report provides a holistic view of the actions and interactions which can lead to desertification. Thus it includes summary information on component elements of the resource base drawn from more detailed and authoritative sources such as the Department of Agriculture appraisals of soil conditions.
W85-05125

COMPARISON OF EQUATIONS USED FOR ESTIMATING AGRICULTURAL CROP EVAPOTRANSPIRATION WITH FIELD RESEARCH,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
R. W. Hill, E. L. Johns, and D. K. Frevert.
Available from the National Technical Information Service, Springfield, VA 22161. Bureau of Reclamation, Technical Report, October 1983. 242 p, 30 Fig, 21 Tab, 36 Ref, 7 App.

Descriptors: *Evapotranspiration, *Estimating equations, *Agricultural engineering, *Stress, *Irrigation, Corn, Alfalfa, Water consumption, Lysimeters.

Research data on alfalfa water use and related yields were obtained for 10 sites in the Western United States. Similar research data was obtained for corn at eight sites. Four different types of research studies were available: lysimeter, line source sprinkler stress plots, and farm yield. Research alfalfa yields and corresponding ET (evapotranspiration) were assumed to be 20% greater than field attained yields and ET, based on experience. Similarly, corn research yields and ET were assumed to be 10% greater than field attained yields and ET. Yield versus ET relationships were derived from the available research data. These equations became the link between the research studies and anticipated farm conditions. They also served as a comparison standard for testing the accuracy of the various empirical ET equations. The equations were compared to the field attained ET value as derived from research yields and the production function at each of the various sites. There was no single equation, out of the 10 evaluated, that matched the field attained ET at all sites with satisfactory consistency. Thus, none of the equations could be selected for general application to all sites without a site correction factor.
W85-05131

ESTIMATING NONPOTENTIAL EVAPOTRANSPIRATION BY MEANS OF THE EQUILIBRIUM EVAPORATION CONCEPT,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
J. A. Mawdsley, and M. F. Ali.
Water Resources Research, Vol. 21, No. 3, p 383-391, March, 1985. 6 Fig, 2 Tab, 33 Ref.

Descriptors: *Equilibrium evaporation, *Evaporation, *Evapotranspiration, *Model studies, Climatology, Soil water, Barley, Grasslands.

The usefulness of the Preistly-Taylor (Mon. Weather Rev., 100, 81-93, 1972) model was greatly increased by modifying it and applying it to nonpotential evapotranspiration using regularly regularly recorded data. The model was tested using three data sets from the United Kingdom: barley, turf, and rye grass. The results demonstrate that the model does not provide a full description of nonpotential evapotranspiration, but this does not mean that the model may not be useful in applied hydrology. To assess the model's potential in this respect the results were compared with those obtained from the Penman-Grindley model (a model widely applied in the United Kingdom at least). This comparison suggests that despite the model's deficiencies it should still prove useful in climates similar to the United Kingdom, and with further testing, in all climates. (Collier-IVI)
W85-05801

2E. Streamflow and Runoff

ESTIMATION OF DRAINAGE AREAS IN A HOMOGENEOUS LANDSCAPE,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
J. D. Phillips.
Water Resources Bulletin, Vol. 20, No. 6, p 847-850, December, 1984. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Drainage area, *Watershed boundaries, *North Carolina, *Albemarle-Pamlico Peninsula, *Wetlands, Basins, Drainage patterns.

It is sometimes necessary to define drainage areas in homogenous landscapes, where non-arbitrary methods are not usable. In areas such as portions of the lower coastal plain of North Carolina where there is little or no topographic relief and where soils, vegetation, geologic structure and other factors are essentially uniform, identification of drainage basin boundaries is difficult or impossible. In the vast swamp and pocosin terrain of the Albemarle-Pamlico Peninsula, not even field sampling of microrelief, soil characteristics, and vegetation can be readily used to identify watershed boundaries. In such a homogeneous landscape, however,

assumptions may be made that the hydrologic and geomorphic controls over drainage basin development are constant within the area. If this is true the drainage area of a stream may be related solely to the stream length and factors governing the length-area relationship are also constant. A simple formula based on these assumptions and the gravity model was proposed which can be used to estimate drainage divides in a homogeneous landscape. Choosing the square as the distance function, the breaking point or drainage divide along a transect between two streams in a homogenous landscape is determined with the formula. The breaking point method of estimating drainage divides is arbitrary but is designed for use only in situations where all non-arbitrary methods of delineating drainage areas have failed or are not feasible. If the assumptions associated with a homogeneous landscape can be accepted, and if it is essential that drainage areas be defined, the method is useful. While arbitrary, it is superior to pure guesswork and does have some theoretical basis. (Collier-IVI)
W85-04990

USE OF A DAM BREAK MODEL TO ASSESS FLOODING AT HADDAM NECK NUCLEAR POWER PLANT,
Westec Services, Inc., Plymouth Meeting, PA.
J. S. Scherrer, and D. L. Chery, Jr.
Water Resources Bulletin, Vol. 20, No. 6, p 905-914, December, 1984. 8 Fig, 4 Tab, 13 Ref.

Descriptors: *Model studies, *Flood forecasting, *Dam failure, *Connecticut River, *Quabbin Reservoir, *Haddam Neck Nuclear Power Plant, *Power plants, Flood damage, Earthquakes, Flood peak.

Many nuclear power plants are located beside rivers for easy withdrawal of water for cooling purposes, but such locations also expose the plants to flooding; even greater flood hazards exist where plants are located downstream of large dams. An evaluation of the greatest depth of flood water that could be expected at a plant-site due to potential dam failure was conducted for the Quabbin Reservoir Dams (Massachusetts) which are 80 miles up the Connecticut River from the Haddam Neck nuclear power plant in Connecticut. The NWS DAMBRK model was selected for making the needed evaluations; it has provision for representing valley storage volumes, dams, bridges, and other encroachments and adding flows at various locations along the reach. The model uses the one dimensional equations of unsteady flow (St. Venant) which consist of conservation of mass and momentum equations. A postulated earthquake was assumed to fail the dams. In such an event, both Winsor Dam and Goodnough Dike are assumed to slump and then be overtopped by water impounded in the reservoir. The simultaneous failure of both dams by overtopping and downcutting would combine the discharge of both the Winsor and Goodnough breaches, and thus would be the most conservative and extreme case for assessment of the downstream consequences. The predicted flood peak would occur at 35.6 hours from the beginning of dam failure and would have a flow of 37,700 cfs. The elevation of this flood peak is approximately 28 ft msl, 7 ft above plant grade of 21.0 msl. The flood has a broad crest being nearly 28 ft msl for about 10 hours and flooding above plant grade would occur for approximately 68 hours. The findings of this analysis demonstrate that the plant is adequately protected from the consequences of the postulated flood event. The most significant amount of time and effort for this evaluation was needed to prepare the input information and calibrate the model. (Collier-IVI)
W85-04998

REGIONALIZATION AND PREDICTION OF FLOODS IN THE FRASER RIVER CATCHMENT, B.C.,
Saskatchewan Univ., Saskatoon. Dept. of Geography.
P. R. Waylen, and M.-K. Woo.
Water Resources Bulletin, Vol. 20. No. 6, p 941-949, December, 1984. 4 Fig, 3 Tab, 12 Ref.

Descriptors: *Flood forecasting, *Fraser River Catchment, *British Columbia, Forecasting, Partial duration series, Regional analysis.

Probability distributions that model the return periods of flood characteristics derived from partial duration series were tested in the Fraser River catchment of British Columbia. Theoretical distributions describing the magnitude, duration, frequency and timing of floods were found to provide a good fit to the observed data. The five estimated parameters summarizing the flood characteristics of each basin were entered into a discriminant analysis procedure to establish flood regions. Three regions were identified, each displaying flood behavior closely related to the physical conditions of the catchment. Within each region, regression equations were obtained between parameter values and basin climatic and physiographic variables. These equations provided a satisfactory prediction of flood parameters and allow the estimation of a comprehensive set of flood characteristics for areas with sparse hydrologic information. (Author's abstract)
W85-05002

FLOOD-INDUCED BED CHANGES IN ALLUVIAL STREAMS,
Universita di Reggio Calabria, Cosenza (Italy). Dipt. di Difesa del Suolo.
B. Sirangelo, and P. Versace.
Hydrological Sciences Journal, Vol. 29, No. 4, p 389-398, December, 1984. 5 Fig, 12 Ref.

Descriptors: *Streambeds, *Italy, *Illice, *Model studies, *Floods, Monte carlo method, Mathematical studies, Stream erosion, Channel morphology.

The streams of southern Italy are often characterized by alluvial beds formed by coarse non-cohesive material ranging from gravels to cobbles and boulders. Their hydraulic geometry is not well defined since the flow often moves from one side of the alluvial bed to the other, thus forming channels which in a short time may disappear. These streams are referred to as 'fiumare'. A stochastic model was proposed to describe flood-induced changes in cross sections of ephemeral streams with coarse bed-material. The model is based on the assumption that the real process can be described as a marked point process. The cumulative distribution functions of both the total change in a fixed interval of time and the maximum scour in the same period were examined. The model was run, using Monte Carlo techniques, with field data obtained from the experimental basin of the Illice stream, a small stream in southern Italy. The stochastic models take into account both the stochastic and the intermittent nature of the hydrological process causing bed modifications and the uncertainty in evaluating the effects of a single flood event. Longer records than were available for the experimental stream should enable the model to be further refined, thus ensuring its greater precision. (Collier-IVI)
W85-05004

TESTING THE APPLICABILITY OF THE CREAMS MODEL TO ESTIMATION OF AGRICULTURAL NUTRIENT LOSSES IN FINLAND,
L. Kauppi.
Vesientutkimuslaitoksen Julkaisuja, No. 49, p 30-39, 1982. 2 Fig, 5 Tab, 6 Ref.

Descriptors: *CREAMS, *Model studies, *Agricultural runoff, *Nutrient losses, *Erosion, *Sediment transport, *Hovi basin, *Vihti, *Finland, *Mathematical models, Pesticides, Nutrients, Nitrogen, Phosphorus, Runoff, Percolation.

CREAMS is a physically based simulation model that estimates runoff, erosion/sediment transport, plant nutrient and pesticide yield from field-sized areas. It was calibrated to Finnish conditions with data from the Hovi basin, situated in Vihti, about 30 kilometers west of Helsinki. The basin is totally agricultural and its area is 12 hectares. The calibration years were 1968 and 1969. Calculated and observed runoff values corresponded with each other quite well on a monthly and annual basis. In 1968 the total observed runoff + percolation was 267 mm and the corresponding value calculated by the model was 289 mm. In 1969 the values were 224 mm (observed) and 229 mm (calculated). The soil losses calculated by the model were small, but because there were no observations it was not possible to compare calculated and observed values. Nitrogen and phosphorus losses calculated by the model were significantly greater than the observed losses. This may be due to incorrect parameter values, because the values had to be estimated from the literature. On the other hand, the observations on nutrient losses may have given misleading values because of insufficient sampling frequency. (Author's abstract)
W85-05062

CHANNEL CHANGE, SEDIMENT TRANSPORT, AND FISH HABITAT IN A COASTAL STREAM: EFFECTS OF AN EXTREME EVENT,
Center for Natural Resource Studies, Berkeley, CA.
R. Coats, L. Collins, J. Florsheim, and D. Kaufman.
Environmental Management, Vol. 9, No. 1, p 35-48, January, 1985. 9 Fig, 7 Tab, 22 Ref.

Descriptors: *Zayante Creek, *San Lorenzo River, *Santa Cruz County, *California, *Streamflow, *Fish habitats, *Sediment transport, *Channels, Bankfull stage, Storms.

A study on sediment transport and channel change was conducted on Zayante Creek and the lower San Lorenzo River in Santa Cruz County, California. A rainstorm with a recurrence interval locally in excess of 150 years occurred during the study year, 1982 WY. Stream surveys indicated that significant aggradation occurred during and after the peak flood. Upper study reaches were substantially recovered after high flows of early April, but the lower study reaches still had significant filling of pools and burial of riffles by sand. Increases in width-depth ratio were minor and localized in upper reaches, but were significant in lower reaches. Large inputs of sand, primarily from landsliding, altered the sediment transport regime. A higher proportion of the bedload is now transported by lower flows than before the January event. Roads and sand quarries contributed significantly to sediment input to the stream. A proposed dam may alter the sediment transport regime of Zayante Creek. Mitigating the effects of this dam on downstream fish habitat may require occasional bankfull discharges. (Author's abstract)
W85-05069

CASE STUDY OF 1981 FLOOD IN THE GODAVARI RIVER,
Flood Meteorological Office, Hyderabad (India).
N. Pandharinath
Mausam, Vol. 35, No. 2, p 195-198, April, 1984. 5 Fig, 1 Tab, 2 Ref.

Descriptors: *Floods, *Godavari river, *India, *Rainfall distribution, Rainfall intensity, River basins, Flood forecasting.

The river Godavari flows across the Deccan plateau rising in the Nasik district of Maharashtra and falls in the Bay of Bengal after travelling about 1465 km. The river was in a flood stage during 10 to 14 August 1981 from Tekra to Dowaleshwaram. Taking each sub-basin as a unit, depth area duration analysis of the 3-day storm was made to assess the contribution of the sub-basins to the flood. The actual 3-day storm average depth of rainfall was compared with that of normal average depth of rainfall of each sub-basin. Floods in the Godavari river in August 1981 were mainly due to heavy rainfalls over Indravati, Wainganga, Wardha and Penganga sub-basins under the influence of a cyclonic storm which moved across the northern part of the basin. Studies of other floods in the Godavari river may yield a method for predicting floods in the Godavari. (Collier-IVI)
W85-05098

CALCULATION OF INFILTRATION LOSSES OF STORM RUNOFF,
I. A. Svetlichnaya.
Water Resources, Vol. 11, No. 2, p 104-108, March-April, 1984. 1 Fig, 6 Ref. Translated from Vodnye Resursy, No. 2, p 44-48, March-April, 1984.

Descriptors: *Storm runoff, *Infiltration, *Mathematical equations, Model studies, Leaching, Moisture, Slopes, Differential equations, Overland flow, Wetness index, Soil physical properties.

One of the main components of the water-balance equation is the surface infiltration loss, consisting of the infiltration losses at the point of entry of the moisture and during overland runoff. There are two approaches to the solution of this problem in hydrology. The first is related to the use of differential equations describing the entry of moisture by means of a diffusion equation. The second approach is based on the use of physical statistical relations which are the result of processing data accumulated as a result of full-scale experiments. An attempt was made to reduce the determination of the dimensional quantities of the infiltration parameter and a second parameter to a determination of the corresponding dimensionless constants, making it possible to unify the treatment without tying the values of the empirical constants to a particular dimension. The method was used to determine parameters using experimental data from a series of studies on artificial sprinkling of small plots. Indices of wetness were used. Under conditions of the forest-steppe zone the problem of developing an index of wetness is greatly complicated as a result of intensive agricultural use of lands, because of differences in the soil discharge by various crops having substantially different growing seasons and water requirements. To use the method for calculating infiltration losses of storm runoff for soils with other hydrophysical properties, it is necessary to have experimentally established precipitation and runoff curves. (Baker-IVI)
W85-05153

ON-SITE INVESTIGATIONS AND NUMERICAL MODELING OF WIND SETUP AND SETDOWN PHENOMENA IN THE MOUTH REGION OF THE ENISEI RIVER,
E. P. Kotrekhov.
Water Resources, Vol. 11, No. 2, p 108-119, March-April, 1984. 4 Fig, 3 Tab, 15 Ref. Translated from Vodnye Resursy, No. 2, p 49-61, March-April, 1984.

Descriptors: *River mouth, *Wind setup, *Wind setdown, *Enisei River, *USSR, Velocity, Waves, Deltas, Water level, Water currents.

The development of waterpower engineering, water transportation, and possible use of water resouces of the basin of the Enisei River has caused increased study of the regularities of the wind setup and setdown in the mouth of the river. On site observations were carried out in August-September of 1972-1974 to obtain data on the dynamics of the flow in the mouth stretch of the river and in the Enisei Gulf during setup and setdown. One of the characteristics of the processes is the rhythmic character of the oscillations of the water levels and current velocities in conformity with changes in the anemobaric (wind pressure) conditions in the southern part of the Kara Sea and in the Enisei Gulf. Movements of water flow in this case were as a rule of a typical long wave character, namely movement of the oscillations themselves in space is observed and translation encompasses the entire column of the flow from the surface to the bottom. A more complete model of Enisei setup and setdown phenomona was examined which took into account the action of the wind, separation of the delta channel into major distributaries, and also natural storage. (Baker-IVI)
W85-05154

SURFACE FILMS AFFECTING VELOCITY PROFILES OF SLOWLY MOVING WATER IN OPEN CHANNELS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
W. D. Kemper, A. S. Humpherys, and J. A. Bondurant.
Irrigation Science, Vol. 5, No. 4, p 235-250, December, 1984. 9 Fig, 4 Ref.

Descriptors: *Surface films, *Open-channel flow, *Velocity, Films, Drag, Water surface, Obstruction to flow, Air-water interface.

Pollen, organic fibers, etc. on the surface of irrigation ditches or furrows often remain still while water below the surface moves. Rates of movement of surface films and underlying water were measured using observable solid and liquid tracers. Water flow rate, surface width, water depth, and channel length were varied in flumes in which the water was allowed to flow over a broad weir crest at the tail end. In some runs the surface was blocked 5 cm in front of the weir. When a slow moving water surface is blocked, velocity of the surface film immediately upstream from the block decreases to a small fraction of its value when the surface is blocked, even though the average water velocity remains constant. Relatively slow motion of this surface imposes a drag on the liquid moving below the surface, with the liquid immediately below the surface film having essentially the same velocity as the surface film. When the flow cross section converged near the surface the fast moving water passing over the broad weir blade developed a pull force on the surface film that affected surface movement as far as two meters upstream from the weir. As water left a pipe and travelled downstream in a channel the resistance to deformation of the new surface film, as indicated by the velocity of the midchannel surface, increased for several minutes until it reached a steady state. Surface films and their effects were present in dirty irrigation water, clean well water, and distilled water that was delivered to a carefully cleaned and protected glass flume a clean laboratory. (Baker-IVI)
W85-05169

LIMNOLOGICAL STUDIES IN A CROSS-SECTION OF THE MIDDLE REACH OF PARANA RIVER, I: GEOMORPHOLOGICAL AND HYDROLOGICAL CHARACTERISTICS (ESTUDIOS LIMNOLOGICOS EN UNA SECCION TRANSVERSAL DEL TRAMO MEDIO DEL RIO PARANA, I: CARACTERES GEOMORFOLOGICOS E HIDROLOGICOS),
Instituto Nacional de Limnologia, Santo Tome (Argentina).
E. C. Drago.
Revista de la Asociacion de Ciencias Naturales del Litoral, Vol. 15, No. 1, p 1-6, September, 1984. 4 Fig, 6 Ref.

Descriptors: *Parana River, *Argentina, *Hydrology, *Geomorphology, Channel morphology, Bedforms, River beds, Flow discharge, Suspended sediments.

The cross-section named 'Perfil Toma de Aguas Corrientes de Parana' is located in the main channel 2.7 km upstream of Parana City (Entre Rios Province, Argentina) and its geographical coordinates are 31 degree 42' 34' S and 60 degree 29' 07' W. The cross-section is morphologically stable, quite deep (22 m) and wide (600 m) at average stages. It is either U-shaped or asymmetrically V-shaped and lacks of sand bars. Because of its morphometry the section constitutes a primary control point that has fixed through long periods of time. In this case, analysis of hydrographical charts periodically surveyed over 66 years confirm the stability of the channel in this part of the river. The sandy bottom has dunes up to 5 m height. These bedforms migrate downstream. The Parana River catchment area up to the studied section is 2,000,000 sq km, representing 78% of the total drainage surface (2,600,000 sq km). The annual mean discharge is 14,000 cu m/s, so that 88% of total valley water volume flows through this cross-section. The suspended sediment concentrations ranged between 58 mg/l and 600 mg/l and the average concentration was 276 mg/l. (Author's abstract)
W85-05172

FLOW RESISTANCE OF ICE-COVERED STREAMS,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
S. P. Chee, and M. R. I. Haggag.
Canadian Journal of Civil Engineering, Vol. 11, No. 4, p 815-823, December, 1984. 6 Fig, 17 Ref.

Descriptors: *Channel flow, *Hydraulics, *Ice cover, Roughness, Velocity, Flow resistance, Channel morphology, Boundaries, Streamflow, Mathematical equations.

The underlying theory of the hydraulics of channel flow with a buoyant boundary as an ice cover is discussed. The velocity distribution is developed in two-dimensional covered channel flow using the Reynolds form of the Navier-Stokes equation in conjunction with the Prandtl - Von Karman mixing length theory. The division of the channel into two subsections is central to the theory. The functional relationship for the division surface is obtained from the developed velocity profile. The composite roughness of the channel is finally derived. Laboratory flumes were used to gain experimental verification of the developed theory. Seven cross-sectional shapes were used. Ice covers were simulated with polyethylene plastic pellets as well as floating plywood boards with roughness elements attached to the underside. The developed theory and laboratory confirmation affirms the existence of two subsection flows in a channel with a buoyant upper boundary such as an ice cover. To obtain hydraulic parameters in an ice-covered channel, it is important to determine the location of the divison surface and this can be achieved through an equation which is provided. The composite roughness of an ice-covered channel can be computed using another equation. Verification is limited mostly to seven laboratory channels. Prototype observations over a wider range of roughness are required. (Baker-IVI)
W85-05459

RATIONAL METHOD REVISITED,
Surrey District, Vancouver (British Columbia). Engineering Dept.
A. A. Smith, and K.-B. Lee.
Canadian Journal of Civil Engineering, Vol. 11, No. 4, p 854-862, December, 1984. 4 Fig, 17 Ref.

Descriptors: *Rainfall-runoff relationships, *Rational method, Mathematical equations, Storm runoff, Hydrology, Design criteria, Rainfall, Runoff, Infiltration.

In the wake of more sophisticated methods of analyzing rainfall-runoff events, the traditional rational method has fallen into disrepute, but the method continues to be used in design offices. Some of the simple notions of the rational method are demonstrated to be useful in a way which yields more reasonable runoff hydrographs from complex storms and which represents the process of rainfall abstractions in a way that is a significant improvement on the crude application of a constant runoff coefficient. One of the standard procedures in the rational method is the choice of a storm duration equal to the time of concentration. The appropriate storm duration to maximize the required detention storage is dependent on rainfall abstractions, catchment response function, and other factors, and cannot be predicted by a general rule. Use of the rectangular response function implied by the rational method, in conjunction with uniform rainfall intensity, results in hydrographs of trapezoidal shape. A key feature of this approach is the determination of the time of concentration. The variation of the runoff coefficient C over the duration of rainfall has been fairly widely recognized. The volume-dependent runoff coefficient is undeniably empirical and cannot be claimed to represent the physical process of infiltration. It resembles the SCS infiltration method in that it assumes runoff to be proportional to precipitation but differs from the SCS equation in that it uses the dynamically varying soil storage potential instead of the initial value. (Baker-IVI)
W85-05460

REMOTE SEMIAUTOMATIC INSTRUMENTATION FOR INTERMITTENT STREAMFLOW MEASUREMENT AND SUSPENDED SEDIMENT SAMPLING,
Alberta Univ., Edmonton. Dept. of Geography.
J. L. Honsaker, I. A. Campbell, and R. B. Bryan.
Canadian Journal of Civil Engineering, Vol. 11, No. 4, p 993-996, December, 1984. 4 Fig, 4 Ref.

Descriptors: *Suspended sediment, *Channels, *Stream flow, *Measuring instruments, Automation, Ephemeral streams, Samplers.

Stream discharge and suspended sediment in ephemeral channels are measured by battery-powered instruments adapted for control by detection of rainfall. The research required a system of reliable, rugged semiautomatic instrumentation. Discharge is measured in a flow-rated Parshall flume using an Aquatot FMS 2280 sonic-echo flow gauge, designed to operate continually with a power line connection in urban storm drains or sewers, or industrial locations. It operates wholly out of the water, generating a sound pulse and detecting its echo from the water surface. Because of logistic problems with battery operation in the field during the 1981 and 1982 seasons, silicon solar cell panels were installed in 1983 to provide daily charging of the main power supply batteries. There was usually adequate time between events to recharge the battery. Suspended sediment was sampled automatically using a sequential sampler. (Baker-IVI)
W85-05461

LONGITUDINAL DISPERSION OF MATTER DUE TO THE SHEAR EFFECT OF STEADY AND OSCILLATORY CURRENTS,
Government Industrial Research Inst., Chugoku, Kure (Japan).
For primary bibliographic entry see Field 8D.
W85-05469

ANALYSIS OF RIVER WAVE TYPES,
Cold Regions Research and Engineering Lab., Hanover, NH.
M. G. Ferrick.
Water Resources Research, Vol. 21, No. 2, p 209-220, February, 1985. 6 Fig, 6 Tab, 20 Ref.

Descriptors: *Waves, *River flow, Stream flow, Saint-Venant equations, Unsteady flow, Model studies, Friction, Inertia, Mathematical equations.

A quantitative method was sought for identifying river wave types and an attempt was made to clarify the relationships between wave types. The analysis is based on the principle that the balance between friction and inertia determines river wave behavior. The Saint-Venant equations are combined to form a system equation. Written in dimensionless form, the system equation provides scaling parameters that quantify the magnitudes of all terms in the equation and indicate the relative importance of friction, inertia, and pressure gradient effects on a wave. By interpreting the scaling parameters probabilistically, additional data can be incorporated into the analysis to account for variable physical characteristics of a river and wave. This more general interpretation provides an improved estimate of the friction-inertia balance, insight into the continuous nature of transitions between wave types, and a measure of the reliability of wave type assessments near a transition. The scaling parameter ranges that correspond to each wave type and transition are identified with data from case studies. These case studies encompass a wide range of river and wave conditions, attesting to the general utility of the approach. (Baker-IVI)
W85-05500

SEPARATION OF THE SNOWMELT HYDROGRAPH BY STREAM TEMPERATURES,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
D. Kobayashi.
Journal of Hydrology, Vol. 76, No. 1/2, p 155-162, January, 1985. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Snowmelt, *Streams, *Water temperature, *Japan, *Hokkaido Island, Snow cover, Hydrographs, Surface flow, Subsurface flow, Runoff, Soil heat.

The temperature of a stream under thick snow cover in northern Hokkaido Island, Japan was 3 to 4 C during the snowmelt flood. This was considerably higher than the temperature of snowmelt and yet the stream was perfectly insulated from heat sources from above the snow cover. Thus, it was reasoned that soil heat was furnishing most of the heat in runoff. The fact that stream temperature does change during the latter half of recession flow, in spite of a decrease in the amount of runoff, suggests that the stream water is discharging from specified subsurface layers or from a network of underground water channels. The depression of stream temperature during high runoff rates was assumed to depend on mixing of the direct discharge of meltwater at 0 C with the indirect discharge of subsurface warm water at 3-3.5 C. The stream temperature of 3-3.5 C on the recession hydrograph resembles the soil temperature at the depth of about 1.5 m. The subsurface component is delayed a little but plays a much more active and significant role than the surface component in composing the snowmelt hydrograph, accounting for 93-94% of the total amount of runoff. Even in the peak discharge the contribution of the subsurface component is more than 80% and in the latter half of the recession discharge the total amount is occupied fully by the subsurface component. (Baker-IVI)
W85-05538

DESIGN DISCHARGES ESTIMATION FOR VARIOUS DESERT SITES NEAR THE DEAD SEA (ISRAEL),
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 2A.
W85-05539

ESTIMATION IN PARTIAL DURATION SERIES WITH INDEPENDENT AND DEPENDENT PEAK VALUES,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
For primary bibliographic entry see Field 4A.
W85-05540

STREAM ECOSYSTEM THEORY,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
K. W. Cummins, G. W. Minshaal, J. R. Sedell, C. E. Cushing, and R. C. Petersen.
Verhandlung Internationale Vereinigung Limnologie Vol. 22, No. 3, p 1818-1827, December, 1984. 1 Fig, 6 Tab, 34 Ref.

Descriptors: *Riparian vegetation, *Ecosystems, *Streams, Lotic environment, Vegetation, Organic matter, Scour, Drought, Reviews.

The major tenet of this paper is that stream and river-side vegetation, the riparian zone, exerts the primary control over biotic associations. This control is mediated both through physical channel influences and the nature of the organic inputs from outside the wetted channel or in stream plant growth. Such corridors of stream side vegetation are inseparable from the biology in the channel and constitute a ribbon of continuity responsible for many universally discernable patterns. Some selected examples of general attempts at classifying patterns in running waters and understanding their underlying controls are summarized. It follows logically that the characteristics of the streamside vegetation system, the riparian zone, constitute the major organizing function for biotic associations in running waters. Presumably most attempts at lotic paradigm building have been intended as models of at least classes of prototype streams. The primary impact of man has been to increase or decrease the impacts of natural events that change stream ecosystems. Within any of the periods of historical importance to stream ecosystems, a temporal perspective is essential. Annual peak discharge or drought can be viewed as reset mechanisms. For example, algal communities are scoured or dried in intermittent channels to very low population levels and resting stages, initiating an annual recolonization and sequential community development. Functional relationships in running water systems are discussed. (Baker-IVI)
W85-05662

ROLE OF WOOD DEBRIS IN MODIFYING CHANNEL GEOMORPHOLOGY AND RIPARIAN AREAS OF A LARGE LOWLAND RIVER UNDER PRISTINE CONDITIONS: A HISTORICAL CASE STUDY,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2J.
W85-05668

SUBMERGED MACROPHYTES AND THE HYDRAULIC ROUGHNESS OF A LOWLAND CHALKSTREAM,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2I.
W85-05675

RIVER BURE, UNITED KINGDOM: PATTERNS OF CHANGE IN CHEMISTRY AND PHYTOPLANKTON IN A SLOW-FLOWING FERTILE RIVER,
University of East Anglia, Norwich (England). School of Environmental Sciences.
B. Moss, H. Balls, I. Booker, K. Manson, and M. Timms
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1959-1964, December, 1984. 5 Fig, 1 Tab, 6 Ref

Descriptors: *River Bure, *England, *Phytoplankton, *Chemical properties, Seasonal variation, River flow, Wetlands, Peat, Water chemistry, Broads.

The River Bure is one of three main rivers which drain northeastern Norfolk, England and which with their valley wetlands and over 40 flooded medieval peat pits constitute the Norfolk Broadland. The Bure, at its mouth, drains 931 sq km primarily of fertile agricultural land, underlain by glacial drift and chalk, and receives sewage effluent from over 50,000 people. Its long-term mean discharge in the stretch studied here is about 3 cubic m/second with a flowrate as low as 1 cm/sec in summer providing time for steady changes in downstream chemistry and phytoplankton to be observed. The main findings include a declining nitrate concentration downriver which is attributed to denitrification, considerable marl deposition and downstream changes in the phytoplankton communities. Increasing nitrate and P concentrations have been associated with the steady eutrophication of the river and it is hoped that restoration of aquatic plants may be achieved by phosphate precipitation at selected sewage treatment works. Nitrate control is not possible because of the diffuse sources. Phytoplankton crops at present appear to be controlled by flushing upstream of Hoveton Bridge and by N availability downstream. Substantal P reduction will be needed to reduce the algal populations. The pattern of phytoplankton community change cannot be explained entirely by changes in water chemistry. A possible explanation is that in the more vigorously flushed upstream sections, fast-growing small centric diatoms and flagellates may be selected for, while downstream the elongate, perhaps slower growing pennate diatoms and Oscillatoria sp. may be at a selective advantage in the less turbulent water. Subsequent effects of inhibition by substances secreted by the cyanophytes may also be important. The pattern is preserved and accentuated among the Broads which show wider ranges of flushing rates, and the observation may be useful to managers of riverine reservoirs wishing to maintain algal communities favored for the most economic treatment of drinking water. (Baker-IVI)
W85-05676

SEASONAL DYNAMICS OF WATER MOVEMENTS AND OF SUSPENDED MATTER IN A LARGE RIVER (DYNAMIQUE SAISONNIERE

DES MOUVEMENTS DE L'EAU ET DES PARTICLES EN SUSPENSION DANS UN FLEUVE),
Lyon-1 Univ., Villeurbanne (France). Section of Freshwater Ecology.
B. Cellot, and M. Bournaud.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 2002-2008, December, 1984. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Rhone River, *France, *Suspended solids, *River flow, *Sediment transport, *Seasonal variation, Organic matter, Particulate matter, Velocity, Flow discharge, Currents, Reservoir releases.

The water movements (discharge, current velocity) in the Rhone River, upstreams of Lyons (France), strongly modulate the transport of fine suspended matter and coarse organic particles. Measurements were carried out at 3 m from the river bank and in the middle of the channel, near the bottom and under the water surface. Stream velocities at different depths show a distinct correlation with the discharge values. Hence, water discharge can be used to describe the movements of the water at different levels of a river section. Whatever the discharge is, the flow rate near the river bank remains half as low as that of the channel; the flow rate in the channel is always maximum at a depth of 1 m from the surface; near the river bank it is maximum at half-depth. Suspended matter, of which the density is correlated with fluctuations in discharge, remains below 50 mg/l, except at the first water level increase in autumn, after the low water period (more than 100 mg/l). The same holds true for the suspended organic particles, with the density of about 0.1-0.3 mg/l, and particulate organic matter (P.O.M.) which at that time may attain 4 mg/l of dry matter; this phenomenon is reinforced by the leaf fall. Then, the successive winter floods bring about the loading of the river, which decreases progressively with the wash of the river bed. This loading of the river continues for a much longer period during the winter following the emptying of the hydroelectric reservoir upstream of Genissiat. The average amount of non-living material carried yearly by the river is estimated at 400,000 tons for the suspended matter and at 4,000 tons for the P.O.M. (Author's abstract)
W85-05681

SUBGLACIAL HYDROLOGY AND SEDIMENT TRANSPORT AT BONDHUSBREEN, SOUTHWEST NORWAY,
Norges Vassdrags- og Elektrisitetsvesen, Oslo. Hydrological Div.
For primary bibliographic entry see Field 2C.
W85-05733

PREDICTION OF COMBINED SNOWMELT AND RAINFALL RUNOFF,
Kanazawa Inst. of Tech. (Japan).
K. Mizumura, and C.-L. Chiu.
Journal of Hydraulic Engineering, Vol. 111, No. 2, p 179-193, February, 1985. 14 Fig, 8 Ref.

Descriptors: *Snowmelt, *Runoff, *Japan, *Sai River watershed, *Prediction, Tanks model, Kalman filtering, Autoregressive models, Model studies.

Snowmelt runoff forms an important water supply for the region of Japan facing the Sea of Japan where it is used to generate electricity, grow rice, and as drinking water. Snowmelt runoff in the spring is stored in reservoirs and, thus, an accurate runoff prediction is necessary for water level controls in the reservoirs. Rainfall runoff and snowfall-snowmelt processes were studied in the Sai River watershed southeast of Kanazawa, Japan. The combined snowmelt and rainfall runoff during the snowmelt period was predicted using a combination of the tanks and autoregressive models, with parameters identified by the Kalman filtering. The tanks model is represented by a cascading series of conceptual reservoirs. The input data used are rainfall, snowfall, runoff and air temperature. The uncertainty in parameter estimation for the tanks model can be reduced by using the Kalman filter. Even if the precipitation at the measuring station is not representative of the entire watershed, the autoregressive model coupled with Kalman filtering can give an accurate prediction of runoff. (Collier-IVI)
W85-05778

CHANNEL SCOURING POTENTIAL USING LOGISTIC ANALYSIS,
Wyoming Water Research Center, Laramie.
Y.-K. Tung.
Journal of Hydraulic Engineering, Vol. 111, No. 2, p 194-205, February, 1985. 5 Fig, 2 Tab, 13 Ref, 1 Append.

Descriptors: *Statistical analysis, *Channel scour, *Scour, *Logistic analysis, Statistical methods, Design criteria.

Occurrence of scouring in channels is a random phenomenon due to several factors including the fact that distribution of bed material is not uniform, channel geometry varies from one location to another, and flow is nonuniform. Water resource engineers often have to relate qualitative dependent variables to one or more independent variables, which may or may not be quantitatve. In the case of channel scouring, the dependent variable is the occurrence or nonoccurrence of scouring, which is binary and qualitative. In such circumstances, the use of conventional regression analysis would encounter a number of difficulties. Logistic regression was applied to a hydraulic problem of relating scouring potential in a channel to depth and velocity of flow. The problem was transformed by regressing the probability of occurrence of the dependent variable on independent varibles; thus the dependent variable is made continuous - to which ordinary regression analysis is less restrictive for application. A series of curves of different potential levels of scouring can be imposed on scatter diagrams of flow velocity and water depth for specific bed materials; these curves provide additional information to the designer and enhance risk-based design. Whether or not the methodology could become a useful addition in water resources engineering analyses further investigations and applications are necessary. (Collier-IVI)
W85-05779

MODELING OF UNSTEADY FLOWS IN ALLUVIAL STREAMS,
National Water Research Inst., Burlington (Ontario). Environmental Hydraulics Section.
B. G. Krishnappan.
Journal of Hydraulic Engineering, Vol. 111, No. 2, p 257-266, February, 1985. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Unsteady flow, *Model studies, *Computer models, *Alluvial rivers, Flow, Prediction, Boundary conditions.

A computer model was developed for the prediction of unsteady and nonuniform flows in alluvial streams. The model uses a generalized expression for evaluating the energy slope in mobile boundary flows. Therefore, it is possible to adopt different friction factor relationships into the model without affecting its structure. It is also possible to upgrade the model easily as new expressions for alluvial bed roughness become available. The model was tested for laboratory and field conditions and shows good agreement with measured data. It is capable of predicting longterm changes in riverbed slope and thus is well suited for estimating change in river regime caused by certain modifications to river flow, such as river diversions, meander cutoffs, river training works, dams and hydroelectric power plants. (Author's abstract)
W85-05782

COMPUTER ANIMATION OF STORM SURGE PREDICTIONS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
C. M. Libicki, and K. W. Bedford.
Journal of Hydraulic Engineering, Vol. 111, No. 2, p 284-299, February, 1985. 8 Fig, 14 Ref. NOAA contracts NA79AA-D-00120 and NA80AA-D-00103.

Descriptors: *Computer models, *Animation, *Storm surges, *Predictions, *Lake Erie, Graphical methods, Simulation, Water level.

With the proliferation of low-cost graphics systems and small computers, high-quality computer graphic representation of the modeling of geophysical flow is feasible. Storm surge activity on Lake Erie was simulated by a Leendertse-type model and the output from this model (water surface elevations) were pictured as three-dimensional surfaces in an animated sequence. Four methods for constructing such images were surveyed: A wire-frame plot on a line-drawing device; a representation as a set of flat panels on a polygon-drawing raster display; a smooth shaded rendering on a point-addressable monochrome display; and a full-color rendering with 'highlights' on a larger color palette display. Each of these methods were assessed in terms of speed, economy, reliability, the ability to render all relevant scales of activity, and the ability to be comprehended readily and unambiguously. (Author's abstract)
W85-05784

RIVER FLOW FORECASTING MODEL FOR STURGEON RIVER,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
D. H. Burn, and E. A. McBean.
Journal of Hydraulic Engineering, Vol. 111, No. 2, p 316-333, February, 1985. 2 Fig, 2 Tab, 25 Ref.

Descriptors: *Sturgeon River, *Ontario, *River flow, *Forecasting, *Model studies, Snowmelt, Kalman filtering, Mathematical analysis, Algorithms, River forecasting, Seasonal variation.

A forecasting technique for predicting river flow resulting from combined snowmelt and rainfall was applied to measured data from the Sturgeon River, Ontario. The technique incorporates Kalman filtering techniques to reflect uncertainty in the measured data as well as errors in the system model. Utility of the forecasting algorithm was demonstrated when applied to a case study area. The methodology provided satisfactory forecasts of the one day ahead river flow resulting from rainfall and snowpack dissipation during the spring freshet period. The Kalman filter model has the advantage of having the model parameters recursively updated; this allows the model to simulate the effects of changing physiographic characteristics of the river basin on river flow. This 'learning' process is evidenced both through a decrease in the confidence limits of the forecasts as the season progresses and an increase in the certainty with which the model parameters are known, as reflected by a decrease in the confidence limits of the estimates of the parameter values. The adaptability of the model further allows it to reflect changes occurring within the river basin during the spring freshet period. (Collier-IVI)
W85-05786

FLOW DISTRIBUTION IN COMPOUND CHANNELS,
Queen Mary Coll., London (England).
P. R. Wormleaton, and P. Hadjipanos.
Journal of Hydraulic Engineering, Vol. 111, No. 2, p 357-361, February 1985. 2 Tab, 1 Ref.

Descriptors: *Flood plains, *Flow characteristics, *Compound channels, Compound hydrographs, Flow discharge, Channels, Model studies.

In an attempt to understand more fully the characteristics of flow in compound channels and to pinpoint more precisely the causes of discrepancies between observed and calculated discharges, the analysis of previous experiments were extended to an investigation of discharges through individual main channel/flood plain subdivisions. The data presented show that even though a calculation method may give a satisfactory value for overall discharge in a compound channel, the distribution of flow between main channel and flood plain may be badly modeled. In general, flood plain flows tend to be underestimated and this is compensated for to a greater or lesser degree by overestimated

main channel discharges. These errors in discharge distribution can lead to even greater inaccuracies in momentum and energy flux which could lead to problems in applying the dynamic flow equations. (Baker-IVI)
W85-05788

HYDROGRAPH SENSITIVITY TO STORM KINEMATICS,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W85-05797

EMPIRICAL STUDY OF FLOOD MEASUREMENT ERROR,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
K. W. Potter, and J. F. Walker.
Water Resources Research, Vol. 21, No. 3, p 403-406, March, 1985. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Flood profiles, *Hydrologic data collections, *Error analysis, Mathematical analysis, Statistical analysis, Streamflow, River flow.

At a gaging station, very large peak discharges are usually estimated by extending the rating curve or by making an indirect measurement; hence these discharges are subject to much larger errors than are directly measured discharges. A crude measure of the uncertainty of the largest observed peak discharge at a gaging station is the ratio of the largest directly measured discharge to the largest observed peak discharge. For 46 gaging stations in the State of Wisconsin this ratio ranges from 0.16 to 0.99, with a median of 0.72. For the annual flood series from the half of the gaging stations with lowest ratios, the coefficients of skewness have considerably higher mean and standard deviation than do those of the remaining flood series. These results are consistent with the impact of measurement error, though they can also be explained by the occurrence of single extremely large floods in several of the annual flood series. (Author's abstract)
W85-05805

NUMERICAL SIMULATION OF TURBULENT FLOWS,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
R. S. Rogallo, and P. Moin.
Annual Review of Fluid Mechanics, Vol. 16, p 99-137, 1984. 7 Fig, 99 Ref.

Descriptors: *Turbulent flow, *Numerical analysis, *Simulation, Fluid mechanics, Dynamics, Computers, Mathematical models.

Numerical simulation has become a viable complement to experiment in both fundamental and applied turbulence research. Its growing popularity reflects both its promise of realistic answers to a difficult problem and the continuing rapid decline in computing costs. This tend is expected to continue. In addition to the advances in computer capacity of the last decade, less easily measured progress has been made in simulation techniques and in the utilization of simulation results. A notable development in numerical algorithms has been the use of spectral methods for direct simulations in simple geometries. This method is not very attractive at present for complex LES (large-eddy simulation) calculations involving mesh mapping and implicit time advancement. The premise of LES, that turbulence calculations can be closed more easily by truncating scales of motion rather than statistical moments, is supported by results, especialy those in wall bounded flows. But the hope that very simple eddy-viscosity models would be sufficient has not proved correct for the anisotropic SGS (sub-grid scale) stresses caused by high mean field gradients, at least with a reasonable number of mesh points. Anisotropic meshes, which cause ambiguity in the definition of SGS length scales, and moderate Reynolds numbers, at which the roles of the various scales overlap, introduce additional modeling difficulties. The nature of the flow near walls requires the expensive resolution of very small scales. Inflow and outflow boundary conditions present a major obstacle in the calculation of complex engineering flows. The future of turbulence simulation appears bright indeed. While there remains work to do on simulation technique, modeling, and numerical methods, the point has already been reached of being able to generate more information than can be digested. The use of stored simulation results places fewer constraints on the questions that can be answered, and allows rapid interactive display of results. (Baker-IVI)
W85-05830

SECONDARY FLOW IN CURVED OPEN CHANNELS,
Universidad Central de Venezuela, Caracas. Inst. de Mecanica de Fluidos.
M. Falcon.
Annual Review of Fluid Mechanics, Vol. 16, p 179-193, 1984. 5 Fig, 24 Ref.

Descriptors: *Secondary flow, *Open channel flow, *Curved channels, Velocity, Uniform flow, Nonuniform flow, Eddy diffusion, Bed shear stress, Model studies.

Steady secondary flow in open-channel bends is reviewed. Specific consideration is given to both uniform and nonuniform curved flow. For the case of steady uniform curved flow in open-channel bends, reasonable distributions of the scondary-flow velocity have been obtained with a simple Boussinesq turbulence model. By using a depth-varying, scalar, eddy-diffusion coefficient together with the null-velocity condition at the channel bed it has been shown that the transverse velocity distribution is sensitive to the friction factor of the flow. For strongly curved nonuniform flows a k-e turbulence model was used which defines a Boussinesq, scalar, eddy-diffusion coefficient, and presents good predictions for some cases. A basic difference between the uniform and nonuniform analyses is that in the former it is assumed that the primary velocity component follows a logarithmic or power-law distribution, while in the latter this distribution is part of the calculation. While the use of simple Boussinesq turbulence models appears to yield acceptable transverse velocity distribuion, this does not seem to be the case for the transverse bed shear stress, which is an important quantity for predicting riverbed topography. It seems that better turbulence models will have to be developed before bank recession and the transverse bed shear stress can be calculated accurately. (Baker-IVI)
W85-05831

MATHEMATICAL MODELS OF DISPERSION IN RIVERS AND ESTUARIES,
Liverpool Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
P. C. Chatwin, and C. M. Allen.
Annual Review of Fluid Mechanics, Vol. 17, p 119-149, 1985. 2 Fig, 109 Ref.

Descriptors: *Estuaries, *River flow, *Mathematical models, *Dispersion, Channels, Open channel flow, Salinity, Reviews.

Good progress has been made recently on dispersion in rivers and open channels, evidenced by the frequent availabiiity of potentially useful models for practically important questions. Progress on the more difficult question of dispersion in estuaries has been less satisfactory. Specific areas reviewed include basic principles of some dispersion models (ensemble means and time averages, effects of instrumentation, mechanisms of dispersion, Taylor's model of longitudinal dispersion, other types of dispersion models for conserved substances, dispersion of nonconserved substances); dispersion in rivers (dispersion soon after release, dispersion from steady sources, some geometrical complications); and dispersion in estuaries (one dimensional models of longitudinal dispersion in estuaries, modeling the longitudinal flux of salinity, the dependence of Km on salinity in estuaries). There should be more recognition of the potential shortcomings of standard techniques like the use of time averaged concentrations and eddy diffusivities, and of the limitations of standard models. Theoreticians should make more effort to present mathematical results in forms that make their importance obvious and to give detailed numerical examples of their application to real flows. Knowledge about dispersion could be significantly advanced by more well designed laboratory experiments. (Baker-IVI)
W85-05832

2F. Groundwater

GROUND WATER YIELDS AND INVENTORY FOR LAND-USE PLANNING IN CRYSTALLINE ROCK AREAS OF WAKE COUNTY, NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
C. W. Welby.
Water Resources Bulletin, Vol. 20. No. 6, p 875-882, December, 1984. 10 Fig, 2 Tab, 12 Ref. Water Resources Research Institute of the University of North Carolina project A-120-NC.

Descriptors: *North Carolina, *Wake County, *Land use, *Groundwater management, *Regional planning, Planning, Water management, Resource management, Population density.

In urbanizing areas underlain by crystalline rocks an inventory of the usable ground water should form an important element in the land-use planning process. Land-use decisions are most often made upon water-well yield data alone, but these data do not address the inventory question. A method utilizing local geology, stream low-flow characteristics, and pumping test data permitted outlining portions of Wake county, North Carolina, which are more favorable and those which are less favorable for ground water supply development. Information from state-required 24-hour pumping test on 232 wells was supplemented by information from an additional 100 wells whose initial yields were determined by shorter pumping tests. Comparison of the ground water inventory values on a per acre or per square mile basis with average water use at various residential densities provides information useful to the responsible political body as it decides about population density distribution and the need for surface water supplies. For Wake County an average density of one residential unit per acre appears generally permissible before overdraft of the ground water supplies becomes a significant risk. By utilizing the ground water inventory and patterns of ground water yields from various rock types, county officials can maximize the effectiveness of public facilities funds. The technique appears useful for other parts of the Piedmont region of the southeastern United States. (Author's abstract)
W85-04994

BRIEF REVIEW OF KRIGING AND ITS APPLICATION TO OPTIMAL INTERPOLATION AND OBSERVATION WELL SELECTION,
Birmingham Univ. (England). Dept. of Civil Engineering.
T. S. Virdee, and N. T. Kottegoda.
Hydrological Sciences Journal, Vol. 29, No. 4, p 367-387, December, 1984. 18 Fig, 35 Ref.

Descriptors: *Kriging, *Observation wells, *Kennet Valley Chalk Aquifer, *United Permeability coefficient, Statistical analysis, Transmissivity, Interpolation, Regional discretization

The current state of kriging in subsurface hydrology was critically reviewed. In an application to a region where boreholes already exist, methods of optimal location of additional observation wells for geophysical parameter investigation and optimal interpolation for the purpose of solving the inverse problem were investigated. The particular case of the location of wells for the measurements of transmissivity and hydraulic head in the Kennet Valley Chalk aquifer, UK, was examined. Results of interpolation of measured hydraulic conductivity values by kriging were compared with results from a standard graphical package for interpolation. Reference was also made to the distribution obtained by the inverse method (in which the conductivity distribution is obtained from the head

distribution). On the basis of the application, the conditional simulation (in which the generated data are both consistent with field values and the field statistical structure) was deemed to be the best. It was also found that different methods of interpolation give widely different distributions in the case of hydraulic conductivity. The kriged map or conditional map of the transmissivity should serve as the basis for regional discretization to which corrections via the inverse model may be made. (Author's abstract)
W85-05003

GROUND WATER DEVELOPMENT FOR MINERAL INDUSTRY IN ARID ZONES OF THE ANDEAN HIGHLANDS, SOUTH AMERICA,
Montgomery (Errol L.) and Associates, Inc., Tucson, AZ.
E. L. Montgomery, and J. W. Harshbarger.
Mining Engineering, Vol. 37, No. 1, p 45-48, January, 1985. 3 Fig, 9 Ref.

Descriptors: *Groundwater potential, *Water resources development, *Mineral industry, *Andes, *Chile, *Peru, *Bolivia, *Argentina, Arid zones, Mountains, Water quality, Transmissivity.

The region of metallic ore deposits in northern Chile, southern Peru, western Bolivia, and northwestern Argentina occurs in arid zones at altitudes as high as 6 km (19,700 ft). Because surface water supplies are meager, new mines require unexploited sources of water. Prolific ground water aquifers occur in salar basins in this region of the Andean Highlands. Exploration water wells have been constructed and aquifer characteristics have been tested in eight salar basins. Results indicate ground water quality is good. Aquifer transmissivity and storage computed from results of pumping tests indicate maximum capacities of more than 170 L/sec (2700 gpm) for individual production water wells. Results of investigations conducted by the authors demonstrate that ground water reservoirs in the Andean Highlands comprise a source of large quantities of water for the mineral industry. (Author's abstract)
W85-05045

HYDROGEOLOGIC AND GEOCHEMICAL STUDIES OF SELECTED NATURAL RADIOISOTOPES AND BARIUM IN GROUNDWATER IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 2K.
W85-05122

USE OF URANIUM-SERIES ISOTOPES FOR STUDYING THERMAL WATERS OF THE FRUNZE REGION,
T. V. Tuzova, P. I. Chalov, R. S. Mangel'din, S. A. Tarasov, and V. I. Alekhina.
Water Resources, Vol. 11, No.1, p 84-89, January-February, 1984. 2 Fig, 2 Tab, 9 Ref. Translated from Vodnye Resursy, No. 1, p 156-160, January-February, 1984.

Descriptors: *Aquifers, *Frunze Region, *USSR, *Uranium radioisotopes, Thermal water, Groundwater recharge, Artesian basins, Hydrogeology.

In 1978-80 a pool of mineral waters occurring at depths of 900-202 m in Paleogene-Neogene deposits was discovered in the region of Frunze (USSR) as a result of exploratory drilling. The pool is located in the central part of the Chu intermontane artesian basin. Results of isotopic studies in the area revealed the absence of an interconnection of waters of the Paleogene-Neogene deposits with waters of the Quaternary deposits. Only in the Pliocene-Lower Quaternary aquifer, well 1240, is mixing of waters of a deep origin with waters of the upper aquifers not precluded. A well was drilled in the zone of a probable deep fault, but owing to its comparatively small depth it did not penetrate the fault and only tapped Pliocene deposits, the water content of which region was presumed to be negligible. The highest value of the ratio of U-234/U-238 was recorded in waters of well 1240. It is possible that this ratio of uranium isotopes characterizes waters of deep origin, which may or may not be connected with waters of the paleozoic rocks of the nothern slopes of the Kirgiz Range, but do participate in the formation of waters of the Paleogene-Neogene aquifer system. On the basis of the uranium disequilibrium it is easy to show that the portion of such waters in recharge of the systems is not more than 5%. (Baker-IVI)
W85-05150

ISOTOPE INVESTIGATIONS OF THE CONDITIONS OF FORMATION OF MINERAL AND THERMAL WATERS IN SOME CAUCASIAN REGIONS,
V. A. Polyakov, G. S. Vartanyan, and M. P. Ezhova.
Water Resources, Vol. 11, No. 2, p 95-104, March-April, 1984. 4 Fig, 2 Tab, 16 Ref. Translated from Vodnye Resursy, No. 2, p 32-43, March-April, 1984.

Descriptors: *Isotope studies, *Hydrology, *Caucasian Mineral Waters region, *Rioni Depression, *Black Sea, *USSR, Aquifer properties, Water analysis, Minerals, Meteoric water, Leaching, Hydrogeology, Thermal waters, Glaciers.

Natural isotope investigations are reviewed for the Caucasian Mineral Waters (CMW) region and the Black Sea artesian basin in the region of the Rioni depression. For mineral waters in the CMW region, in the stretch from the Narznov Valley to the northern boundary of the Koslovodsk deposit, the mineral waters are formed due to meteoric waters, which leach both the water-containing rocks of the sedimentary strata and the Paleozoic rocks of the crystalline basement. During circulation the waters are saturated with thermometamorphic carbon dioxide arriving from the basement along tectonic fracture zones. In the zone of the Essentuke deposit the saline-alkaline waters of the Lower and Upper Cretaceous deposits are typical of waters leaching from sedimentary rocks. No inflow of waters from the crystalline basement is noted. Possibly, the Essentuki waters are closely related hydrodynamically to the Lower Cretaceous waters of the Naguti zone. The Naguti deposit of saline-alkaline waters, confined to an aquifer in Upper Cretaceous deposits, is formed by mixing of metamorphic marine waters squeezed into this aquifer and meteoric waters arriving from the Lower Cretaceous aquifer and characterized by high dynamics. Data from the thermal waters of the Rioni Depression indicate that the aquifer is recharged by melting of glaciers of the Great Caucasus. The chemical composition of the waters is determined by processes of leaching of the water-bearing rocks and water exchange time in various parts of the artesian system. There is little inflow of water from the lower lying Jurassic deposits. The residence time of the water in various parts of the Neocomian system is estimated as from 500 to 10,000 years. Discharge of the subsurface waters of the Cretaceous deposits into ground-waters of the Rioni depression is observed. (Baker-IVI)
W85-05152

SENSITIVITY ANALYSIS APPLIED TO UNSATURATED FLOW MODELING OF A RETORTED OIL SHALE PILE,
Battelle Pacific Northwest Labs., Richland, WA.
M. D. Freshley, A. E. Reisenauer, and G. W. Gee.
Soil Science Society of American Journal, Vol. 49, No. 1, p 28-34, January-February, 1985. 9 Fig, 2 Tab, 28 Ref. DOE contract DE-AC06-76RLO 1830.

Descriptors: *Oil shale, *Unsaturated flow, *Solid wastes, Water pollution sources, Model studies, Sensitivity analysis, Precipitation, Vegetation, Evapotranspiration, Drainage, Permeability coefficient.

A method for systematic determination of sensitivity was applied to a model of water movement through retorted oil shale waste or spent shale. The resulting sensitivity equations are linear and were normalized by relative magnitudes of input to and output from the flow model to facilitate comparison between variables. A comparison of two submodels for water uptake by vegetation was also included because such models do not lend themselves to systematic analysis. The systematic method was applied by considering changes in annual totals of drainage, evaporation, and transpiration as well as changes in water flux over depth and time as indicators of model sensitivity. The sensitivity analysis applied to the study of water movement through spent shale determined sensitivity of the model to selected input parameters. The relative sensitivities can be used to determine which model input parameters should be carefully measured and which can be estimated. Results of the analysis demonstrate that the model of flow through spent shale is most sensitive to precipitation, meteorological data used to estimate potential evapotranspiration, initial conditions of the materials, and rooting depth and density. Consequently, efforts should be directed toward accurately measuring these parameters. Insensitivity of the flow model to hydraulic conductivity suggests that order of magnitude errors in measuring hydraulic properties of materials can be tolerated. Similarly, insensitivity of the limits of the sink term indicates that these parameters can be estimated. (Baker-IVI)
W85-05181

CHARACTERIZATION OF WATER FROM LAVERKIN SPRINGS, UTAH,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
For primary bibliographic entry see Field 2K.
W85-05309

MODELING THE INTERRELATIONSHIP OF GROUNDWATER AND SURFACE WATER,
Geological Survey, Lakewood, CO.
T. C. Winter.
In: Modeling of Total Acid Precipitation Impacts. 1984. p 89-119, 11 Fig, 58 Ref.

Descriptors: *Groundwater, *Model studies, *Surface water, *Mathematical studies, *Surface groundwater relations, *Groundwater movement, Numerical analysis, Acidification, Chemical properties, Acid rain, Hydrologic models, Simulation analysis, Theoretical analysis.

The interrelationship of groundwater and surface water is reviewed to make researchers involved in acid precipitation aware of the interaction of the two. Because of the complexity of analytical models, many researchers use changes in surface water levels to derive the interrelationship of groundwater and surface water. With the development of numerical simulation, more complex problems could be solved. Computer-simulation studies have identified a stagnation point at which the hydraulic head along a boundary is at a minimum. Sampling of groundwater for chemical analysis needs to be done with consideration of groundwater flow systems and hydrogeochemical processes. Surface water bodies reflect chemical contributions from groundwater sources more quickly than previously believed, probably due to increase in height of nearby groundwater mounds following infiltration directly adjacent to surface water bodies.
W85-05318

GROUND-WATER MODELING,
GeoTrans, Inc., Reston, VA.
J. W. Mercer, and C. R. Faust.
National Water Well Association, Worthington, OH., 60 p. 47 Fig, 8 Tab, 124 Ref, 5 Append.

Descriptors: *Model studies, *Groundwater, *Aquifer testing, *Mathematical analysis, Mathematical equations, Mathematical models, Mathematical studies, Numerical analysis, Groundwater pollution, Computers, Artesian flow, *Groundwater movement, Finite difference methods, Finite element method.

This report is directed towards managers and hydrologists with little or no modeling experience. It not only explains basic concepts in mathematical and numerical methods, but also presents the limi-

tations and uses of groundwater models as they are applied to help solve complicated ground-water problems. The chapters are arranged as follows: 1) overview; 2) mathematical models; 3) numerical models; 4) applications; and 5) recent developments. This book, by itself, is not sufficient to perform a modeling study; it is designed to be used with other, more detailed references.
W85-05351

APPLICABILITY OF EFFECTIVE PARAMETERS FOR UNSTEADY FLOW IN NONUNIFORM AQUIFERS,
Cornell Univ., Ithaca, NY. Dept. of Civil and Environmental Engineering.
A. I. El-Kadi, and W. Brutsaert.
Water Resources Research Vol, 21, No. 2, p 183-198, February, 1985. 14 Fig, 2 Tab, 31 Ref. NSF grant INT-8213639.

Descriptors: *Groundwater flow, *Aquifer properties, *Unsteady flow, Riparian aquifers, Spatial distribution, Temporal distribution, Simulation, Stochastic process, Permeability coefficient.

Spatial and temporal variability of water movement is studied in riparian aquifers and the limitations of the concept of effective parameters commonly used to represent an aquifer with spatially variable material properties as a uniform and homogeneous one are assessed. The stochastic approach, that is the assumption that the flow domain is a collection of multiple samples from a stochastic model, is suitable primarily for solving variability problems if uncertainty exists due to insufficient data. To reduce uncertainty of output variables, a conditional simulation may be used to describe input variables. Because of the difficulty in using a more rigorous approach with partly saturated flow and with compressibility effects included a modified form of the linearized Boussinesq equation was used in the analysis. A Monte-Carlo technique was used in the stochastic analysis of unsteady gravity drainage flow. The results of the transient flow problem showed the independent nature of both the variability of the output variables and of the values of the effective parameters. Only under certain conditions is it possible to define a single set of effective parameters to reproduce the median outflow hydrograph. The effective parameters were found to depend on both the distribution of the hydraulic conductivity and its spatial correlation. (Baker-IVI)
W85-05498

MULTICRITERION NETWORK DESIGN USING GEOSTATISTICS,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
I. Bogardi, and A. Bardossy.
Water Resources Research, Vol. 21, No. 2, p 199-208, February, 1985. 7 Fig, 2 Tab, 41 Ref. NSF grant CEE 8110778.

Descriptors: *Geostatistics, *Network design, *Multicriterion decision making, Aquifers, Aquifer properties, Porosity, Algorithms, Computers.

A design method is presented for observation networks aimed at measuring several spatially correlated and anisotropic parameters of different importance. The decision variables are network density, distance between observation points for the various parameters, and observation effort. In the study geostatistics and multicriterion decision making (MCDM) have been combined in order to find an observation network trading off estimation accuracy and observation effort. Several parameters exhibiting geostatistical characteristics can be accounted for. The Composite Programming method appears a compromise objective for the statistical criteria and another compromise objective for the observation efforts criteria, then seeks for a trade-off between the two compromise objectives. An adjustment algorithm has been developed to be able to use the approach for expanding an existing network. The approach is simple and the algorithm may be implemented on minicomputers. A cost effective exploration network has been designed for a two layer aquifer system. This design is quite robust with respect to variogram parameters and changes in the weight set assigned to the parameters. (Baker-IVI)
W85-05499

VARIATIONAL-LAGRANGIAN ANALYSIS OF AQUIFERS WITH APPLICATION TO ARTESIAN WELLS,
Royal Academy of Belgium, Brussels.
M. A. Biot, and A. Delmer.
Water Resources Research, Vol. 21, No. 2, p 249-255, February, 1985. 6 Tab, 9 Ref.

Descriptors: *Aquifer properties, *Wells, *Artesian wells, Mathematical equations, Drawdown, Thermodynamics, Pumping, Finite element method.

A unifying variational principle of virtual dissipation of wide interdisciplinary generality is discussed in the more restricted context of aquifer analysis. It is applied to artesian well problems one with constant drawdown, the other with constant pumping rate for both small and large well capacity. The basic variational procedure involves a new approach to irreversible thermodynamics which is discussed and illustrated in the restricted context of aquifer analysis. The artesian well problems treated are intended to indicate how these methods may be applied to aquifers and the accuracy which can be expected. Numerical results have been obtained for values of the drawdown as a function of the distance from the well which are not available in the present literature. For sufficiently large values of time the influence radius is given by the same approximate value for all three problems irrespective of conditions at the well. The same conceptual approach may be used to deal with more complex geometries, multiple and inclined aquifers, incomplete wells, mixed free surface and confined systems. In addition, the more general thermodynamic theory provides means of treating problems which involve thermal and physical-chemical properties with filtering, convection diffusion, and adsorption. The procedure leads to a large variety of finite element methods by using as generalized coordinates values of the fields at the nodes of a grid with polynomial interpolations at intermediate points. (Baker-IVI)
W85-05503

NEW TYPE OF CURVE METHOD FOR THE ANALYSIS OF PUMPING TESTS IN LARGE-DIAMETER WELLS,
Institute of Hydrology, Wallingford (England).
R. S. Wikramaratna.
Water Resources Research, Vol. 21, No. 2, p 261-264, February, 1985. 3 Fig, 4 Tab, 2 Ref.

Descriptors: *Pumping tests, *Wells, Aquifer management, Groundwater management, Water supply development, Confined aquifers, Drawdown.

An improved method is proposed for the analysis of pumping test data from large-diameter wells in confined aquifers. An example is given which illustrates some of the problems which arise with the existing method and which shows the advantages of the proposed method. The method makes use of the same analytical solution as the previously existing method of analysis, and it is therefore subject to the same set of assumptions and limiting conditions to the situations where it can be applied. The modified method, which is based on a new set of type curves, is superior to the old method. The main advantages are that it is easier to compare the fit of the different type curves, since the comparison can be made with less relative movement of the two plots. It is possible to interpolate visually between the values for beta for which type curves exist where the correct match is an intermediate value. The method eliminates possible spurious match points by the introduction of the matchlines. A convenient check is provided on the correct choice of the match line by the existence of two transmissivity estimates which must agree if the analysis is correctly carried out; in practice it is reasonable to expect them to differ by less than about 1%. This agreement will be found whenever the two matchlines coincide, regardless of the fit between the data and the type curve; thus it is a necessary but not a sufficient condition for a correct match. (Baker-IVI)
W85-05505

RECHARGE IN KARST AND DUNE ELEMENTS OF A SEMI-ARID LANDSCAPE AS INDICATED BY NATURAL ISOTOPES AND CHLORIDE,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
G. B. Allison, W. J. Stone, and M. W. Hughes.
Journal of Hydrology, Vol. 76, No. 1/2, p 1-25, January, 1985. 12 Fig, 1 Tab, 43 Ref.

Descriptors: *River Murray, *South Australia, *Groundwater recharge, *Karst, *Dunes, Isotopic tracers, Chlorides, Semiarid lands, Sinkholes, Sand dunes, Groundwater movement, Calcrete, Sinkholes, Vegetation.

The rates and mechanisms of recharge were investigated an area where groundwater salinities are variable. The amount of salt stored in some of the landscape settings common in the Murray Basin in South Australia were also studied. The River Murray flows across the geological feature known as the Murray Basin, a shallow structural depression of Early Tertiary age. The study area contains examples of the landforms, surficial deposits, and vegetation found in the Mallee Region in South Australia. The two major landscape settings studied were calcrete flats with sinkholes and sand dunes overlying the calcrete. Five minor settings were investigated and identified as undisturbed calcrete, primary (older) sinkholes, secondary (younger) sinkholes, sand dunes with native vegetation and sand dunes with introduced pasture. Data from a limited series of boreholes were interpreted to suggest that recharge varied from in excess of 100 mm/yr for secondary sinkholes to less than 0.1 mm/yr beneath sand dunes with native vegetation. Recharge under the dunes has apparently increased by more than two orders of magnitude following clearing of the native vegetation about 50 yr ago. About 90% of a 10,000 sq km area has been cleared which has ensured that inflow of saline groundwater to the adjacent River Murray will increase and, in view of the amount of salt stored in both the unsaturated and saturated zones, will continue for a very long time. Profiles of the chloride concentration of soil water at sites where the inferred recharge is lowest are consistent with the hypothesis that there is in excess of 50,000 yr recharge stored in the thick unsaturated zone. Some evidence for changes in recharge rate over this time scale is seen. (Baker-IVI)
W85-05530

HYDROGEOCHEMISTRY OF THE MEADE THRUST ALLOCHTHON, SOUTHEASTERN IDAHO, U.S.A., AND ITS RELEVANCE TO STRATIGRAPHIC AND STRUCTURAL GROUNDWATER FLOW CONTROL,
Colorado Univ. at Colorado Springs. Dept. of Geology and Applied Earth Sciences.
A. L. Mayo, A. B. Muller, and D. R. Ralston.
Journal of Hydrology, Vol. 76, No. 1/2, p 27-61, January, 1985. 9 Fig, 7 Tab, 51 Ref.

Descriptors: *Groundwater flow, *Aquifers, *Meade Thrust Allochthon, *Idaho, Hydrogeochemistry, Flow, Geohydrology, Isotope studies, Geochemistry, Calcium, Magnesium.

Classical geochemical and isotopic techniques were used to study groundwater flow patterns in the folded carbonate, sandy and shaly strata of the Meade thrust allochton, southeastern Idaho. Two major groundwater regimes were identified. Aquifers of the upper regime are restricted to strata above the Phosphoria Formation. Their waters circulate within a few hundred meters of the surface. Discharge waters are of recent meteoric origin, having temperatures of 12 C or less, and are generally undersaturated with respect to calcite, and have Ca/Mg of about 2.5. Groundwater flow is generally bedding plane controlled and discharge is along bedding and thrust splay surfaces. No indication was found of significant

groundwater circulation between this and underlying strata (tier two). Aquifers of the lower regime, tier two, are restricted to consolidated strata below the Phosphoria Formation which generally hydraulically isolates them from tier-one aquifers. Groundwater flow in tier two circulates as much as 1900 m below land surface. Discharge waters have temperatures up to 26 C. Groundwater flow is generally bedding plane controlled, and discharge is along deep-seated extension and thrust faults. Tier-two aquifers appear to be contained within the allochthon, with no evidence suggesting they communicate with deeper circulating systems. (Baker-IVI)
W85-05531

D/H VARIATIONS OF METEORIC WATERS IN ALBUQUERQUE, NEW MEXICO, U.S.A.,
New Mexico Univ., Albuquerque. Dept. of Geology.
C. J. Yapp.
Journal of Hydrology, Vol. 76, No. 1/2, p 63-84, January, 1985. 7 Fig, 2 Tab, 19 Ref.

Descriptors: *Meteoric water, *Albuquerque, *New Mexico, *Deuterium, *Hydrogen, Precipitation, Runoff, Surface waters, Snowmelt, Groundwater, Aquifer recharge, Little Ice Age.

Natural D/H variations were used to examine the relationships between precipitation, surface water and groundwater in Albuquerque, especially since there are no stable-isotope data on the waters in the Albuquerque vicinity and such a study would establish a preliminary data base. Data are provided along with a discussion on the natural variations of deuterium/hydrogen ratios in precipitation, river waters and groundwaters near the city. The various meteoric water components contributing to the hydrologic regime in Albuquerque exhibit a wide range of delta-D values. In additional to a horizontal variation in groundwater delta-D values, there is also evidence of vertical stratification of groundwater delta-D values within the western groundwater domain. The deeper groundwater component in the western domain apparently did not originate from modern Rio Grande recharge. Regional evidence of temporal variations in precipitation D/H ratios suggests the Little Ice Age as one interval when river waters might have been more negative than at present. If the deuterium-depleted deep groundwater actually did originate under different climatic conditions, it suggests that at least a portion of the groundwater in the study area is being mined. (Baker-IVI)
W85-05532

MOTION OF THE SEAWATER INTERFACE IN A COASTAL AQUIFER BY THE METHOD OF SUCCESSIVE STEADY STATES,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
J. Bear, U. Shamir, A. Gamliel, and A. M. Shapiro.
Journal of Hydrology, Vol. 76, No. 1/2, p 119-132, January, 1985. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Coastal aquifers, *Groundwater flow, *Saline-freshwater interfaces, *Israel, Interfaces, Seawater intrusion, Groundwater manage ent, Mathematical models.

Approximate expressions have been developed for the motion of the interface toe, especially the linear one, for incorporation into a management model of an aquifer in which the location of the interface is one of the criteria. The management model is constructed as a linear program, and it was therefore important to have a linear expression for the motion of the interface. The management model that is developed focuses on the operation of the aquifer for one season or for one year, and therefore the validity of the approximation must be examined for this time period. There is considerable deviation between the approximate solution and the results of the numerical model. The approximate results are, however, indicative of the true movement for conditions encountered in the coast aquifer of Israel. (Baker-IVI)
W85-05535

BANK STORAGE CHARACTERISTICS OF A FINITE AQUIFER DUE TO SUDDEN RISE AND FALL OF RIVER LEVEL,
M. A. Gill.
Journal of Hydrology, Vol. 76, No. 1/2, p 133-142, January, 1985. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Aquifer properties, *Bank storage, *Groundwater movement, *Seepage, Boundary conditions, Model studies, Surface-groundwater relations, Water level.

Unsteady seepage flow in a two-dimensional water table aquifer is analyzed for recession/accretion due to a sudden rise or fall of water level in the adjoining river. The present solution will hopefuly widen the scope of the experimental research since most of the model aquifers are of finite length. Some boundary effects are bound to creep into the solutions which are valid for infinite aquifers but are used for finite ones. The one-dimensional solution is a particular case of the two-dimensional solution. The limitations under which one-dimensional solution can be used are also clearly elucidated in the two-dimensional solution. Where the aquifer is relatively thick and short, the one-dimensional solution cannot be used. The advantage of the solution for a finite aquifer is that it can also be used for infinitely long aquifers. The influence of the impervious barrier which delimits a finite aquifer in the x-direction can thus be eliminated. (Baker-IVI)
W85-05536

GENERALIZED WELL FUNCTION EVALUATION FOR HOMOGENEOUS AND FISSURED AQUIFERS,
British Geological Survey, London (England).
J. A. Barker.
Journal of Hydrology, Vol. 76, No. 1/2, p 143-154, January, 1985. 2 Fig, 17 Ref.

Descriptors: *Fissured aquifers, *Well function, *Evaluation, *Laplace equation, Fissure water, Geologic fractures, Aquifers, Drawdown.

The main conceptual ideas used in modelling fissured aquifers are reviewed. The solution to the problem of a pumping test using a large-diameter well is presented in a form which is relatively simple. The well function for a large-diameter well fully penetrating a fissured aquifer can be expressed in terms of the Laplace transform of the drawdown. This function contains, as special cases, many previously studied well functions for both fissured and homogeneous aquifers. Evaluation of drawdowns from this function can be achieved by numerical inversion of the Laplace transform; this provides a general method for computing a large range of well functions. Flow equations are presented followed by an outline of their solution. Only fissured aquifers are considered since homogeneous aquifers can be regarded as a special case where there is no matrix storage. (Baker-IVI)
W85-05537

ISOTOPE HYDROLOGY STUDY OF MOLAI AREA IN LACONIA,
Democritus Nuclear Research Center, Athens (Greece).
J. L. Leontiadis.
Report DEMO 81/4, April 1981. 67 p, 13 Fig, 5 Tab, 4 Maps, 18 Ref.

Descriptors: *Groundwater, *Aquifers, *Groundwater recharge, *Groundwater movement, *Geohydrology, *Groundwater runoff, *Groundwater storage, *Springs, *Isotopic tracers, Isotope studies, Fault springs, Reservoirs, *Greece.

The isotopic composition of the groundwater was used in order to investigate the mechanism of recharge of the Molai plain and the coastal brackish springs of the area. According to the results of this study and in contrast to the existing hydrological views at that time, the Tripolitza carbonates northeast of the plain do not form a unique aquifer nor contribute to the recharge of the plain, which is mainly fed by the local rainwater. The brackish springs at Glyfada are fed by the Tripolitza carbonates northeast of the Mavrovouni-Koupia fault, through an isolated spring from the neogene aquifer of the plain conduit. The water content of the corresponding reservoir was estimated in the range of 2318 to 3091 cu m. The brackish springs at Plytra are fed by the marbles of the Chavallas and Skardolakka mountains through the bedrock of the Assopos river and the neogene aquifer of that part of the plain. The water content of the corresponding reservoir was estimated to be more than 284 mega cu m. The brackish coastal springs between Palea Monemvasia and Hierax are fed by the Tripolitza limestones southeast of the Mavrouvouni-Koupia fault. The sinkhole southeast of Metamorphosis is located in these rocks.
W85-05595

ECOLOGICAL INVESTIGATIONS ON THE ALLUVIAL SEDIMENTS OF THE DANUBE IN THE VIENNA AREA - A PHREATOBIOLOGICAL PROJECT,
Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Limnologie.
For primary bibliographic entry see Field 2J.
W85-05656

SAPPING PROCESSES AND THE DEVELOPMENT OF THEATER-HEADED VALLEY NETWORKS ON THE COLORADO PLATEAU,
California Inst. of Tech., Pasadena. Guggenheim Jet Propulsion Center.
For primary bibliographic entry see Field 2J.
W85-05729

SIMULATION OF CHANGES IN GROUNDWATER LEVELS ASSOCIATED WITH STRIP MINING,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 4C.
W85-05731

DISPLACEMENT OF CONNATE WATER FROM AQUIFERS,
Texas A and M Univ., College Station. Dept. of Geology.
P. A. Domenico, and G. A. Robbins.
Geological Society of America Bulletin, Vol. 96, No. 3, p 328-335, March, 1985. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Connate water, *Meteoric water, *Aquifers, Mathematical models, Geologic formations, Dispersion, Groundwater recharge.

A mathematical model is developed for the mixing of meteoric and original formation waters in homogeneous aquifers. The theoretical analysis indicates that geologic formations that have had a few to a few tens of pore volumes of meteoric water pass through them may be at steady state with respect to further displacement of their contained fluids. Depending on constraints in the recharge area, the steady state may vary from near meteoric water throughout the whole formation to a spatial variation in concentration ranging from meteoric water in the recharge areas to highly concentrated water at the discharged ends of the system. The former condition is attained when the recharge area incorporates the total depth and breadth of the formation. Where this condition is not satisfied, the concentrations that evolve are controlled by the original concentration of the formation water, the composition of recharging meteoric water, the dispersion parameters, and the size of the recharge area in comparison to the total breadth of the formation as measured along its strike. For heterogeneous formations, the concentration patterns that evolve seem to depend further on contrasts by hydaulic conductivity. This is demonstrated in the Milk River sandstone, which is characterized by several extensive zones of dilute water within narrow, high-conductivity pathways and marked increases in concentration in adjacent, lower-permeability rock. In parts of the aquifer where higher-permeability pathways appear to be absent, the isochlores form a broad linear band with a marked increase in concentration in the flow direction. (Author's abstract)
W85-05732

CONTINUUM MODEL FOR SIMULTANEOUS CHEMICAL REACTIONS AND MASS TRANSPORT IN HYDROTHERMAI SYSTEMS,
California Univ., Berkeley. Dept. of Geology and Geophysics.
P. C. Lichtner.
Geochimica et Cosmochimica Acta, Vol. 49, No. 3, p 779-800, March, 1985. 3 Fig, 2 Tab, 74 Ref, 4 Append. NSF grant EAR 81-15859 and DOE contract DE-AT03-83ER-13100.

Descriptors: *Hydrothermal studies, *Chemical reactions, *Mass transport, *Continuum models, Porous media, Groundwater movement, Mathematical equations, Solute transport, Permeability, Porosity, Advection, Dispersion, Diffusion, Shock waves.

A time-space continuum model for transport of hydrothermal fluids in porous media is presented which provides for simultaneous, reversible and irreversible chemical reactions involving liquids, gases and minerals. Homogeneous and heterogeneous reactions are incorporated in the model in a similar fashion through source/sink terms added to the continuity equation. The model provides for moving reaction fronts through surfaces of discontinuity across which occur jump discontinuities in the various field variables satisfying generalized Rankine-Hugoniot relations. Reversible reactions including aqueous complexing, oxidation-reduction reactions, mineral precipitation and dissolution reactions and adsorption and explicitly accounted for by imposing chemical equilibrium constraints in the form of mass action equations on the transport equations. This is facilitated by partitioning the reacting species into primary and secondary species corresponding to a particular representation of the stoichiometric reaction matrix referred to as the canonical representation. The transport equations for the primary species combined with homogeneous and heterogeneous equilibria result in a system of coupled, nonlinear algebraic/partial differential equations which completely describe the evolution of the system in time. Spatially separated phase assemblages are accommodated in the model by altering the set of independent variables across surfaces of discontinuity. Constitutive relations for the fluid flux corresponding to primary species are obtained describing transport of both neutral and charged species by advection, dispersion and diffusion. Numerical implementation of the transport equations is considered and both explicit and implicit finite difference algorithms are discussed. Analytical expressions for the change in porosity and permeability with time are obtained for an assemblage of minerals reacting reversibly with a hydrothermal fluid under quasi-steady state conditions. Fluid flow is described by Darcy's law empioying a phenomenological expression relating permeability and porosity. Finally an expression for the local retardation factor of solute species is derived for the case of advective transport in a single spatial dimension which accounts for the effects of homogeneous and heterogeneous equilibria including adsorption on the rate of advance of a reaction front. The condition for the formation of shock waves is given. (Author's abstract)
W85-05762

GROUND WATER AS A SILICA SOURCE FOR DIATOM PRODUCTION IN A PRECIPITATION-DOMINATED LAKE,
Wright State Univ., Dayton, OH. Dept. of Geology
For primary bibliographic entry see Field 2H.
W85-05775

COMPARISONS OF SUCCESSIVE ITERATION AND DIRECT METHODS TO SOLVE FINITE ELEMENT EQUATIONS OF AQUIFER CONTAMINANT TRANSPORT,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W85-05790

DETECTION OF LINEAR BOUNDARIES BY DRAWDOWN TESTS: A SEMILOG TYPE CURVE MATCHING APPROACH,
Stanford Univ., CA. Dept. of Petroleum Engineering.
A. Sageev, R. N. Horne, and H. J. Ramey, Jr.
Water Resources Research, Vol. 21, No. 3, p 305-310, March, 1985. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Drawdown tests, *Graphical analysis, *Drawdown, *Linear boundaries, *Reservoirs, *Aquifers, Wells, Permeability, Water level.

A new method for pressure drawdown analysis in reservoirs affected by linear boundaries was developed based on a semilog curve matching approach and may be applied to both constant pressure and impermeable linear boundary cases. A semilog type curve was derived by which the distance between a well and the linear boundary may be estimated. The new analysis method is an improvement over the current double straight line analysis method. The pressure response of the well is matched without the need to find two straight lines, and several advantages result. First, the analysis may be performed for interference tests for which the first semilog straight line never develops. Second, the duration of the test required for the new method is shorter by an order of magnitude than that required for existing semilog methods, since it is not necessary to wait for the second straight line to develop. (Author's abstract)
W85-05793

SEEPAGE TO COLLECTION GALLERY NEAR SEACOAST,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Water Resources Research, Vol. 21, No. 3, p 311-316, March, 1985. 8 Fig, 2 Ref.

Descriptors: *Seepage, *Aquifers, *Groundwater movement, *Collection galleries, Drawdown, Wells, Saltwater intrusion, Conformal mapping.

Collection galleries (horizontal ditches or slotted pipes) are useful for abstracting large flows from aquifers without causing large drawdowns. One important use for galleries is along seacoasts where excessive drawdowns can cause seawater intrusion and pollution of the fresh water aquifer. Conformal mapping was used to obtain a solution for seepage to a collection gallery that is parallel to a seacoast. The solution permits calculation of the gallery drawdown that is required to withdraw any given flow rate and also allows calculation of the maximum flow rate that can be abstracted without causing sea water intrusion. In some applications there may be very little difference between the critical flow rates for a gallery and for a well. In general it will be easier to actually abstract this amount of flow with a gallery because of the relatively large aquifer contact area. (Collier-IVI)
W85-05794

HILLSIDE SEEPAGE: AN ANALYTICAL SOLUTION TO A NONLINEAR DUPUIT-FORCHHEIMER PROBLEM,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
S. R. Yates, and A. W. Warrick.
Water Resources Research, Vol. 21, No. 3, p 331-336, March, 1985. 5 Fig, 2 Tab, 10 Ref, 1 Append

Descriptors: *Mathematical problems, *Seepage, *Soil water, *Dupuit-Forchheimer theory, *Groundwater movement, *Aquifers, Unsaturated zone, Infiltration, Leakage aquifers, Leaky boundaries.

Dupuit-Forcheimer (DF) analyses have proven valuable for simplifying flow problems where a free surface exists above a shallow, slightly permeable barrier. A nonlinear, steady state, two-dimensional problem which is represented in a one-dimensional form was solved. The field problem considered is for flow in a shallow soil subject to uniform accretion and overlying a sloping bedrock. An integrating factor is used to solve the nonlinear equation subject to upper and lower boundary conditions of known hydraulic head or flow. An exact analytical solution is developed for steady flow in a sloping Dupuit aquifer. Constant areal accretion in the form of recharge from the surface and/or a leaky substratum occurs. The solution is useful for checking more comprehensive numerical treatments, and in the limit, those with time dependence. (Collier-IVI)
W85-05796

SENSITIVITY ANALYSIS FOR STEADY STATE GROUNDWATER FLOW USING ADJOINT OPERATORS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
J. F. Sykes, J. L. Wilson, and R. W. Andrews.
Water Resources Research. Vol. 21, No. 3, p 359-371, March, 1985. 12 Fig, 16 Ref.

Descriptors: *Groundwater movement, *Sensitivity theory, *Paradox Basin, *Leadville formation, *Utah, Groundwater recharge, Piezometric head, Computer models, Finite element theory, Boundary conditions, Hydraulic conductivity.

Adjoint sensitivity theory is currently being considered as a potential method for calculating the sensitivity of nuclear waste repository performance measures to the parameters of the system. For groundwater flow systems, performance measures of interest include piezometric heads in the vicinity of a waste site, velocities or travel time in aquifers, and mass discharge to biosphere points. The parameters include recharge-discharge rates, prescribed boundary heads or fluxes, formation thicknesses, and hydraulic conductivities. The derivative of a performance measure with respect to the system parameters is usually taken as a measure of sensitivity. To calculate sensitivities, adjoint sensitivity equations are formulated from the equations describing the primary problem. The solution of the primary problem and the adjoint sensitivity problem enables the determination of all of the required derivatives and hence related sensitivity coefficients. Adjoint sensitivity theory was developed for equations of two-demensional steady state flow in a confined aquifer. Both the primary flow equation and the adjoint sensitivity equation were solved using the Galerkin finite element method. The developed computer code was used to investigate the regional flow parameters of the Leadville Formation of the Paradox Basin in Utah. The results illustrate the sensitivity of calculated local heads to the boundary conditions. Alternatively, local velocity related performance measures are more sensitive to hydraulic conductivities. (Author's abstract)
W85-05799

PRESSURE BUILDUP ANALYSIS FOR TWO-PHASE GEOTHERMAL WELLS: APPLICATION TO THE BACA GEOTHERMAL FIELD,
S-Cubed, La Jolla, CA.
T. D. Riney, and S. K. Garg.
Water Resources Research, Vol. 21, No. 3, p 372-382, March, 1985. 16 Fig, 14 Ref. Lawrence Berkeley Laboratory contract 4514510.

Descriptors: *Baca geothermal field, *Redondo Creek, *New Mexico, *Geothermal power, *Wells, Injection wells, Permeability, Groundwater

A geothermal system may be two-phase before production or may evolve into a two-phase system as a result of fluid production. Recently published pressure transient analysis methods for two-phase geothermal wells were employed to analyze the pressure buildup data for several wells located in the Redondo Creek area of the Baca geothermal field in New Mexico. There is a two-phase region initially present near the top of the Baca reservoir and all of the Baca wells induce flashing in the near-well bore formation during production. Nonproductive wells at Baca geothermal field have been used as injection wells. The ability of these wells to accept high injection rates implies that all permeable zones may not be productive zones. Zones at which fluid enters the well bore from the formation were located by interpretation of the downhole drilling information and pressure/temperature surveys and the initial reservoir temperature and pressure in these zones was estimated

Interpretation of the buildup data for each well considered well bore effects (e.g., phase change in the well bore fluid and location of the pressure sensor with respect to the permeable horizon) and the carbon dioxide content of the the fluid and its effects on the phase behavior of the reservoir fluids and differentiated between the single- and two-phase portions of the pressure buildup data. Different straight-line approximations to the two portions (i.e., single- and two-phase) of the data on the Horner plot were used to obtain corresponding estimates for the single- and two-phase mobilities. A slope in the single phase portion of the Horner plot reflects the buildup behavior in the production zone and extends over two log cycles; it was used to estimate the formation permeability-thickness (kH) product. (Collier-IVI)
W85-05800

EVALUATION OF THE POLUBARINOVA-KOCHINA FORMULA FOR THE DAM PROBLEM,
Hochschule der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Fachbereich Informatik.
U. Hornung, and T. Krueger.
Water Resources Research, Vol. 21, No. 3, p 395-398, March, 1985. 5 Fig, 3 Tab, 12 Ref.

Descriptors: *Groundwater movement, *Numerical analysis, *Seepage, *Dams, Unconfined aquifers, Free boundaries, Mathematical analysis.

The stationary problem of unconfined groundwater flow through a rectangular dam has been solved by P. Ya. Polubarinova-Kochina (Theory of Ground Water Movement, Princeton University Press, Princeton, NJ, 1962). The analytical formulas presented by Polubarinova-Kochina were used to obtain accurate numerical values for the phreatic surface and for the height of the seepage face. Above an impervious layer, a homogeneous porous dam separates two lakes; the upper boundary of the domain filled with water is the phreatic surface which is the free boundary to be determined. These values provide a reference with which to compare numerical methods for seepage problems. (Collier-IVI)
W85-05803

CALCULATION OF SEEPAGE FROM A RESERVOIR BY THE MATHEMATICAL MODELING METHOD,
E. A. Khachatryan, G. T. Khachaturyan, and A. B. Bagdasaryan.
Hydrotechnical Construction, Vol. 18, No. 7, p 303-307, July, 1984. 4 Fig, 4 Ref. Translated from Gidrotekhnichkesoe Stroitel'stvo, No. 7, p 21-25, July, 1984.

Descriptors: *Seepage, *Reservoirs, *Mathematical models, *Akhuryan River, *USSR, Water loss, Model studies, Grout curtains, Geology.

The reservoir being created by constructing a 90 m high earth dam with a central loam core in a narrow canyon of the Akhuryan River is an integral part of the Akhuryan irrigation system. The seasonal storage reservoir is intended for irrigating 15,000 ha of newly developed lands and also for increasing the water supply of 20,000 ha of presently irrigated lands. A special feature of the geological structure of the soils in the region of the reservoir is the presence of an ancient buried channel of the Akhuryan River located on the river bank of the present channel. The permeability coefficients in the entire region both horizontaly and vertically vary within very wide limits. The permeable stratum of soils is inhomogeneous, and anisotropic. The curves of the seepage losses were determined as a function of the water level in the reservoir for different variants of the length of the grout curtain, by means of which the optimal length of the grout curtain can be determined by technicoeconomic calculations. Determination of the gradients and losses of water requires the establishment of the seepage field (head field) both within the reservoir and in the regions of the present valley and ancient channel of the Akhuryan River, which strongly affects the character of the seepage flow. Cutoff measures are needed in the foundation of the dam and it is irrational to extend the grout curtain along the right wall more than 1000 m, since with its farther continuation the seepage losses decrease negligibly. (Baker-IVI)
W85-05822

AQUIFER TEST ANALYSIS IN NONRADIAL FLOW REGIMES: A CASE STUDY,
Oak Ridge National Lab., TN.
E. D. Smith, and N. D. Vaughan.
Ground Water, Vol. 23, No. 2, p 167-175, March-April, 1985. 7 Fig, 2 Tab, 23 Ref. Office of Defense Waste and By-Product Management, DOE contract DE-AC05-840R21400.

Descriptors: *Aquifers, *Groundwater movement, *Nonradial flow, *Tennessee, *Conassauga Group, Drawdown, Pumping, Geologic fractures, Transmissivity, Storage, Geohydrology.

A low-rate aquifer pumping test was conducted in a folded and fractured limestone formation in the Conasauga Group of East Tennessee. An elongate drawdown pattern was observed, suggesting the pumping response was controlled by a highly conductive zone associated with a pair of anticlinal folds that bisect the test site. This drawdown pattern, the nonlinearity of graphs of observation well drawdown versus the log of time, and the existence of a linear relationship between drawdown and the square root of pumping time indicate that flow in response to pumping was nonradial. Thus, use of pumping test interpretive techniques based on radial flow models would be invalid. This situation may occur frequently when pumping tests are done in low-permeability media, because fractures and other discontinuities often dominate the hydraulic behavior of low-permeability media. The solution technique used to estimate aquifer parameters treats the fold axes as a highly conductive vertical fracture in an anisotropic matrix of much lower hydraulic conductivity. The complexity of both the site and the solution technique necessitated iterative trial-and-error variable substitution to estimate aquifer parameters. The resulting solution includes estimates of matrix transmissivity in two directions, the storage coefficient of the matrix, and the effective length and location of the master fracture. Estimates of hydraulic parameters lack the apparent precision of values that would be generated by radial flow techniques, but they are consistent with geologic conditions at the site and present a clearer picture of the hydrogeologic regime than could be obtained with other investigative techniques. The solution technique used, whose field application has not been described previously in published literature, makes it possible to interpret the results of aquifer tests in complex hydrogeologic settings. This and related analytical techniques for other nonradial flow situations may prove useful in other hydrogeologic investigations in low-permeability media affected by folds, faults, fractures, or solution channels. (Author's abstract)
W85-05837

FAULT SEVERED AQUIFERS ALONG THE PERIMETERS OF WYOMING ARTESIAN BASINS,
Wyoming Univ., Laramie. Dept. of Geology and Geophysics.
P. W. Huntoon.
Ground Water, Vol. 23, No. 2, p 176-181, March-April, 1985. 4 Fig, 16 Ref.

Descriptors: *Geologic faults, *Aquifers, *Groundwater movement, *Wyoming, *Artesian basins, Geohydrology, Geologic formations.

The mountain uplifts which border the major artesian basins of Wyoming are asymmetric antiforms bounded on one flank by large displacement Laramide thrust faults. These thrusts sever the hydraulic continuity of aquifers, thereby creating separate circulation systems in the hanging wall and foot wall blocks. Fault severing of the Paleozoic aquifers can be identified by (1) potentiometric discontinuities across the faults, (2) water quality contrasts across the faults, and (3) geothermally heated waters in the foot wall blocks. Isolated but active circulation systems develop in the hanging wall blocks in which good permeabilities and good quality water prevail. In contrast the foot walls are generally characterized by poor permeabilities and poor water qualities. Fault severing of the Paleozoic aquifers in the Wyoming foreland province is a significant factor because nearly half of the basin perimeters are fault severed. The result is that exploration for large-volume, good-quality supplies must focus on the hanging wall blocks in the fault severed environments. (Author's abstract)
W85-05838

RELATIONS BETWEEN AQUIFER ELECTRICAL AND HYDRAULIC PROPERTIES,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
W. E. Kelly, and R. K. Frohlich.
Ground Water, Vol. 23, No. 2, p 182-189, March-April, 1985. 10 Fig, 23 Ref. NSF grant ENG 7819408.

Descriptors: *Aquifers, *Electrical properties, *Hydraulic properties, *Rhode Island, Hydraulic conductivity, Geohydrology, Particle size, Soil types.

The primary factor controlling material-level relations between aquifer electrical and hydraulic properties in the clay-free aquifer materials of southern Rhode Island is an inverse relation between in-situ porosity and grain size. In-situ density, grain size and laboratory hydraulic conductivity data support this conclusion. Relations between either layer resistivities and hydraulic conductivity, or a Dar Zarrouk parameter and transmissivity, are influenced by aquifer layering and the position of the aquifer layer relative to nonproducing layers. In the study area, the best relations between electrical and hydraulic properties are obtained where the transverse resistance of the aquifer is measured. (Author's abstract)
W85-05839

POTENTIOMETRIC MAPPING FROM INCOMPLETE DRILL-STEM TEST DATA: PALO DURO BASIN AREA, TEXAS AND NEW MEXICO,
Stone and Webster Engineering Corp., Cherry Hill, NJ.
E. S. Bair, T. P. O'Donnell, and L. W. Picking.
Ground Water, Vol. 23, No. 2, p 198-211, March-April, 1985. 10 Fig, 30 Ref.

Descriptors: *Aquifer characteristics, *Potentiometric mapping, *Palo Duro Basin, *Texas, *New Mexico, *Groundwater potential, *Drill-stem tests, Wells, Geohydrology.

Drill-stem test (DST) data from wildcat wells and wells sponsored by the U.S. Department of Energy were used to construct pressure-depth diagrams and regional potentiometric surfaces of the Wolfcamp and Pennsylvanian aquifers. These deep-basin aquifers represent the two regionally important downgradient aquifers that underlie the host rock at the proposed high-level nuclear-waste repository sites in the Palo Duro Basin area of Texas and New Mexico. More than 5,500 DSTs were screened and classified according to shut-in pressure and shut-in time criteria devised to evaluate the quality of the DST data and to delete dubious DST data. After screening, three sets of pressure-depth diagrams and potentiometric-surface maps were constructed, corresponding to three levels of data refinement. The initial Wolfcamp and Pennsylvanian regional potentiometric surfaces contained several prominent local mounds and depressions with unrealistic variations in the direction and magnitude of hydraulic gradients. Pressure-depth data and records and maps of historic oil and gas production showed that many DSTs were performed in depressured oil and/or gas production zones. The low shut-in pressures recorded during these tests caused abnormally low heads to be calculated and contoured. Formation pressures recorded in these depressured zones represent local temporal pressures in a regional flow system that is probably steady state. Deletion of depressured DSTs produced regional potentiometric surfaces that were more realistic but contained a few large local mounds and depressions caused by local aberrant DST data. Deletion of local aberrant grossly

underpressured DSTs not attributable to oil and/or gas production and local aberrant grossly overpressured DSTs, based on comparison of initial shut-in pressures and heads in the same well and/or in adjacent wells at a similar depth in the same geologic unit, produced potentiometric surfaces that show regional and some local variations in flow directions and hydraulic gradients. Linear regression of the pressure-depth data showed that most of the refinement in the data was due to culling depressured DSTs. Some additional refinement was due to culling local aberrant grossly underpressured and grossly overpressured DSTs. (Author's abstract)
W85-05841

AQUIFER-PARAMETER EVALUATION FROM VARIABLE-RATE PUMPING TESTS USING CONVOLUTION AND SENSITIVITY ANALYSIS,
Kansas State Geological Survey, Lawrence.
M. A. Butt, and C. D. McElwee.
Ground Water, Vol. 23, No. 2, p 212-219, March-April, 1985. 2 Fig, 3 Tab, 31 Ref.

Descriptors: *Aquifers, *Pump testing, *Hydraulic properties, *Convolution, *Sensitivity analysis. Geohydrology, Mathematical analysis, Drawdown, Transmissivity, Storage coefficient.

The reliability of predictive and management models for ground water would be improved by better aquifer-parameter estimation. As progress continues in the use of computers to simulate ground-water systems, parallel progress must occur in data collection and analysis. Among the various methods available for the determination of aquifer parameters, pumping tests occupy a prominent position. The maximum advantage is gained from a pumping test when geological knowledge of the aquifer and the analysis of aquifer test data complement each other. A technique involving the use of convolution and sensitivity analysis was developed to obtain the 'best fit' of aquifer parameters in a least-squares sense from a pumping test with variable pumping rate. The method also can be used to analyze the residual drawdown data obtained during the recovery period. In addition, this method can also analyze drawdown and recovery data conjunctively. Constant drawdown and variable discharge data of artesian flowing wells also can be analyzed by this method. The method is straightforward, quick, inexpensive, and is always objective. No graphical plots or graphical interpretations are needed. As a measure of error, the rms (root-mean-square) error in drawdown is calculated along with correlation coefficient between pumping-test data and the theoretically generated data, using the converged values of transmissivity and storage coefficient. (Author's abstract)
W85-05842

COMPARISON OF METHODS FOR ESTIMATING GROUND-WATER PUMPAGE FOR IRRIGATION,
Geological Survey, Boise, ID. Water Resources Div.
S. A. Frenzel.
Ground Water, Vol. 23, No. 2, p 220-226, March-April, 1985. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Groundwater, *Pumpage, *Irrigation water, *Snake River Plain, *Idaho, Statistical analysis, Water management, Groundwater management, Instantaeous discharge.

Groundwater pumpage for irrigation was measured at 32 sites on the eastern Snake River Plain in southern Idaho during 1983. Pumpage at these sites also was estimated by three commonly used methods, and pumpage estimates were compared to measured values to determine the accuracy of each estimate. Statistical comparisons of estimated and metered pumpage using an F-test showed that only estimates made using the instantaneous discharge method were not significantly different (alpha = 0.01) from metered values. Pumpage estimates made using the power consumption method reflect variability in pumping efficiency among sites. Pumpage estimates made using the crop-consumptive use method reflect variability in water-management practices. Pumpage estimates made using the instantaneous discharge method reflect variability in discharges at each site during the irrigation season. (Author's abstract)
W85-05843

ANALYSIS OF STEADY-STATE FLOW IN SEMICONFINED AQUIFERS: A NEW APPROACH,
Physical Research Lab., Ahmedabad (India).
S. K. Gupta, and P. Sharma.
Ground Water, Vol. 23, No. 2, p 227-232, March-April, 1985. 3 Fig, 2 Tab, 7 Ref, 1 Append.

Descriptors: *Semiconfined aquifers, *Aquifers, *Groundwater movement, *Steady flow, *Mathematical analysis, Wells, Pumping tests, Hydraulic properties

The well known methods of analyzing pumping tests in a semiconfined aquifer are of two types based on steady-state conditions and based on unsteady-state conditions. Curve matching techniques and methods involving analysis of the straight line portion of the distance drawdown plot are either subjective or limited in usefulness. A new method for evaluation of aquifer parameters was developed utilizing a formula based on the following concept In the case of semiconfined aquifers the ratio of steady-state drawdown to its gradient with respect to the logarithm of radial distance from the pumping well determines the transmissivity of the aquifer. As the method does not involve curve matching, it avoids subjectivity. The method is limited by errors introduced in estimation of some of the parameters outside of certain ranges. A straight-line method gives a reasonable estimate of transmissivity alone. (Collier-IVI)
W85-05844

COMPUTERIZED GROUND-WATER RESOURCES INFORMATION SYSTEM,
Michigan State Univ., East Lansing. Dept. of Geology.
G. W. Monaghan, and G. J. Larson.
Ground Water, Vol. 23, No. 2, p 233-239, March-April, 1985. 5 Fig, 10 Ref, 4 Append.

Descriptors: *Computerized data bases, *Groundwater management, *Geohydrology, *Hydrologic data collections, Computer models, Wells, Path of pollutants, Groundwater movement, Groundwater pollution, Water management.

A major restriction to the use of maps and cross sections of subsurface conditions is that they require a considerable investment in time and labor to construct and are often out of date soon after they are completed. To make geohydrologic information more readily available to those involved in groundwater investigations, a computerized retrieval system, called the Michigan Computerized Groundwater Resources Information Bank, was developed. The MCGRIB system is a computerized data base of hydrogeologic information consisting over 15,000 individual entries if which most are drillers' logs of water, oil, and gas wells drilled in Michigan since 1965. It also includes software that allows the user to display hydrogeologic data for any specified area in tabular or map form. The system provides a data base upon which sophisticated analog and digital models can be applied. In the event of accidental spills of toxic substances, the information included within the MCGRIB system could be used by local authorities to ascertain the vulnerabililty of nearby aquifers to contaminations and allow rapid assessment of contaminant movement. In addition to lithologic and hydrologic data, the MCGRIB system can easily be expanded to accept geochemical information about the ground water. Although the system is designed mainly for glaciated regions it can be adapted to almost any geologic setting. The main advantages of the system are that it can be updated regularly and can rapidly provide pertinent information about subsurface hydrogeologic conditions. (Collier-IVI)
W85-05845

COMPUTERIZED TECHNIQUE FOR ESTIMATING THE HYDRAULIC CONDUCTIVITY OF AQUIFERS FROM SPECIFIC CAPACITY DATA,
Wisconsin Geological and Natural History Survey, Madison.
K. R. Bradbury, and E. R. Rothschild.
Ground Water, Vol. 23, No. 2, p 240-246, March-April, 1985. 5 Fig, 2 Tab, 15 Ref, 2 Append. DOE contract DE-AC05-84OR21400.

Descriptors: *Data processing, *Permeability coefficient, *Aquifers, *Specific capacity, *Wisconsin, Pumping tests, Capacity, Computer models.

Specific capacity data obtained from well construction reports can provide useful estimates of hydraulic conductivity (K). A simple computer program has been developed which can correct specific capacity data for partial penetration and well loss and, using an iterative technique, provide rapid estimates of K at hundreds of data points The program allows easy data handling and is easily linked with existing statistical programs or contour mapping routines. The method was tested at two field sites in Wisconsin, one underlain by a sandy outwash aquifer, the other by fractured dolomite. In both areas, estimates of K from corrected specific capacity data agree reasonably well with data from pumping tests. (Author's abstract)
W85-05846

GENERAL PURPOSE MICROCOMPUTER AQUIFER TEST EVALUATION TECHNIQUE,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
C. J. Hemker
Ground Water, Vol. 23, No. 2, p 247-253, March-April, 1985. 4 Fig, 17 Ref, 1 Append.

Descriptors: *Aquifers, *Data analysis, *Computer programs, *Pumping tests, Nonlinear regression, Mathematical analysis, Algorithms.

Although determination of aquifer characteristics from pumping test data is generally carried out using type curves or other graphical techniques, a number of computer methods have been developed recently for this purpose. Based on the principle of least squares, these methods of nonlinear regression can be applied to any flow system for which analytical expressions of the drawdown distribution are known. In view of the growing general interest in the application of microcomputers in groundwater hydrology, a BASIC routine has been developed for estimating any number of aquifer parameters. The least squares solution is calculated by Marquardt's algorithm, using the singular-value decomposition of the Jacobian matrix. The robust computing method obtained can be applied to all kinds of pumping tests. Aquifer characteristics as well as their standard deviations are computed with optimal speed and accuracy. The technique is demonstrated by a simple application to steady flow in a leaky aquifer and an example is provided. Other applications are easily implemented and programs for unsteady-state aquifer tests, recovery tests and multiple aquifer tests are available. (Author's abstract)
W85-05847

2G. Water In Soils

INFILTRATION INTO A CLASS OF VERTICALLY NON-UNIFORM SOILS,
Institute of Hydrology, Wallingford (England).
K. Beven.
Hydrological Sciences Journal, Vol. 29, No. 4, p 425-434, December, 1984. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Infiltration, *Soil water, *Soil profiles, Soil types, Soil horizons, Permeability coefficient, Model studies, Rainfall rates.

Traditionally, non-uniformities with depth have been classified with respect to layers of the soil. In the analysis of flow through soils that are non-uniform with depth, it is often assumed that soil hydraulic properties are more homogeneous within horizons or layers than between layers. A more

continuous approach to changes in hydraulic characteristics with depth may be more appropriate in some soils, particularly in the case of near surface properties affecting infiltration. An infiltration model based on the Green-Ampt assumptions was developed for a class of non-uniform soils in which saturated hydraulic conductivity decreases as an exponential function of depth, and the storage-suction factor is a constant. Assumptions about soil hydraulic characteristics implicit in the model are that saturated hydraulic conductivity should be adequately described by a functional relationship and the product of potential difference at the wetting front and the difference in the moistures content across the wetting front should be constant with depth. An analysis of measured hydraulic conductivity and porosity data suggests that the model may be useful in some soils where the changes of hydraulic characteristics with depth are of this form. A method for using the model with time variable rainfall rates is given. The model was applied to simulate the experimental measurements of infiltration into layered sand profiles. Agreement was satisfactory even for this case. (Collier-IVI)
W85-05006

AGRICULTURAL WATER POLLUTION CONTROL: AN INTERDISCIPLINARY APPROACH,
Max C. Fleischmann Coll. of Agriculture, Reno, NV.
For primary bibliographic entry see Field 6B.
W85-05067

EVALUATION OF AGRICULTURAL DROUGHT USING PROBABILITY DISTRIBUTION OF SOIL MOISTURE INDEX,
Indian Agricultural Research Inst., New Delhi. Div. of Agricultural Physics.
For primary bibliographic entry see Field 2B.
W85-05075

LEACHING OF SOLUBLE SALT DURING INFILTRATION AND REDISTRIBUTION,
Hanover Univ. (Germany, F.R.). Inst. fuer Bodenkunde.
I. S. Dahiya, M. Singh, J. Richter, and M. Singh.
Irrigation Science, Vol. 5, No. 1, p 15-24, April, 1984. 5 Fig, 2 Tab, 27 Ref.

Descriptors: *Leaching, *Salts, *Infiltration, *Redistribution, *Soil water, Soil types, Sandy soils, Loam soils, Clay soils.

Miscible displacement of soluble salts during infiltration and redistribution of water was studied experimentally in vertical, homogeneous columns of sandy, sandy loam and clay soils with initially uniform salt and moisture contents. Calcium chloride, mixed uniformly in initially dry and moist soils, was leached with water under transient and steady infiltration conditions. The salt and water profiles were determined immediately following infiltration and after matching total infiltration and redistribution times. Irrespective of different flow conditions and soil types, the 'centre of mass' of salt front coincided with the 'piston front' that would exist given perfect displacement of water initally present in the soil by the water being infiltrated (piston-flow model). Furthermore the advance of 'center of mass' of salt front was independent of the water application rate and initial soil water content in all soils following both infiltration and redistribution. (Author's abstract)
W85-05163

APPLICATION OF THE POTENTIAL CONCEPT TO SOIL WATER EQUILIBRIUM AND TRANSPORT,
Colorado Agricultural Experiment Station, Fort Collins.
A. T. Corey, and A. Klute.
Soil Science Society of America Journal, Vol. 49, No. 10, p 3-11, January/February, 1985. 1 Fig, 43 Ref.

Descriptors: *Soil water potential, *Water transport, Soil properties, Water potentials, Thermodynamics.

The view that a total soil water potential can be defined such that the water component will always move from regions of higher to regions of lower potential and, that if the total potential is constant at all points, the water component is in equilibrium is examined. Transport of water component in a soil solution occurs by two mechanisms: convection of the solution or gas phase in which the water exists, and diffusion of the component water relative to the bulk motion of the phase. The major shortcoming is a failure to distinguish between components of a potential that apply only to elements of the soil solution and those that apply only to the water component. Concepts from texts dealing with transport processes and thermodynamics show that there is no single potential that is a function of the state of the soil solution only, whose gradient will always indicate the direction of net transport of the water component, or which, if constant in all parts of the system, will ensure that equilibrium exists. (Baker-IVI)
W85-05178

EVALUATION OF CLOSED-FORM ANALYTICAL MODELS TO CALCULATE CONDUCTIVITY IN A FINE SAND,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and K. R. Rehfeldt.
Soil Science and Society of American Journal, Vol. 49, No. 1, p 12-19, January-February, 1985. 6 Fig, 3 Tab, 21 Ref. Bureau of Mines grant GI1151132 UNIV NEV.

Descriptors: *Soil properties, *Sand, *Permeability coefficient, Soil water, Model studies, Computer models.

The soil water characteristic curve was determined for an undisturbed core of fine sand over a range of negative pressure heads observed in the field, 0 to 150 cm, below about the 30 cm depth. These data were used to predict relative hydraulic conductivity in a computer code of closed-form analytical solutions developed by van Genuchten for the theoretical models of Burdine and Mualem. Van Genuchten's approach is versatile, convenient and sufficiently accurate for practical purposes. However, the reliability of the method may depend on physically reasonable estimates of various parameters and an adequate data base. (Baker-IVI)
W85-05179

MEASUREMENT OF SOIL WATER CONTENT USING TIME-DOMAIN REFLECTROMETRY (TDR): A FIELD EVALUATION,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
G. C. Topp, and J. L. Davis.
Soil Science Society of American Journal, Vol. 49, No. 1, p 19-24, January/February, 1985. 8 Fig, 3 Tab, 8 Ref.

Descriptors: *Soil water, *Measuring instruments, *Time-domain reflectrometry, Gravimetric sampling, Sampling.

Field evaluation of time-domain reflectrometry (TDR) for the measurement of soil water content was conducted under a crop of silage corn where measurements were taken from seeding time to harvest. Parallel pair transmission lines varying in length from 0.125 to 1 m were installed vertically at three sites; at one site horizontal lines and additional vertical transmission lines with electrical impedance discontinuities were installed for comparison. TDR measured water contents are compared to values obtained by gravimetric sampling. The study demonstrates that with a battery-powered instrument, the TDR technique is an accurate method for measuring soil water content in the field. The accuracy found was comparable to that of gravimetric samples. In both cases, the limit of accuracy appeared dependent upon the variability of the soil. When both methods used the same soil, standard deviation of differences were as low as 0.02 cu m/cu m. When TDR and gravimetric samples measured noncoincident samples, the standard deviation increased to 0.06 cu m/cu m. Both horizontally and vertically installed lines gave satisfactory measurements of water content. The horizontally installed lines, measuring over a larger horizontal cross-sectional, area showed less variation than vertical lines. The variety of transmission line configurations which have been evaluated provide considerable flexibility in choice of transmission lines to yield the desired water content information. (Baker-IVI)
W85-05180

GENERALIZED SOLUTION TO INFILTRATION,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
A. W. Warrick, D. O. Lomen, and S. R. Yates.
Soil Science Society of America Journal, Vol. 49, No. 1, p 34-38, January/February, 1985. 3 Fig, 4 Tab, 21 Ref. OWRT project B-097-ARIZ.

Descriptors: *Infiltration, *Permeability coefficient, *Soil water, Mathematical equations, Richards' equation.

A generalized solution to the Richards moisture flow equation is developed for infiltration. The equation is expressed in terms of dimensionless time, depth, and water content. The reduced form applies for the hydraulic functions of van Genuchten or of Brooks and Corey as well as to other scaled forms and the solution utilizes the procedure of Philip. While the approach could be used for methods of solution other than that of Philip, his algebraic forms are particularly easy to apply and therefore were used. Possibly, the same approach could also prove useful for describing redistribution or cyclic water inputs even though the associated numerical calculations would, by necessity, be nonanalytical. In field situations where only scant information is available, textural classes may be used to estimate infiltration and wetting depths. If a great deal is known regarding soil properties, the results may be applied to systematically describe heterogeneity. For application, specifically measured hydraulic conductivities can be best-fitted to the forms used here or generalized empirical values can be used from the literature. (Baker-IVI)
W85-05182

EFFECT OF CATION EXCHANGE ON CALCULATED HYDRODYNAMIC DISPERSION COEFFICIENTS,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
M. J. L. Robin, and D. E. Elrick.
Soil Science Society of America Journal, Vol. 49, No. 1, p 39-45, January-February, 1985. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Cation exchange, *Soil properties, *Dispersion, Hydrodynamics, Unsaturated flow, Chlorides, Potassium, Chemical reactions, Adsorption isotherms, Soil water.

Cation exchange is one of the most common reactions involving cations in soils. Although the reaction involves at least two cations, it is often described in transport equations by adsorption isotherms, which describe the behavior of a single cation associated with the solid phase as a function of its concentration in the liquid phase. The results of cation-exchange isotherm measurements made on an air-dry, salt-free, Ca-saturated Brookston silty clay loam are reported and the effect of a cation exchange reaction term on the calculated dispersion coefficient is presented. The cation exchange experiments demonstrated that the cation exchange data agreed very well with Laryea's adsorption isotherm. It was also noted that, although the exchange isotherms indicated a possible failure to reach equilibrium it was still possible to calculate very good fits of the isotherms at the experimental negative-change concentrations. The dispersion coefficient values obtained for Cl(-) and K(+) are about one order of magnitude higher than expected. This cannot be explained by the choice of the reaction term and may be due to the presence of immobile water and/or to anion exclusion. (Baker-IVI)
W85-05183

STATISTICAL RELATIONSHIP BETWEEN APPARENT DIELECTRIC CONSTANT AND WATER CONTENT IN POROUS MEDIA,
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium). Unit of Management and Water Resources.
M. Ansoult, L. W. De Backer, and M. Declercq.
Soil Science Society of America Journal, Vol. 48, No. 1, p 47-50, January-February, 1985. 3 Fig, 16 Ref.

Descriptors: *Porous media, *Statistical models, *Soil water, *Dielectric constant, Electrical properties, Moisture, Soil properties.

Soil could be considered in a physical sense as a three-component mixture of air, solid, and water. Generally, the dielectric constant of air equals 1, that of solids equals 4, and that of pure water equals 80. The apparent dielectric constant of a soil, is greatly influenced by the volumetric mater content. A theoretical relationship between the apparent dielectric constant and the water content of porous media is presented. The dielectric effect of the porous medium is investigated at the microscopic scale of the probable path of an electric charge. The proposed model simulates well the experimental relationship in soils for degrees of freedom varying between 6 and 8. (Baker-IVI)
W85-05184

EFFECT OF TEMPERATURE-DEPENDENT HYDRAULIC PROPERTIES ON SOIL WATER MOVEMENT,
Alabama Agricultural Experiment Station, Auburn.
J. W. Hopmans, and J. H. Dane.
Soil Science Society of America Journal, Vol. 49, No. 1, p 51-58, January-February, 1985. 11 Fig, 22 Ref, 1 Append.

Descriptors: *Soil water, *Temperature effects, *Soil hydraulic properties, Boundary conditions, Soil properties, Head, Soil surface, Permeability coefficient.

Soil water movement was simulated under different temperature regimes for a variety of initial and boundary conditions. Corrections of soil hydraulic properties due to temperature changes were either based on experimental data extracted from the literature or on theoretical considerations. In the latter case, multiples of the calculated temperature coefficient of surface tension of water, which affect soil water pressure head, were also used to more nearly approximate experimentally determined values of dh/dT (the change of pressure head with temperature). The effect of temperature on water movement was found to depend on the type of boundary conditions, especially one at the soil surface where changes were most drastic, and on the kind of temperature regime superimposed on it. Temperature effects were much more pronounced for a pressure head than for a flux boundary condition at the soil surface. For temperature varying with both time and depth, the effects of temperature seemed to be minimal if the hydraulic properties were determined at the mean temperature of the profile. The latter suggests that those soil hydraulic properties which are determined in the lab for application to field condition should probably be determined at a temperature that is near the mean soil temperature under field conditions. The results also showed that temperature effects on soil water movement become more pronounced as the temperature coefficient of soil water pressure head increases and the kind of effect depends on whether the existing temperature is above or below the reference temperature. (Baker-IVI)
W85-05185

WATER RELATIONS OF SATURATED BENTONITE: SOME EFFECTS OF TEMPERATURE AND SOLUTION SALT CONCENTRATION,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils.
D. E. Smiles, C. J. Barnes, and W. R. Gardner.
Soil Science Society of America Journal, Vol. 49, No. 1, p 66-69, January-February, 1985. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Soil water, *Bentonite, *Temperature effects, *Salinity, Saturated flow, Viscosity, Clay, Unsaturated soils, Air-water interface.

Attention is drawn to data that provide additional insights into some aspects of the temperature dependence of clay/water interaction, as well as indicating some useful empirical relations in clay systems. Transient flow and equilibrium pressure membrane experiments were used to determine some water relations of bentonite pastes in the range of water content from 6 to 33. The pastes were prepared in equilibrium with three different sodium chloride concentrations and the experiments were performed at temperatures of 277, 293, and 306 K. For each solution salt concentration the moisture characteristic was effectively temperature independent, and the effect of solution concentration was qualitatively, but not quantitatively, in agreement with electrical double layer theory Both the cumulative outflow and the water content profiles in the transient flow experiments revealed clear temperature dependence. This effect was accounted for by the temperature dependence of the kinematic viscosity of water. Apparently temperature dependence, over and above effects on viscosity, in the moisture characteristics and flow properties in unsaturated soils arises not in double-layer effects, but in effects on the air water interfaces in these systems. (Baker-IVI)
W85-05186

TEMPORAL RESPONSE OF SOIL DENITRIFICATION RATES TO RAINFALL AND IRRIGATION,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
A. J. Sexstone, T. B. Parkin, and J. M. Tiedje.
Soil Science Society of America Journal, Vol. 49, No. 1, p 99-103, January-February, 1985. 6 Fig, 2 Tab, 19 Ref. NSF grant DEB-80-12168.

Descriptors: *Denitrification, *Soil chemistry, *Rainfall, *Irrigation effects, Temporal distribution, Soil water, Porosity, Nitrogen loss, Anaerobic conditions, Microsites, Sampling.

The short-term response of field denitrification rates to rainfall and irrigation is reported. Peak denitrification rates usually occurred for brief periods after a moisture addition, but the response time and duration were different for light and heavy textured soil. A maximum denitrification rate was generally observed following both natural and laboratory wetting events. This increased rate did not occur until after a characteristic lag time which depended on soil texture. A major effect of increased soil moisture is thought to be a decreased rate of oxygen supply leading to the establishement of anaerobic zones of microsites where denitrification can occur. The sandy loam soil used in this study is non-aggregated and does not hold water readily, while the clay loam soil had good structure and holds much more water at any given moisture potential. When the soil was relatively dry, rate estimates could be extrapolated over a 2 to 3 day period provided that a sufficient number of cores were evaluated. The denitrification rate in the sandy loam soil increased immediately after water addition and reached a maximum rate within 3-5 hr and returned to preirrigation levels within 12 hr. A similar, but slower denitrification response occurred in the clay loam soil, requiring 8-12 hr before a maximum rate was observed and 48 hr before the original background rate was restored. Significant denitrification losses can occur in bursts in response to rainfall, and sampling schemes based on integration of denitrification rate measurements must include these episodes to obtain meaningful estimates of N loss. A denitrification response to rainfall was not always the case, however, suggesting that NO3(-) or carbon may also limit nitrogen loss. (Baker-IVI)
W85-05187

EFFECT OF RAINDROP IMPACT ENERGY AND WATER SALINITY ON INFILTRATION RATES OF SODIC SOILS,
Agricultural Research Organization, Bet-Dagan (Israel).
M. Agassi, J. Morin, and I. Shainberg.
Soil Science of America Journal, Vol. 49, No. 1, p 186-190, January-February, 1985. 5 Fig, 2 Tab, 16 Ref.

Descriptors: *Soil water, *Infiltration, *Rain, *Salinity, *Sodic soils, Rainfall infiltration, Runoff, Dispersion, Electrolytes, Drop impact, Kinetic energy, Soil aggregates.

It is hypothesized that the infiltration rate of soils exposed to rain with no energy could be predicted from studies of the effect of soil sodicity and electrolyte concentration on hydraulic conductivity of soils. Conversely, when high energy rain is applied, the mechanical impact of the water drops will increase the susceptibiiy of the soil surface to both the soil exchangeable sodium percentage (ESP) and the electrolyte concentration in the applied water. Two soils were used for the study: a Calcic Haploxeralf (loess) from a site where annual precipitation is 400 mm, and a Typic Chromoxerert (vertisol) from a site where annual precipitation is 500 mm. Three levels of exchangeable sodium were taken for each soil. Rain was applied at two energy levels: high energy rain with kinetic energy of 22.9 J/mm sq m and a low energy rain with kinetic energy less than 0.01 J/mm sq m. Both the water drop impact energy and the electrolyte concentration in the applied rain have a decisive effect on the infiltration rate drop of soils. When the chemical dispersion processes are minimal the mechanical impact of the drops predominate and the crust formation is mainly due to the disintegration of the soil aggregates and their compaction to a thin skin seal. When the soil ESP is high, > 2.5, and the water salinity is low, rain water, chemical dispersion processes have an increasing role in determining the infiltration rate of the soils. (Baker-IVI)
W85-05188

EFFECT OF WATER QUALITY AND DRYING ON SOIL CRUST PROPERTIES,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
M. Ben-Hur, I. Shainberg, R. Keren, and M. Gal.
Soil Science Society of America Journal, Vol. 49, No. 1, p 191-196, January-February, 1985. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Soil crusts, *Water quality, *Drying, Infiltration, Irrigation, Runoff, Rain, Arid regions, Salinity, Dispersion, Soil surface.

The presence of a crusted soil surface due to rainfall is a common feature of many soils, particualrly in the arid and semi-arid regions. The effect of drying of the crusted soil on the stability of the crust and its properties is examined. Drying the soil crust causes an increase in the crust permeability. This increase is due to the formation of cracks and the new structure at the soil surface. Both processes intensify as the crust dries. Whereas the wet crust is stable and maintains the original properties of the crust (low infiltration rate and the crust being almost independent of the salinity of the water in the subsequent storm). The structure of the crust upon drying changes and both crust permeability and crust's response to the salinity of the solution increase. The formation of a new and less cohesive structure at the soil surface upon drying increases the permeability of the crust and causes it to be more sensitive to the destructive effect introduced by the impact of the raindrops. (Baker-IVI)
W85-05189

GEOLOGY AND SOILS OF THE RHODE RIVER WATERSHED,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
J. W. Pierce.
In: Environmental Data Summary for the Rhode River Ecosystem (1970-1978), Section A: Long Term Physical/Chemical Data, Part 1: Airshed and Watershed, 1982. p 181-216, 7 Tab, 7 Ref, 3 Append.

Descriptors: *Watersheds, *Soil profiles, *Maryland, *Geological surveys, *Mineralogy, *Geolog-

ic formations, *Soil texture, Minerals, *Soil types, Rhode River Watershed, Montmorillonite, Kaolinite, Illite, Sand, Quartz, Clays, Alluvium, Baseline studies.

Data from three different projects were compiled to study the geology and solids of the Rhode River Watershed. The NSF-RANN and Smithsonian funded project sought to provide data on the type of minerals present in the silt and clay fractions of the soils and to see if any differences existed from watershed to watershed. The Forest Ecology Study analyzed soil textures and minerals. An EPA-funded study provided detailed mapping of the soils in the field-sized watersheds allowing determination of the solids present at each sampling site. Seven geologic fromations crop out in the Rhode River watershed. From these formations fifteen different soil series have developed. The stream valleys and a considerable portion of the shoreline of the Rhode River are covered with recent alluvial deposits. Sand constituted slightly over 40% of the soil followed by clay and silt. The soils of the single-use watersheds and the streams contained more sand and silt while the samples from tidal Muddy Creek had more silt and clay. The average mineralogy of the samples scattered over the entire watershed has considerably more montmorillonite than the average for the field sized watersheds. The variations in mineralogy may be due, in part, to textural differences. Quartz is the most common mineral in the soils followed by montmorillonite, illite, and kaolinite. Samples from the banks of Muddy Creek indicate a possible further fractionation during transport.
W85-05356

SEASONAL AND ANNUAL VARIATION IN THE TEMPERATURE AND MOISTURE CONTENT OF SOLIDS ON THREE SINGLE LAND-USE RHODE RIVER WATERSHEDS,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
D. L. Correll.
In: Environmental Data Summary for the Rhode River Ecosytem (1970-1978). Section A: Long Term Physical/Chemical Data, Part 1: Airshed and Watershed, 1982. p 217-259, 2 Fig, 5 Tab, 1 Ref.

Descriptors: *Watersheds, *Data collections, *Maryland, *Forest watersheds, *Agricultural watersheds, *Soil moisture retention, *Soil surveys, *Soil temperature, *Air temperature, *Seasonal variation, Baseline studies, Soil properties, Annual distribution, Elevation, Soil water.

Three small watershed basins representative of cropland, forest and pasturelands were studied from 1976 through 1979 with soil moisture and temperature probes buried at depths of 5, 15, 30, and 75 cm. In situ gravimetric moisture determinations were made by coring for comparison with gypsum block probe readings. Analysis of temperature data showed that significant vertical gradients were often found at all sites and that differences were apparent between land uses. However, within a given land use and at the same soil depth variations between elevational contours were usually not significant. Data for mean air temperature and soils at 5 and 75 cm depths show some differences in response for the three land use areas. Surface soils reached the highest temperature in pastureland and had the lowest temperature in cropland. Forest surface soils displayed the least temperature fluctuation. In laboratory studies, more variation in soil moisture retention was found in cropland soils. Field data on soil moisture retension for the three basins are summarized by month, elevational contour, and by soil depth. High soil moisture tensions occurred in summer and fall, typically peaking in September or October. Soil moisture tensions typically were lower at the pastureland site. At all sites tensions were very low from December through May, except at 5 cm depth.
W85-05357

ANALYTICAL SOLUTION TO THE PROBLEM OF SEEPAGE INTO COUNTERFORT DRAINS,
Kingston Polytechnic, Kingston upon Thames (England). School of Civil Engineering.
E. N. Bromhead.
Canadian Geotechnical Journal, Vol. 21, No. 4, p 657-662, November, 1984. 4 Fig, 6 Ref.

Descriptors: *Drainage, *Water seepage, *Trenches, *Counterfort drains, Permeability, Soil water, Mathematical studies, Slope stabilization.

The earliest treatment of the seepage of water to trench drains may have been that of Richardson (Richardson, L.F. 1908. Scientific Proceedings of the Royal Dublin Society, Vol. 11, No. 27, p 295-316). An analytical solution to the problem that defeated Richardson is presented. This solution assumes that the trench drains penetrate all the way through a soil layer of finite thickness and uniform permeability to an impermeable basal layer. The sides of the drains are wetted, and are at atmospheric pressure, which is the datum for all pressure measurements, but the drains operate with a negligible head of water in them. Details are presented on the design and peformance of trench and counterfort drains. Agreement between the analytical and numerical solutions is good, with the numerical approach proving to be much more economic in terms of computer resources. The results have been expressed in a form suitable for use in counterfort drain installations for slope stabilization. (Baker-IVI)
W85-05528

EXPLORATION OF A RIGID ICE MODEL OF FROST HEAVE,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2C.
W85-05791

HILLSIDE SEEPAGE: AN ANALYTICAL SOLUTION TO A NONLINEAR DUPUIT-FORCHHEIMER PROBLEM,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 2F.
W85-05796

FINITE ELEMENT MATRIX AND MASS BALANCE COMPUTATIONAL SCHEMES FOR TRANSPORT IN VARIABLY SATURATED POROUS MEDIA,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W85-05798

STABILITY OF THE GREEN-AMPT PROFILE IN A DELTA FUNCTION SOIL,
Princeton Univ., NJ. Dept. of Civil Engineering.
P. C. D. Milly.
Water Resources Research, Vol. 21, No. 3, p 399-402, March, 1985. 2 Fig, 15 Ref.

Descriptors: *Soil water, *Green-Ampt profile, *Richards equation, *Delta function, Permeability coefficient, Mathematical analysis.

The sharp wetting front of Green and Ampt represents a solution of the Richards equation for infiltration into a delta-function soil. Delta-function diffusivity is not a sufficient condition for the existence of a stable Green-Ampt profile. In order that the sharpness of this profile be maintained in the presence of a small perturbation of the profile shape, it is sufficient that the second derivative of hydraulic conductivity with respect to moisture content be positive for all values of moisture content. An inspection of theoretical and experimental data on the hydraulic conductivity suggests that this condition is usually satisfied. The profile is also stable if the first derivative of hydraulic conductivity with respect to moisture content is proportional to a delta function. Soils that are the closest to having a Green-Ampt profile as a solution of the Richards equation are also the ones in which such a profile is least likely to be stable. (Collier-IVI)
W85-05804

2H. Lakes

WATER QUALITY CHARACTERISTICS OF THE HARIMA NADA COASTAL AREA, COD LOAD CAUSED BY PRIMARY PRODUCTION,
Hyogo Prefecture Environmental Science Inst., Kobe (Japan).
For primary bibliographic entry see Field 2L.
W85-04969

ELECTROCHEMICAL DETERMINATION AND CHARACTERIZATION OF SURFACE ACTIVE SUBSTANCES IN FRESHWATERS,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
B. Cosovic, V. Vojvodic, and T. Plese.
Water Research, Vol. 19, No. 2, p 175-183, 1985. 11 Fig, 2 Tab, 20 Ref. NBS grant NBS/IG-191/JF.

Descriptors: *Surfactants, *Humic acids, *Drinking water, *River water, *Groundwater, *Electrochemistry, *Chemical analysis, Polarography, Detergents.

Surface active material has been analyzed in samples of different freshwater systems: river water, groundwater and tap water, by electrochemical methods based on the measurement of the adsorption effects at the mercury electrode. Two electrochemical methods were used: the measurement of the suppression of the polarographic maxima and a.c. polarography. A rough characterization of predominant surface active compounds was performed through a comparison of the shape and the intensity of the electrochemical responses with those obtained with different model surfactants. It was found that humic substances represent predominant surface active substances in freshwater systems. The total surfactant activity corresponds to approx. 0.5-20 mg/cu dm of humic substances. Anionic detergents were analyzed by the spectrophotometric methylene blue method. The highest values (100-300 micro g/cu dm) were found in river water samples which were taken downstream from the city location. The total surfactant activity values of river water samples as measured by the electrochemical methods were only exceptionally influenced by the presence of detergents. (Author's abstract)
W85-04972

INORGANIC CARBON LIMITED GROWTH KINETICS OF SOME FRESHWATER ALGAE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
J. T. Novak, and D. E. Brune.
Water Research, Vol. 19, No. 2, p 215-225, 1985. 15 Fig, 2 Tab, 23 Ref, 1 Append.

Descriptors: *Inorganic carbon, *Growth kinetics, *Algae, *Limiting nutrients, Light intensity, Water temperature, Competition, Species composition, Cyanophyta, Chlorophyta, Anabaena, Chlorella, Selenastrum, Scenedesmus, Oscillatoria, Microcoleus.

The inorganic carbon limited growth kinetics were determined for three green and three blue-green algae over a range of light and temperatures. Anabaena flos aquae was found to be the only algae to grow at 39 C. Selenastrum capricornutum and Scenedesmus quadricauda were favored at low temperatures with Selenastrum growing best at high light and carbon levels while Scenedesmus was the most rapidly growing algae under low light, carbon and temperature conditions. Chlorella was the fastest growing algae at temperatures from 27 to 33 C under all light and inorganic carbon concentrations. Neither Oscillatoria nor Microcoleus were found to be the dominant algae under the conditions tested. However, under reduced light and temperature conditions, Oscillatoria grew well at high inorganic carbon concentrations. (Author's abstract)
W85-04977

AVAILABILITY OF DISSOLVED IRON FROM TJEUKEMEER, THE NETHERLANDS, FOR

IRON-LIMITED GROWING SCENEDESMUS QUADRICAUDA,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, M. J. W. Veldhuis, and J. R. Moed.
Water Research, Vol. 19, No. 2, p 235-239, 1985. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Iron, *Lake Tjeukemeer, *Netherlands, *Scendesmus, *Limiting nutrients, *Algae, Chlorophyta, Lakes, Nutrients, Algal growth, Particulate matter, Colloids.

Tjeukemeer is a shallow, humic, alkaline and eutrophic lake in The Netherlands. Concentration of dissolved Fe(III)-ions is very low in summer and does not exceed 10 to the -23 power M. Iron uptake rates in Tjheukemeer may depend on the rates of dissolution of colloidal and particulate Fe(OH)3 and on photodegradation of naturally occurring Fe-complexes. If these rates are slow relative to those of Fe uptake, the growth rate of some phytoplankton species may decrease. In such a case Fe availability rather than Fe depletion would limit algal growth rates. Ultrafiltration of water from Tjeukemeer revealed that most dissolved Fe (< 0.2 micro m) is found in colloids between 350 and 2000 A. All dissolved Fe from NH4Fe(SO4)2.12H2O in the growth medium occurred in particles < 350 A, half of which did not exceed 100 A. The half-saturation growth constant (K sub s) of Fe-limited growth of Scenedesmus quadricauda in the presence of EDTA at pH 8.0 and using the natural Fe colloids was almost 3 times that using NH4Fe(SO4)2.12H2O. The maximum growth rate (mu max) was not affected by the particle size of the limiting Fe substrate. Fe from the natural colloids is approximately one-third as much available as from NH4Fe(SO4)2.12H2O. Explainations of algal succession by resource competition as derived from K sub s values using artificial media, do not reflect the natural form and availability of the growth limiting nutrients involved. The chemostat is a helpful tool to investigate the role of these physico-chemical factors in phytoplankton ecology. (Collier-IVI)
W85-04978

ALGAL CONTROL OF LAKE GEOCHEMISTRY; REDOX CYCLES IN ROSTHERNE MERE, U.K.,
Freshwater Biological Association, Ambleside (England).
W. Davison, C. S. Reynolds, and B. J. Finlay.
Water Research, Vol. 19, No. 2, p 265-267, 1985. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Rostherne Mere, *United Kingdom, *Redox cycles, *Algae, *Geochemistry, *Lakes, *Sediment-water interface, *Bottom water, Phytoplankton, Hypolimnion, Iron, Sulfate, Sulfur, Carbon, Anoxic conditions, Methanogenesis, Oxidation.

The chemistry of the bottom waters of a lake may depend upon the particular algal species dominating the phytoplankton. Apparently some some common algal species whose life cycles include a dormant stage at the sediment surface can have a significant influence on the chemistry of the overlying hypolimnion. Most notably iron and sulfate are bypassed as electron sinks in favor of carbon which will serve as a substrate for methanogenesis. The suprising absence of the reduced forms of iron and sulfur from the anoxic hypolimnion of biologically productive Rostherne Mere is attributed to carbon decomposition processes occurring within the sediment rather than at its interface. The dominant phytoplankton (Microcystis or Ceratium) sink, and initially remain viable as a layer on the sediment surface. Oxidation of carbon occurs deeper within the sediment and is isolated from the water column. Carbon probably acts as the electron acceptor (methanogenesis) because the supply and removal of inorganic redox couples is limited by molecular diffusion. As a consequence of the particular biological features of the lake and of its dominant phytoplankton species, organic decomposition and consequent electron transfer is displaced from the hypolimnion and sediment-water interface to deeper sediments. The sediment-water interface is effectively replaced by a physical barrier of sedimenting algae resisting decomposition. This barrier separates the different redox processes of bottom water and deep sediment. Iron and sulfur are simply bypassed as electron sinks in favor of carbon itself in the form of mobile methane. (Collier-IVI)
W85-04982

MICROCALORIMETRIC APPROACH TO DETERMINE RELATIONSHIPS BETWEEN ENERGY SUPPLY AND METABOLISM IN RIVER EPILITHON,
University Coll. of North Wales, Bangor. School of Animal Biology.
M. A. Lock, and T. E. Ford.
Applied and Environmental Microbiology, Vol. 49, No. 2, p 408-412, February, 1985. 5 Fig, 15 Ref. Natural Environment Research Council (United Kingdom) grant GR3/4295 A.

Descriptors: *Epilithon, *Metabolism, *Microorganisms, Organic matter, Bacterial physiology.

In a study to determine the relative importance of various apparent molecular weight fractions to the metabolism (heat output) of attached microorganisms in rivers, a marked lack of response to gross changes in the external organic matter supply was noted over the course of several hours. Such a response by a mixed autotrophic-heterotrophic community could be attributed to the autotrophs being the sole organic energy source for the heterotrophs. However, substantial metabolic activities were noted in attached microbial communities grown in darkness (algae free), thus indicating that riverborne organic matter was a major energy source. This paradox was attributed to a proposed lag in the availability of dissolved and colloidal organic matter to the heterotrophic microorganisms. (Author's abstract)
W85-05052

KINETIC STUDIES OF BACTERIAL SULFATE REDUCTION IN FRESHWATER SEDIMENTS BY HIGH-PRESSURE LIQUID CHROMATOGRAPHY AND MICRODISTILLATION,
Limnologisch Inst., Nieuwersluis (Netherlands).
K. A. Hordijk, C. P. M. M. Hagenaars, and T. E. Cappenberg.
Applied and Environmental Microbiology, Vol. 49, No. 2, p 434-440, February, 1985. 5 Fig, 2 Tab, 23 Ref.

Descriptors: *Sediments, *Bacterial physiology, *Sulfates, *High pressure liquid chromatography, *Microdistillation, Sediment-water interface, Isotope studies.

Indirect photometric chromatography and microdistillation enabled a simultaneous measurement of sulfate depletion and sulfide production in the top 3 cm of freshwater sediments to be made. The simultaneous measurement of sulfate depletion and sulfide production rates provided added insight into microbial sulfur metabolism. The lower sulfate reduction rates, as derived from the production of acid-volatile S(2-)-35 only, were explained by a conversion of this pool to an undistillable fraction under acidic conditions during incubation. A mathematical model was applied to calculate sulfate reduction from sulfate gradients at the sediment-water interface. To avoid disturbance of these gradients, the sample volume was reduced to 0.2 g (wet weight) of sediment. Sulfate diffusion coefficients in the model were determined (D sub s = 0.000003 sq cm/s at 6 C). The results of the model were compared with those of radioactive sulfate turnover experiments by assessing the actual turnover rate constants (2 to 5/day) and pool sized of sulfate at different sediment depths. (Author's abstract)
W85-05053

GAS EXCHANGE-WIND SPEED RELATION MEASURED WITH SULFUR HEXAFLUORIDE ON A LAKE,
Lamont-Doherty Geological Observatory, Palisades, NY.
R. Wanninkhof, J. R. Ledwell, and W. S. Broecker.
Science, Vol. 227, No. 4691, p 1224-1226, March, 1985. 2 Fig, 1 Tab, 21 Ref.

Descriptors: *Gas exchange, *Wind speed, *Sulfur hexafluoride, *Lakes, Air-water interfaces, Fate of pollutants.

Gas-exchange processes control the uptake and release of various gases in natural systems such as oceans, rivers, and lakes. Not much is known about the effect of wind speed on gas exchange in such systems. In the experiment described here, sulfur hexafluoride was dissolved in lake water, and the rate of escape of the gas with wind speed (at wind speeds up to 6 meters per second) was determined over a 1-month period. A sharp change in the wind speed dependence of the gas-exchange coefficient was found at wind speeds of about 2.4 meters per second, in agreement with the results of wind-tunnel studies. However, the gas-exchange coefficients at wind speeds above 3 meters per second were smaller than those observed in wind tunnels and are in agreement with earlier lake and ocean results. (Author's abstract)
W85-05055

CRITICAL OXYGEN CONCENTRATION OF FINNISH LAKES,
R. Laaksonen, and V. Malin.
Vesientutkimuslaitoksen Julkaisuja, No. 49, p 54-57, 1982. 5 Fig, 1 Ref.

Descriptors: *Dissolved oxygen, *Finland, *Lakes, Seasonal variation, Monitoring, Water quality.

Data on observed oxygen concentrations in Finnish lakes are available in the water quality register from 16,969 observation sites for the period 1961-1980. Of these, 8504 had been sampled in March-April. On an individual lake basis, oxygen concentration was measured in 20-28% of Finland's 55,000-75,000 lakes, and the concentration at the end of the winter season was measured in 10-14% of the lakes. Oxygen concentrations below 11% of the saturation value were recorded at least once in 2353 of the observation sites examined in March-April (>5 m deep sites); a total of 2118 of the lakes investigated (28%) had at least on occasion a severe disturbance in the dissolved oxygen level. In one lake out of every four the bottom water layers were either totally or nearly totally oxygen depleted at the end of the winter season, with the result that the return of phosphorus from the bottom silt was significantly enhanced. Of the low-oxygen observation sites (O2 < 11% of saturation), over half contained low-oxygen water to a level of less than 21% of the height of the water column. The greatest frequencies of occurence of low oxygen lakes (O2 < 11%) varied considerably in different areas of the country: the greatest frequencies of occurrence were in the river Kokemaenjoki watercourse (38%) and in Ostrobothnia (35%; the minimum frequencies were in the river Kymijoki watercourse (21%), particulary in the southern part (18%), in the northern region of Lapland (19%), and in Northern Carelia (20%). The generality of low-oxygen lakes is to a large extent due to natural factors but the effects of human activities in certain regions are clearly discernable. (Collier-IVI)
W85-05064

QUANTITY AND COMPOSITION OF PHYTOPLANKTON, PARTICULARLY CHLOROPHYTA, IN LAKES OF DIFFERENT TROPHIC LEVELS,
R. Mantere, and P. Heinonen.
Vesientutkimuslaitoksen Julkaisuja, No. 49, p 58-63, 1982. 6 Tab, 19 Ref.

Descriptors: *Finland, *Phytoplankton, *Chlorophyta, *Trophic level, *Lakes, *Algae, Eutrophic lakes, Oligotrophic lakes, Species composition, Species distribution, Bioindicators, Water pollution effects.

The distribution and species composition of green algae was investigated in Finnish lakes of different trophic states and nutrient sources. All the samples were obtained from the Vuoksi river basin in

southeast Finland during June, July, and August of 1971 and 1977. The total phytoplankton biomass was lowest in the oligotrophic lakes, increasing considerably in cultural eutrophic lakes (where biomass was as much as ten times the corresponding level in natural eutrophic lakes). The species number of green algae increased with increasing eutrophication. The best indicator organisms for eutrophication were the green algae Kirchneriella contorta (Schmidle) Bohlin, Micractinium pusillum Fres. and Pediastrum duplex Meyen, P. Tetras (Ehrenb.) Ralfs. and P. boryanum (Turp.) Menegh. The only green algal species indicative of oligotrophy was Arthrodesmus incus (Breb.) Hass. The considerable increase in green algae in response to the mineralized nutrients of municipal waste waters implies that the monitoring of these organisms could possibly provide a means of investigating the effects of municipal effluents on recipient waters. (Collier-IVI)
W85-05065

LAKE WATER GEOCHEMISTRY OF TWO GEOLOGICALLY CONTRASTED AREAS IN KUUSAMO, NORTH-EASTERN FINLAND,
Oulu Univ. (Finland). Dept. of Geology.
R. Piispanen, and U. Myllymaa.
Vesientutkimuslaitoksen Julkaisuja, No. 49, p 64-75, 1982. 6 Fig, 2 Tab, 28 Ref, 1 Append.

Descriptors: *Geochemistry, *Lakes, *Kuusamo, *Finland, *Iijoki basin, *Koutajoki basin, Calcium, Magnesium, Potassium, Sodium, Iron, Manganese, Drainage basins, Hydrogen ion concentration.

Metal (Ca, Mg, K, Na, Fe, Mn) compositions of water in 48 lakes of moderate size (0.5-0.99 sq km) have been studied from two geologically contrasted drainage basins (the Iijoki and the Koutajoki systems) in Kuusamo North-eastern Finland. The lake waters within the Iijoki drainage area, which coincides with the Presvecokarelian basement complex (southern part of the area), carry less Ca and Mg and have lower pH, conductivity and alkalinity compared with the lake waters of the northern part of the area (the Koutajoki drainage basin) where the bedrock is composed mainly of rocks that belong to the Karelian formations. In the northern part the lake waters are rich in Ca (mean = 8.2 mg/l) and Mg (mean = 2.6 mg/l). This is obviously due to the existence of sedimentogeneous calcareous schists and carbonate albitites and spilitic carbonate veins in the substratum. On the basis of a test the differences between the drainage basins can be regarded as statistically very significant ($p < 0.001$) as to alkalinity and pH. The Koutajoki values for Ca and Mg are high, but those for K, Na and Fe low compared with Finnish lake waters in general. The contents of Ca and Mg are however lower than those of the world mean lake and river waters. Those of the Iijoki basin are nearly the same as the corresponding values in Norway, North Sweden and northwestern USSR. (Author's abstract)
W85-05066

INVERTEBRATE COLONIZATION OF SUBMERGED WOOD IN A CYPRESS-TUPELO SWAMP AND BLACKWATER STREAM,
Savannah River Ecology Lab., Aiken, SC.
J. H. Thorp, E. M. McEwan, M. F. Flynn, and F. R. Hauer.
American Midland Naturalist, Vol. 113, No. 1, p 56-68, January, 1985. 4 Fig, 3 Tab, 25 Ref, 2 Append. DOE contract DE-AC09-76SROO819.

Descriptors: *Invertebrates, *Swamps, *Blackwater streams, *Species composition, Ecological distribution, Distribution patterns, Species diversity, Midges, Mayflies.

The effects of location within a swamp-stream ecosystem on colonization rate and community structure of the macroinvertebrate assemblages of submerged wood were examined. Uniform-sized sections of freshly cut wood from water tupelo trees (Nyssa aquatica L.) were suspended below floating platforms at swamp and stream sites for periods of 1-8 weeks. The location of wood substratum affected community structure to a large degree and patterns of colonization to a slight extent. Logs in the swamp-tributary site held almost three times as many individuals and twice as many taxa as did logs in the swamp and outflow stream sites. Stream sites, however, were similar in proportions of various functional and taxonomic groups. Except for the abundance of true midges (Chironomidae), the densities of most major taxonomic groups were significantly affected by location within the swamp-stream ecosystem. Recruitment of individuals and species were extremely rapid and reached a rough steady state at most sites within 1 week. Filter-feeding taxa were numerically dominant early but soon were subordinate to gatherer and scraper functional feeding groups. This trend resulted primarily from the progressive increase in abundances of riffle beetles and mayflies. Current velocity, seston particle size, dispersal capacity and competition for space may be important factors affecting community structure and colonization patterns in this aquatic ecosystem. (Author's abstract)
W85-05120

CHARACTERISTICS OF THE FORMATION OF THE OXYGEN REGIME AND PH OF NATURAL WATER UNDER THE EFFECT OF SUBMERGED VEGETATION IN THE IVANKOVO RESERVOIR,
L. O. Elnor.
Water Resources, Vol. 11, No. 2, p 151-159, March-April, 1984. 3 Fig, 2 Tab, 31 Ref. Translated from Vodnye Resursy, No. 2, p 122-131, March-April, 1984.

Descriptors: *Submerged plants, *Dissolved oxygen, *Hydrogen ion concentration, *Ivankova Reservoir, *USSR, Aquatic plants, Macrophytes, Water quality, Rivers, Lakes, Reservoirs.

Aquatic plants are assumed to have a substantial effect on the formation of water quality, its ionic composition, and gas regime, and to actively participate in the self-purification processes. Despite the considerable complexity of the formation of the gas regime of a water body and especially the oxygen regime, it is necessary to clearly present the contribution of macrophytes to the formation of the oxygen regime, since the oxygen content in water in many respects determines the quality and biological properties of natural waters. The increasing shortage of biologically sufficient natural water necessitates the implementation of water resources development projects designed to aid processes of self-purification of biota in every possible way. As part of water projects, aquatic plants should be introduced, both from the standpoint of their participation in self-purification and their economic value as a raw material. In narrow, shallow brooks with low current velocities and predominant develoment of precisely submersed vegetation, vegetation has a decisive effect on water quality indices, including the gas regime. In the part of the littoral zone occupied by submersed vegetation the contribution of the vegetation to the formation of the oxygen regime is determined mainly by the level of its development. Although at a higher level of coverage submersed vegetation has a decisive effect on the formation of the oxygen regime and pH of natural water, under the real conditions of the Ivankovo reservoir, the proportion of stretches with a high level of coverage by submersed vegetation is small. The contribution of higher aquatic vegetation (specifically submersed vegetation) amounts to only several percent of the contribution of phytoplankton to photosynthetic production of oxygen. (Baker-IVI)
W85-05158

MODELING OF CO2 DYNAMICS IN A BODY OF FRESHWATER,
V. A. Alekseev, A. A. Georgiev, and A. O. Kokorin.
Water Resources, Vol. 11, No. 2, p 159-162, March-April, 1984. 2 Fig, 10 Ref. Translated from Vodnye Resursy, No. 2, p 132-135, March-April, 1984.

Descriptors: *Carbon dioxide, *Model studies, *Algal growth, *Photosynthesis, Algae, Temperature effects, Light intensity, Oxygen, Organic matter, Seasonal variation, Hydrogen ion concentration, Eutrophication.

A model was developed which would describe the dynamics of carbon dioxide in a water body and take into account the development of algae. The model was created on the basis of experiments conducted on the ETECOS (experimental ecosystem) device. Profiles of the temperature, light, pH, and concentration of oxygen and suspended organic particles were obtained as a result of the experiments. The conditions of the active photosynthesis of Chlorella during summer heating in the presence of calm weather were examined. The model represents a system of four nonlinear diffusion equations. The flow of carbon dioxide from the atmosphere cannot provide a carbon dioxide concentration sufficient for active bloom of the water body under conditions of summer heating and calm weather. The concentration of live Chlorella particles in the zone of active photosynthesis was about 15 mg dry wt/liter. The initial pH and alkalinity values were respectively 7.0 and 2.7 meq/liter. According to the model calculations, in this case the CO2 content in the zone of active photosynthesis drops to zero in 13 days. Its deficit will begin to strongly limit the photosynthetic process and growth of algae. Measurements of pH values and calculations of the amounts of assimilated carbon dioxide equivalent to them can be used for characterizing the photosynthetic rate. It is considered, however, that this method is less sensitive than the light and dark bottle technique in two modifications, oxygen and radiocarbon. The present model can also be used for evaluating what hydrodynamic conditions are the worst from the viewpoint of the quality of the water and oxygen regime of a water body. (Baker-IVI)
W85-05159

LIMNOLOGICAL STUDIES IN A CROSS-SECTION OF THE MIDDLE REACH OF PARANA RIVER, VI: WATER TEMPERATURE (ESTUDIOS LIMNOLOGICOS EN UNA SECCION TRANSVERSAL DEL TRAMO MEDIO DEL RIO PARANA, VI: TEMPERATURA DEL AGUA),
Instituto Nacional de Limnologia, Santo Tome (Argentina).
E. C. Drago.
Revista de la Asociacion de Ciencias Naturales del Litoral, Vol. 15, No. 1, p 79-92, September, 1984. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Parana River, *Argentina, *Water temperature, Air temperature, Flow discharge, Climate.

This paper deals with water temperatures at a cross-section of the middle reach of the Parana River and its relationships with the air temperature and discharge. During 1976-1981 the water temperature was vertically and transversely homogeneous. The maximum differences detected between surface and near-bottom waters (24 m depth) was 2.5 C. The highest temperatures were 30 C (26 Feb. 81) and 28.5 C (29 Dec. 77), respectively. The minimum temperature in those points was 12.9 C (18 June 79). The mean water temperature for the period was 21.84 C. Both the high water discharge flowing through the studied cross-section and its origin in warm regions influence the water temperature, damping its daily and seasonal fluctuations and minimizing the differences along the middle reach. Air temperature is the main factor responsible for thermal variations in the river temperature. Linear correlations between the mean water temperature in the middle of the channel and the average of daily mean maximum air temperatures during the 30 days previous to sampling data were performed. The best relationships were found with water temperature lagging 15 days behind air temperatures ($r = 0.95$, $p < 0.001$ and $r = 0.94$, $p < 0.001$, respectively). The monthly mean air temperature was also closely related to the mean water temperature ($r = 0.93$, $p < 0.001$). (Author's abstract)
W85-05177

PLANKTON OF TWIN LAKES, COLORADO,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
D. M. Lieberman.

Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-82-21. February 1983. 17 p, 15 Fig, 3 Tab, 16 Ref, 1 Append.

Descriptors: *Phytoplankton, *Zooplankton, *Taxonomy, *Environmental effects, *Powerplants, *Lakes, Limnology, Shrimp, Copepods, Rotifers, Diatoms, Chlorophyta, Chrysophyta, Cyanophyta, Algae, Crustaceans, Aquatic environment, Fauna, Flora, Pumped storage, Systematics, Twin Lakes, Mt. Elbert Pumped-Storage Powerplant, Colorado.

The effects were studied of the Mt. Elbert Pumped-Storage Powerplant on the ecology of Twin Lakes. Twin Lakes are a pair of connected dimictic lakes, formed as the result of glacial action on alluvial deposits. A taxonomic species study is presented of the common plankton collected since 1974 from Twin Lakes. A total of 11 zooplankters and 14 phytoplankters were identified from the limnetic zone of Twin Lakes and the associated Mt. Elbert Forebay. The four divisions of zooplankton included four species of Rotifera, three species of Copepoda, three species of Cladocera, and one species of Mysidacea. The dominant zooplankters were the rotifers and copepods. The nocturnal opossum shrimp, Mysis relicta are abundant in Twin Lakes but were not collected in plankton samples. Cladocerans were rarely collected and made up less than 1 percent of the zooplankton population. The lower lake has a greater density of zooplankton than the upper lake. The four divisions of phytoplankton included three species of Chrysophyta, three species of Chlorophyta, six species of Bacillariophyta (diatom), and two species of Cyanophyta. The phytoplankton was dominated by the yellow-brown algae, Dinobryan, and the diatoms, Asterionella and Synedra. During 1981, average density of phytoplankton reached a maximum of 4870 organisms/liter during September in the upper lake; the average density in the lower lake peaked during March at 18,042 organisms/liter. (See also W80-02049, W81-05743, and W82-06403)
W85-05303

EFFECTS OF OPERATING THE MT. ELBERT PUMPED-STORAGE POWERPLANT ON TWIN LAKES, COLORADO: 1981 REPORT OF FINDINGS,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
J. F. LaBounty, and J. J. Sartoris.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-83-2. December 1982. 88 p, 62 Fig, 24 Tab, 44 Ref, 2 Append.

Descriptors: *Aquatic environments, *Lakes, *Ecological effects, *Powerplants, *Limnology, *Baseline studies, Dissolved oxygen, Nitrogen, Phosphorus, Chlorophyll, Conductivity, Phytoplankton, Zooplankton, Benthos, Hydrogen ion concentration, Twin Lakes, Colorado, Pumped storage, Environmental effects, Fish, Entrainment, Mt. Elbert powerplant.

A series of studies is being performed to identify and quantify changes in the aquatic ecology of Twin Lakes due to the Mt. Elbert Pumped Storage Powerplant operations which began in 1981. Since it is too early to identify any ecological changes, these results along with those from other studies done since 1971 are being used to define the preoperational limnology of Twin Lakes. Maximum water temperature for both lakes recorded in August 1981 was 18 C. The lowest measured dissolved oxygen concentration during 1981 was 1.7 milligrams/liter. The pH ranged between 6.5 and 8.3, and conductivity levels were between 69 and 102 micro S/cm. Total P concentrations ranged from < 1 micrograms/liter to 31 micrograms/liter. Nitrate N concentrations ranged from < 10 to 170 micrograms/liter. Average daily primary productivity rates ranged from a low of 84 milligrams C/sq m/day during March to a high of 126.6 milligrams C/sq m/day during May. Chlorophyll a concentrations ranged from 0.4 milligrams/cu m to 18.8 milligrams/cu m. Average phytoplankton and zooplankton densities reached maximums of just over 18000 organisms/liter (September 1981) and 153 individuals/liter (June 1981), respectively. The benthos includes chironomid larvae, oligochaetes, and fingernail clams. (See also W78-03838, W79-09424, and W81-00844)
W85-05304

REGIONAL SURVEY OF CHEMISTRY OF HEADWATER LAKES AND STREAMS IN NEW ENGLAND: VULNERABILITY TO ACIDIFICATION,
Columbia National Fisheries Research Lab., Orono, ME. Field Research Station.
T. A. Haines, and J. Akielaszek.
Report FWS/OBS-80/40.15; Air Pollution and Acid Rain Report 15, April 1983. 141 p, 44 Fig, 26 Tab, 71 Ref, 2 Append.

Descriptors: *Lakes, *Acidity, *Acidification, *Acid rain, *Alkalinity, Surveys, Model studies, *Hydrogen ion concentration, Chemical properties, Water analysis, Streams, Trace elements, Calcium, Bedrock, Acidic water, New England, Surface water.

A survey was conducted of 226 headwater lakes and low order streams of the six New England states to assess the status of these waters with respect to acidification from air pollution and acid rain. Approximately 59% of the waters surveyed had high calcite saturation indices and were considered susceptible to acidification. Alkalinity was considered the best measure of vulnerability to acidification and bedrock geology was the best physical factor that could be used to predict surface water alkalinity. Both historical water chemistry comparisons and acidification models indicate that the vulnerable lakes have declined in alkalinity and increased in hydrogen ion content, presumably as a result of atmospheric deposition of acid. About 8% of the waters surveyed were acidic (pH less than 5.0), had elevated aluminum concentration (greater than 200 micrograms per liter), or both, conditions that may be toxic to sensitive fish species. (See also W75-01473)
W85-05312

WEAK ACID/BASE SYSTEMS IN DILUTE ACIDIFIED LAKES AND STREAMS OF THE ADIRONDACK REGION OF NEW YORK STATE,
Syracuse Univ., NY. Dept. of Civil Engineering.
C. T. Driscoll, and J. J. Bisogni.
In: Modeling of Total Acid Precipitation Impacts. 1984. p 53-72, 5 Fig, 9 Tab, 28 Ref.

Descriptors: *Acidification, *Acidic water, *Hydrogen ion concentration, *Lakes, *Bases, *Organic acids, *Neutralization, *Model studies, *Organic carbon, Acids, Aluminum, Acid rain, Streams, Hydrologic models, Water quality, Chemical properties, Organic matter, Big Moose Lake, North Lake, Little Moose Lake.

Attempts were made to quantify the weak acid/base chemistry of dilute acidified lake and stream systems in the Adirondack Mountain region of New York State. Samples were collected over an annual cycle at 24 sites from three lakes (Big Moose Lake, North Lake, and Little Moose Lake) and eight tributaries. Analyses of water quality parameters and acid neutralizing capacity (ANC) were performed on samples taken on 15 sampling dates. Adirondack waters had a greater ANC than expected based on equilibrium with atmospheric CO2. The difference between measured ANC and theoretical ANC in equilibrium with atmospheric CO2 might be considered to be the residual ANC consisting of Al or natural organic matter. Natural organic acids were fit to monoprotic proton dissociation constant model and the total, organic C proton dissociation/association sites were observed to be empirically correlated to total organic C concentration. Al levels appear to fit an Al trihydroxide solubility model. Al buffering appears to control the lower limit of pH value observed in Adirondack waters.
W85-05316

COMPARISON OF SEASONAL AND DIURNAL PATTERNS OF SOME PHYSICO-CHEMICAL PARAMETERS OF THE OPEN AND CLOSED PARTS OF LOKTAK LAKE, MANIPUR, INDIA,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
D. K. Banerjee, B. Bhatia, and I. Haq.
International Journal of Environmental Studies, Vol. 21, No. 3/4, p 243-250, October, 1983. 9 Fig, 1 Tab, 25 Ref.

Descriptors: *Loktak Lake, *India, *Physicochemical properties, *Seasonal variation, *Diurnal variation, Dissolved oxygen, Carbon dioxide, Hydrogen ion concentration, Calcium, Water pollution.

Loktak Lake, situated near Imphal, India has a total area of about 69,120 acres of which the closed part occupies about 518 hectares. The closed part of the lake is well protected and not subject to any human intervention except controlled fishing. The open lake is subject to uncontrolled fishing, dumping of human wastes and pollution from its input waters. Water samples were collected from the surface and the bottom between December 1977 and December 1978. In both the open as well as the closed lake the pH displayed a clear seasonal variation, with the highest values in winter and the lowest values during the post monsoon period. The pH values were somewhat lower at the bottom than at the surface during most of the period. In the open lake, dissolved oxygen (DO) displayed high values during winter and low values in the post monsoon period. In the closed lake there was no pattern of seasonal change in the DO. Diurnal patterns were discernible, both in the closed and open lakes. Free carbon dioxide values in the bottom samples from the closed lake were lower in the daytime and higher at night. This pattern was not consistently observed for the surface samples. The pH values were high during the day and low at night. Calcium variations were opposite to those of the pH for bottom samples of closed lake, but not of open lake. The diurnal patterns of the open lake were quite different from those of the closed lake. Deviations from the normal expected diurnal variation pattern of simple physicochemical parameters and of the relationship between these may possibly serve as a useful criterion of the degree of perturbation to which a lake is subjected due to human or natural causes. (Baker-IVI)
W85-05444

GROWTH STUDIES OF AZOLLA PINNATA RBR. IN A PERMANENT POND,
Indian Inst. of Tech., New Delhi. Centre for Rural Development and Appropriate Technology.
For primary bibliographic entry see Field 5D.
W85-05447

ENHANCED LONGITUDINAL MIXING IN A LAKE CAUSED BY INFLOW-INDUCED CIRCULATION,
Connecticut Agricultural Experiment Station, New Haven. Dept. of Ecology and Climatology.
F. J. Ferrandino, and D. E. Aylor.
Water Resources Research, Vol. 21, No. 2, p 221-228, February, 1985. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Lake Lillinonah, *Connecticut, *Mixing, *Water circulation, Destratification, Seasonal variation, Lakes, Alkalinity, Tracers, Inflow, Entrainment, Countercurrent flow.

The course of mixing during the summer between the two basins of Lake Lillinonah (Connecticut) was observed using alkalinity as a natural tracer of water movements. The net alkalinity flux from the large to the small basin was shown to be related to the rate of buoyant energy input delivered to the small basin by the inflowing river. A portion of this power goes into the creation of a longitudinal circulation via the process of entrainment. The cold inflow plunges and follows the bottom of the reservoir entraining ambient water into the underflow. The entrained water is replaced by a shallow return flow. The observed interbasin alkalinity flux can be accounted for if the incoming waters entrain an equal volume of ambient water as it enters the reservoir. The order of magnitude of the associated countercurrent flow is consistent with direct

observation of water movement. Some of the buoyant energy delivered by the inflowing river is stored in the potential energy of thermal stratification: isopycnals are tilted upward toward the inflow. During early summer as the inflow decreases rapidly, this stored energy is released, setting up transient flows which temporarily enhance the interbasin exchange of water. A three-layer model, incorporating the above two inflow-induced mixing processes, accounts for 90% of the mixing observed over the course of a summer. (Baker-IVI)
W85-05501

PRIMARY AND BACTERIAL PRODUCTION IN TWO DIMICTIC INDIANA LAKES,
Georgia Univ., Athens. Dept. of Biochemistry.
C. R. Lovell, and A. Konopka.
Applied and Environmental Microbiology, Vol. 49, No.3, p 485-491, March, 1985. 7 Fig, 3 Tab, 23 Ref. NSF grant DEB-8201857 and OWRT grant B-127:IND.

Descriptors: *Indiana, *Crooked Lake, *Little Crooked Lake, *Bacteria, *Primary productivity, Seasonal variation, Vertical distribution, Lakes, Rainfall, Thymidine, Dimictic lakes.

The relationship between bacterial production and primary production was studied in two dimictic lakes that have significant levels of metalimnetic primary production. The study was conducted on Crooked and Little Crooked Lakes in Noble County, Indiana. Bacterial production was related to primary production with respect to both vertical and seasonal distribution in the water columns of both lakes. A lag of about 2 weeks between a burst in primary production and the subsequent response in bacterial production was noted. The vertical distribution of bacterial production in the water column of the less productive lake, Crooked Lake, was determined by the vertical distribution of primary production, but no clear relationship between seasonal maxima of primary and bacterial production in this lake was noted. High rates of bacterial production in Crooked Lake during May indicate the importance of allochthonous carbon washed in by spring rains. Bacterial production accounted for 30.6 and 31.8% of total production in Crooked Lake and Little Crooked Lake, respectively from April through October. High rates of bacterial production during late September and October were observed in both lakes. Calculation of the fraction of bacterial production supported by phytoplankton excretion implies an important role for other mechanisms of supplying carbon, such as phytoplankton autolysis. Several factors affecting the calculation of bacterial production from the thymidine incorporation rates in these lakes were examined. (Baker-IVI)
W85-05507

SEASONAL BACTERIAL PRODUCTION IN A DIMICTIC LAKE AS MEASURED BY INCREASES IN CELL NUMBERS AND THYMIDINE INCORPORATION,
Georgia Univ., Athens. Dept. of Biochemistry.
C. R. Lovell, and A. Konopka.
Applied and Environmental Microbiology, Vol. 49, No. 1, p 492-500, March, 1985. 6 Fig, 5 Tab, 28 Ref. NSF grant DEB-8201857 and OWRT grant B-127:IND.

Descriptors: *Bacteria, *Primary productivity, *Seasonal variation, *Little Crooked Lake, *Indiana, Eutrophic lakes, Vertical distribution, Dimictic lakes, Isotopic tracers, Thymidine.

The rates of incorporation of C-14 labeled HCO3(-) and H-3 labeled methyl thymidine were used to determine rates of primary and bacterial production, respectively in Little Crooked Lake, Indiana. Growth rates of bacteria in diluted natural samples were determined for epilimnetic and metalimnetic bacterial populations during the summers of 1982 and 1983. Exponential growth was observed in these diluted samples, with increases in cell numbers of 30 to 250%. No lag was noted in bacterial growth in 14 of 16 experiments. Doubling times of natural bacteria calculated from thymidine incorporation rates and in situ cell numbers ranged from 0.35 to 12.00 days (median, 1.50 days). Bacterial production amounted to 66.7 g C/sq m from April through September, accounting for 29.4% of total production during this period. The vertical and seasonal distribution of bacterial production in Little Crooked Lake was strongly influenced by the distribution of primary production. From April through September 1983, the depth of maximum bacterial production rates in the water column was related to the depth of high rates of primary production. On a seasonal basis, primary production increased steadily from May through September, and bacterial production increased from May through August and then decreased in September. (Baker-IVI)
W85-05508

THYMIDINE INCORPORATION BY FREE-LIVING AND PARTICLE-BOUND BACTERIA IN A EUTROPHIC DIMICTIC LAKE,
Georgia Univ., Athens. Dept. of Biochemistry.
C. R. Lovell, and A. Konopka.
Applied and Environmental Microbiology, Vol. 49, No. 3, p 501-504, March, 1985. 3 Tab, 26 Ref. NSF grant DEB-8201857 and OWRT grant B-127:IND.

Descriptors: *Bacteria, *Cyanophyta, *Little Crooked Lake, *Indiana, Thermal stratification, Primary productivity, Eutrophic lakes, Dimictic lakes, Thymidine.

In Little Crooked Lake (Indiana), filamentous cyanobacteria are present as the dominant phytoplankton type throughout the period of thermal stratification. The percentage of H-3 labeled methyl thymidine incorporated into samples from this dimictic eutrophic lake and retained on polycarbonate membranes of 3.0-, 1.0-, and 0.2 micro-m pore size was studied. Overall, particle-bound production accounted for only 2 to 19% of total bacterial production from April to August in all water layers. It appears that the supply of colonizable particles (damaged cyanobacterial filaments) is an important factor affecting the level of particle-bound bacterial activity in this lake. (Baker-IVI)
W85-05509

ANNUAL CYCLE OF BACTERIAL SECONDARY PRODUCTION IN FIVE AQUATIC HABITATS OF THE OKEFENOKEE SWAMP ECOSYSTEM,
Georgia Univ., Athens. Inst. of Ecology.
R. E. Murray, and R. E. Hodson.
Applied and Environmental Microbiology, Vol. 49, No. 3, p 650-655, March, 1985. 3 Fig, 2 Tab, 34 Ref. BSR grants 8215587 and 8114823.

Descriptors: *Bacteria, *Okefenokee Swamp, *Aquatic habitats, *Productivity, Secondary production, Annual cycle, Seasonal variation, Organic carbon, Particulate matter, Dissolved solids.

Rates of bacterial secondary product from five aquatic habitats (four prairies and one open-water lake) in the Okefenokee Swamp are reported. While it is not possible to measure bacterial uptake of each individual potential substate, bacterial secondary production by free-living bacteria is a conservative estimate of the rate of turnover of the available dissolved organic carbon pool. An understanding of the seasonal dynamics of bacterial production thus provides information concerning both the seasonal availability of high-quality particulate organic carbon (the bacterial biomass itself) and the seasonal fate of dissolved organic carbon (DOC) released by primary producers. Bacterial secondary production was found to be seasonally high, varying by up to 98-fold over the year, and paralleling the annual cycle of macrophyte growth and decomposition. The high rates of bacterial secondary production suggest that the transformation of DOC into high quality bacterial biomass is an important process in the flow of energy from primary producers to other trophic levels. (Baker-IVI)
W85-05512

TEMPERATURE AND LIGHT EFFECTS ON THE GROWTH OF POTAMOGETON CRISPUS IN COLLINS LAKE, NEW YORK STATE,
Union Coll., Schenectady, NY. Dept. of Biology.
For primary bibliographic entry see Field 4A.
W85-05523

MODEL USE AND VERIFICATION OF ECOLOGICAL PARAMETERS FOR AN OLIGOTROPHIC LAKE (LAKE STECHLIN, G.D.R.),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
R. Koschel, and P. Kasprzak.
Ecological Modelling, Vol. 26, No. 1/2, p 97-101, December, 1984. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Oligotrophic lakes, *Model studies, *Ecology, *Lake Stechlin, *Germany (Democratic Republic), Lakes, Plankton, Biomass, Algal growth, Zooplankton, Phytoplankton, Productivity, Simulation.

The applicability of an ecological model (SALMO) was tested for the oligotrophic Lake Stechlin. For the simulation of production processes of Lake Stechlin the model was slightly modified by the inclusion of water inflow and outflow. Comparison of the computed and observed parameters for 1974 and 1975 indicated that better consideration of biological and space inhomogeneities of the water body and deeper causal analysis of plankton growth and loss factors are wanted. The pytoplankton values show a better agreement in 1975 than in 1974. In 1975 the input of the nuclear power plant's cooling water was low. The simulated and measured seasonal periodicity and values of zooplankton biomass show considerable discrepancies. Several conclusions regarding the use of the model are noted including improved consideration and registration of biological and space inhomogeneities of the water body; deeper causal analysis of factors controlling zooplankton and phytoplankton growth; and better specification and investigation of ecological loss-factors for zooplankton and phytoplankton. (Baker-IVI)
W85-05602

TESTING OF A COMPLEX ECOLOGICAL MODEL FOR SHALLOW WATER BODIES,
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
H.-P. Kozerski, G. Schellenberger, H. Behrendt, and V. Mohaupt.
Ecological Modelling, Vol. 276, No. 1/2, p 103-113, December, 1984. 7 Fig, 12 Ref.

Descriptors: *Model studies, *Shallow water, *Lake Muggelsee, *Germany (Democratic Republic), Eutrophic lakes, Phosphorus, Nitrogen, Phytoplankton, Algae, Diatoms, Bacteria, Zoobenthos, Organic matter, Sedimentation.

A 15 component model has been developed and tested in three steps, which run from tests of the submodels to tests of the complete model on new independent data from the Lake Muggelsee (German Democratic Republic). The model has been used for a network of five interrelated lakes of the Spree-Dahme river system southeast of Berlin. The retention times range from some days to one and a half months. The aim of the ecosystem model is to improve understanding and to predict the changes in water quality of the lake. The components phytobenthos, zoobenthos, zooplankton and fish seem to be of relatively small importance for water quality in this eutrophic lake and were thus neglected. From the tests performed it is demonstrated that the model is able to give a good description and prediction of the general dynamics of algae and nutrients sufficient for purposes of water management. The main areas where additional work is needed are the better determination of ecophysiological coefficients of algae, the effects of light and temperature on phytoplankton, and hydrodynamic problems. (Baker-IVI)
W85-05603

FIELD STUDIES ON THE BREAKDOWN OF NUPHAR LUTEA (L.) SM. (NYMPHAEACEAE), AND A COMPARISON OF THREE MATHEMATICAL MODELS FOR ORGANIC WEIGHT LOSS,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
T. C. M. Brock, M. J. H. de Lyon, E. M. J. M. Van Laar, and E. M. M. Van Loon.
Aquatic Botany, Vol. 21, No. 1, p 1-22, January, 1985. 5 Fig, 4 Tab, 47 Ref.

Descriptors: *Aquatic plants, *Decomposition, *Waterlily, Macrophytes, Nitrogen, Phosphorus, Potassium, Detritus, Nutrients.

Aspects of the decomposition of the aquatic macrophyte Nuphar lutea were studied using the litter bag method in the field. The organic weight loss during breakdown was described by means of 1 simple and 2 composite exponential models. The nitrogen, phosphorus and potassium concentration of the remaining detritus were analyzed. It appeared that the in situ breakdown of the Nuphar detritus was described beter by the composite exponential models than by the simple exponential model. In most cases the 2-component model showed a slightly better description than the decaying coefficient model. Some plant parts of Nuphar lutea showed significant differences in breakdown rate. The roots and root stocks of Nuphar lutea both have a longer life span and a slower breakdown than other parts. The slower breakdown of roots and root-stocks can be explained in part by their low initial nitrogen levels. The disappearance of the decomposing Nuphar lutea leaves from the litter bags is influenced by seasonal factors. The breakdown of the coarse detritus was significantly faster in summer than in autumn. The patterns of nitrogen, phosphorus and potassium dynamics of the decomposing Nuphar material were dependent on the type of plant part, the season and the system. In all parts of this study the Nuphar detritus showed at least a temporary increase in nitrogen concentration. While it is evident that in the field numerous factors influence the decay and nutrient dynamics of macrophyte detritus, some factors will be more important than others. (Baker-IVI)
W85-05606

BREAKDOWN OF MACROPHYTES IN A RESERVOIR WETLAND,
Texas Univ. at Dallas, Richardson. Inst. for Environmental Sciences.
B. H. Hill.
Aquatic Botany, Vol. 21, No. 1, p 23-31, January, 1985. 2 Fig, 3 Tab, 30 Ref.

Descriptors: *Aquatic plants, *Decomposition, *Wetlands, Texas, Reservoirs, Macrophytes, Invertebrates, Flooding, Cattails.

The rate of aquatic plant decay in a freshwater wetland adjacent to a Texas reservoir was determined. The effects of inundation and exposure on macrophyte decay and the colonization of decaying macrophytes by aquatic macroinvertebrates were also studied. The wetland experienced periods of exposure and inundation because of annual variations in stream flow and evaporation. Exposure of the wetland community in this ecosystem occurred in the autumn about the time of macrophyte senescence. Inundation of the exposed wetland occurred by late autumn. Weight losses from leaf laminae and petioles of Nelumbo lutea, and from leaves of Ludwigia leptocarpa and Typha angustifolia were measured by exposing leaf material in mesh bags. The Nelumbo leaf laminae decayed faster than all other litter types while Nelumbo leaf petioles decayed the slowest. The relative breakdown rates were: Nelumbo leaf laminae > Ludwigia > Typha > Nelumbo leaf petioles. Macro invertebrate colonization of litter bags was initially low, then increased rapidly by the 15th day of exposure. Numbers of macroinvertebrates declined sharply following the peak for all litter types except Nelumbo leaves, perhaps reflecting the higher palatability and food quality of the Nelumbo leaves. Macroinvertebrate numbers on the Nelumbo leaves litter packs remained high through the first 65 days of the study, then declined rapidly. The functional feeding group composition of the macro-invertebrate aggregation colonizing leaf bags was similar for all types of plant litter and did not change throughout the study. (Baker-IVI)
W85-05607

PREDICTIONS OF VEGETATION CHANGE FOLLOWING FIRE IN A GREAT SALT LAKE MARSH,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
L. M. Smith, and J. A. Kadlec.
Aquatic Botany, Vol. 21, No. 1, p 43-51, January, 1985. 4 Tab, 21 Ref.

Descriptors: *Salt marshes, *Revegetation, *Fire, *Great Salt Lake, *Utah, *Succession, *Species composition, Model studies, Gleasonian models, Marshes, Plant growth, Shade, Light intensity.

A Gleasonian model of succession was used to predict the species composition of a freshwater marsh following fire. Seed bank samples from 5 vegetation types were used in conjunction with plant life history characteristics to make predictions of post-fire species composition for each vegetation type and the entire study area. Vegetation regrowth was rapid in Typha spp, Scirpus lacustris and S. maritimus sites, but very limited in Distichlis sites and therefore, shade tolerance was an important factor in predictions. Model predictions of marsh plant species composition following the fire were not good for the specific vegetation types of Scirpus lacustris, S. maritimus, Distichlis spicata and open water. Much of the lack of agreement between predictions and field data may have been due to shade classifications. Shade may directly reflect substrate temperature. There was good agreement between prediction and actual species occurrence for Typha spp. vegetation and for the total study area. (Baker-IVI)
W85-05608

EFFECTS OF NITRATE, PHOSPHATE AND POTASSIUM FERTILIZATION ON GROWTH AND NUTRIENT UPTAKE PATTERNS OF PHRAGMITES AUSTRALIS (CAV.) TRIN. EX STEUDEL,
Michigan State Univ., East Lansing. Dept. of Zoology.
K. E. Ulrich, and T. M. Burton.
Aquatic Botany, Vol. 21, No. 1, p 53-62, January, 1985. 8 Fig, 1 Tab, 10 Ref. OWRT grant B-055-MICH.

Descriptors: *Plant growth, *Nitrates, *Phosphates, *Potassium, *Reeds, Nutrients, Fertilizers, Plants, Aquatic plants.

Emergent aquatic plants have great potential for nutrient uptake from sewage-enriched substrates and for biomass production. Phragmites australis, a herbaceous perennial emergent aquatic plant, is an excellent species for culture because of its high capacity for biomass production. The effects of independently varied additions of nitrate, phosphate and potassium upon the growth and nutrient uptake patterns of P. australis were examined. P. australis shoot growth and root plus rhizome growth were heavily influenced by nitrate and phosphate treatments and their interactions. Potassium fertilization had no effect on plant growth or nutrient uptake. Distribution of plant net primary production between above-ground and below-ground tissues was most heavily influenced by the nitrate supply. Use of high nitrate levels may more than double the proportion of above-ground as compared to below-ground tissues. Shoot production was maximized by the highest treatment level of nitrate coupled with the two highest treatment levels of phosphate (3.88 and 7.81 g/sq m). Production levels of large-scale plantings of P. australis might be lower than that found for isolated tubs because of the likelihood of increased self-shading and competition for carbon dioxide. (Baker-IVI)
W85-05609

STUDIES ON THE BOTTOM SEDIMENTS AND EPIPELIC ALGAE OF THE RIVER ELY, SOUTH WALES, U.K.,
University Coll., Cardiff (Wales). Dept. of Plant Science.
For primary bibliographic entry see Field 5C.
W85-05611

AMMONIFICATION AS AFFECTED BY THE OXYGEN LEVEL OF WATER,
Kalyani Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W85-05615

RELATIONSHIPS BETWEEN PHOSPHORUS LOADING AND TROPHIC STATE IN CALCAREOUS LAKES OF SOUTHEAST WISCONSIN,
Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 5C.
W85-05620

CHANGES IN CLADOCERA COMMUNITY STRUCTURE AND FOSSIL PIGMENT STRATIGRAPHY AS COMPARED TO THE FIRE HISTORY OF ELK LAKE, CLEARWATER CO., MN, U.S.A.,
Indiana Univ. at Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W85-05624

VARVE-DATED EUTROPHICATION HISTORY OF A SMALL LAKE,
Joensuu Univ. (Finland). Karelian Inst.
For primary bibliographic entry see Field 5C.
W85-05628

PHOSPHORUS RELEASE FROM THE SEDIMENTS OF FLAMING GORGE RESERVOIR, WYOMING, U.S.A.,
Utah Water Research Lab., Logan.
J. J. Messer, J. M. Ihnat, and D. L. Wegner
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1457-1464, December, 1984. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Sediments, *Phosphorus, *Flaming Gorge Reservoir, *Wyoming, Reservoirs, Eutrophication, Iron, Lake restoration, Chlorophyta, Anoxic conditions.

Flaming Gorge Reservoir is a mainstem reservoir on the Colorado River in semi-arid southern Wyoming, having a maximum capacity of 5 x 10 to the 9th power cu m and a length of 145 km. Following complete filling of the reservoir in 1973 extensive blooms of blue-green algae have occurred in both of the upper arms of the reservoir whose hypolimnia become anoxic during 1-3 months in the late summer. Sediments in the two upper arms are characterized by highly different phosphorus chemistry. The Blacks Fork arm is low in Fe and non-apatite inorganic P, while the Green River arm is high in both of these species. Apatite-P values are high and similar in both arms. P release rates determined in laboratory simulations using intact cores ranged from 0.10 to 11.1 mg P/sq m/day, and were significantly higher under anaerobic conditions. Anaerobic release rates were highly correlated with NaOH-extractable P concentrations. Effects of the extraction procedure on the apparent NaOH-P concentration were highly apparent, but the correlation between P release and sediment P concentration remained strong for all extraction techniques. The particular technique used may have potential for predicting the necessity for sediment P immobilization in lake restoration programs. (Baker-IVI)
W85-05630

PATTERNS OF PHYTOPLANKTON POPULATIONS AND THEIR RELATIONSHIP TO TROPHIC STATE IN AN ELONGATE RESERVOIR,
Baylor Univ., Waco, TX. Dept. of Biology.
O. T. Lind
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1465-1469, December, 1984. Fig, 2 Tab, 5 Ref

criptors: *Reservoirs, *Belton Reservoir, xas, *Trophic levels, *Eutrophication, *Phyto- kton, Population dynamics, Limnology, Nutri- Transparency, Chlorophyll.

nany reservoirs the trophic state gradient is cult to detect by the use of trophic state indices ch are based on light extinction by the phyto- kton populations because of intense inorganic suspensions. Belton Reservoir in central Texas n exception. This elongate and sinuous reser- receives little inorganic silt and in its trophic relations functions as a typical lake. Thus it is d to the study of linear gradients of nutrient centrations, trophic states, transparency, and to possible establishment of discrete values of c variables. The spatial heterogeneity among oplankton populations at five locations along trophic state gradient were examined by use of nilarity index. A doubling in the concentration hytoplankton produced an increase in the hic state index of ten, from 40 to 50. The hic state indices calculated for Belton Reser- by both Secchi disk and chlorophyll each eased along the gradient from headwaters to . Phytoplankton population during summer autumn were approximately four times less the dam than in the headwaters. Phytoplank- populations were very heterogeneous. Recog- bly different populations were present along long axis with its strong gradient of trophic s. Because of their elongate configuration, res- irs will probably have greater heterogeneity lakes of similar area. Belton Reservoir has a ing rate of about once per year, and therefore be typical of conditions necessary to promote gh amount of heterogeneity. (Baker-IVI)
5-05631

F LITTER PROCESSING IN A VIRGINIA ERVOIR: THE ROLE OF TEMPERATURE D FISH,
ginia Polytechnic Inst. and State Univ., Blacks- g. Dept. of Biology.
C. Hendricks, G. Simmons, Jr., and F. Taylor.
handlung Internationale Vereinigung Limnolo- Vol. 22, No. 3, p 1482-1485, December, 1984. 2 2 Tab, 7 Ref.

criptors: *Leaves, *Litter, *Reservoirs, *Vir- a, Temperature effects, Fish, Invertebrates, roorganisms.

re appear to be a number of ways in which a can become fragmented. An experimental leaf cessing study was performed in a reservoir and le for larger vertebrates in the processing of es is suggested. Maple leaves were exposed for ods of one, two and three months in enclosed open units with or without fish. Significant erences between processing rates were found at end of the first 91 day period, at the end of 63 , and at the end of the second 91 day period. se data suggest that larger organisms, probably fish, were playing a role in processing the es in the open trays as they did not have access he leaves in the enclosures. Microorganisms ed a critical role during the first month of cessing and their activities were tied closely to temperature of the water. The invertebrate dders probably contributed to the leaf process- in the spring and early summer. Fish seemed to an important role in leaf processing particular- n the advanced stages of processing. (Baker-
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5-05632

FECTS OF URBAN STORMWATER NOFF ON RESERVOIR PHYTOPLANK- N,
rge Mason Univ., Fairfax, VA. Dept. of Biol- .
primary bibliographic entry see Field 5C.
5-05633

IMARY PRODUCTION AND ITS FATE IN E STORAGE BASIN OF MERY-SUR-OISE,
le Normale Superieure, Paris (France). Lab. de logie.
Dessery, C. Lancelot, and G. Billen.
Verhandlung Internationale Vereinigung Limnologie Vol. 22, No. 3, p 1504-1509, December, 1984. 2 Fig, 3 Tab, 3 Ref.

Descriptors: *River Oise, *Mery-sur-Oise Basin, *France, *Primary productivity, *Zooplankton, *Bacterioplankton, Sedimentation, Carbon, Carbon cycle.

The basin of Mery-sur-Oise is an artificial basin, fed by the river Oise and used as a storage reservoir for a drinking water plant. Its volume is about 400,000 cu m, with an average depth of 9 m. Water from the Oise is injected with high energy, preventing any stratification of the water column. The mean residence time of the water is about 4 days. The river Oise at Mery is about 75 m wide and 5 m deep. Its mean annual discharge is about 150 cu m/sec, but values of 50 cu m/sec for summer are typical. A comparison between these two ecosystems offers a unique opportunity to study the effects of some physical and morphological factors on the biological function of aquatic systems. Primary production, zooplankton grazing, bacterioplankton activity and sedimentation were measured during the year 1982 in the river Oise and in the basin of Mery-sur-Oise. A carbon budget was established for the summer period in both environments. In the basin dissolved primary production remains at about 5% of particulate production. The inputs of allochthonous organic material largely dominate the autochthonous primary production. In the summer, zooplankton, including cladocerans, copepods and rotifers, ingest daily about 10% of the phytoplankton biomass. This represents about 1 g C/sq m/day, or about 17% of the total flux of imported and produced phytoplankton. Budget calculations show that 47% of the latter flux is exported with the outflow, while 26% is deposited on the bottom and 8% is lysed and degraded by planktonic bacteria, which appear to utilize mostly allochthonous dissolved organic carbon. The morphological differences between the river and the basin induce no important differences either in primary production or in the part of autochthonous primary production in the total supply of organic matter; allow the development in the basin of a more abundant zooplankton community, which consumes a significant part of the total supply of phytoplanktonic material; induce an important sedimentation of particulate material, including phytoplankton; and reduce the bacterial activity in the water column. (Baker-IVI)
W85-05634

CHANGES IN THE QUALITY OF RIVER OISE WATER DURING RETENTION IN THE STORAGE BASIN AT MERY (FRANCE) (EVOLUTION DE LA QUALITE DE LA RIVIERE OISE LORS DE SA RETENTION DANS LE BASSIN DE 'STORAGE' DE MERY (FRANCE)),
Universite Libre de Bruxelles (Belgium). Lab. d'Oceanographie.
G. Billen, C. Cavelier, S. Dessery, C. Lancelot, and M. Meybeck.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, P 1510-1515, December, 1984. 8 Fig, 1 Tab, 6 Ref.

Descriptors: *Storage reservoirs, *Water quality, *Oise, *France, Retention time, Water supply, Destratification, Suspended solids, Sedimentation, Flow discharge.

The storage basin of Mery-sur-Oise provides Oise water to a water treatment works which serves 500,000 inhabitants. The basin retains the water for a period of 4 days. The volume is 400,000 cu m, the maximum depth is 9 m and the surface area is 4.5 ha. The function of the reservoir is three-fold: smoothing out the short term variations in the quality of the water from the Oise; providing a reserve of 2 to 3 days water in case of pollution of the river, and amelioration of the quality of the water before treatment. Because of its very short residence time and the daily destratification caused by its exploitation, the reservoir of Mery-sur-Oise is affected mainly by the materials in suspension in the water. The reservoir acts as an arm of the Oise with a very slow flow and which is fed with water daily. The strength of the sedimentation and the internal development of sediments confirms the lacustrine character in the absence of stratification, and the importance of the allochthonous material for the organic carbon budget is another fluviatile characteristic. The reservoir has not attained equilibrium after three years of operation. (Moore-IVI)
W85-05635

DEPENDENCE OF PHYTOPLANKTON ON ZOOPLANKTON IN A MAN-MADE LAKE,
Politechnika Slaska, Gliwice (Poland).
B. Grzybowska, and B. Wodzinska.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1517-1520, December, 1984. 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Reservoirs, *Phytoplankton, *Zooplankton, Primary productivity, Eutrophication, Seasonal variation, Poland.

Phytoplankton and zooplankton were studied in a man-made lake polluted with municipal and industrial wastewaters and warm water from a steam power plant near Rybnik, Poland. This reservoir was filled in 1973. Microplankton measured during the four years produced blooms in February and March consisting of Asterionella formosa, sometimes with Fragilaria crotonensis. Autumn blooms appeared only twice. The nannoplankton during the whole year consisted of species of Cryptomonas, Trachelomonas, Scenedesmus, other Chlorococcales, Anabaena and other small algae in various proportions. A mass appearance was never found of any one algal species. The percentage of nannoplankton in the total phytoplankton was high except during the periods of microplankton blooms. The microplankton did not appear to be a food for filter-feeding zooplankton. The nannoplankton biomass fluctuated during the year within the range 0.1-1.3 mg/l. Large quantities of small algae appeared during the absence of filter feeding zooplankton. Increase of zooplankton may be correlated with decrease of the consumed nannoplankton. After the disappearance of the zooplankton, the nannoplankton again became important. A low stable value of nannoplankton biomass during the whole year is characteristic. This suggests a comparison to the uniform grazing of a meadow by a herd adapted quantitatively to the area of the meadow, where a fertility is expressed as an increment in herd size. (Baker-IVI)
W85-05636

APPLICABILITY OF THE OECD EUTROPHICATION MODELS TO SPANISH RESERVOIRS,
Centro de Estudios Hidrograficos, Madrid (Spain).
J. L. O. Casas, and R. P. Martinez.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1521-1535, December, 1984. 7 Fig, 3 Tab, 7 Ref.

Descriptors: *Reservoirs, *Eutrophication, *Model studies, *Spain, Nutrients, Phosphorus, Chlorophyll, Mathematical equations.

Seventeen reservoirs in Spain were monitored for a maximum period of three years, both within the receiving waterbodies and at the major tributaries. The normalized P loading term provides a fairly good approximation in a large number of Spanish reservoirs providing a significant statistical correlation coefficient. The empirical relationship between average summer chlorophyll concentration and average annual lake P concentration, either measured or deduced from the normalized P load does not allow for a satisfactory fit by means of a potential function. The regression equations resulting from the OECD waterbodies are substantially different from those obtained from the Spanish reservoirs. There appears to be a fairly good correlation between mean summer Secchi disc depth and the flushing corrected inflow P loading. A similar good correlation is provided by mean summer Secchi depth and mean annual in lake P concentration. The relationships obtained are close to those found for the OECD waterbodies, particularly to the equations found for the Shallow Lakes and Reservoir Group. The hypolimnetic oxygen depletion rate does not appear to show any relationship with annual total P loading in spite of

taking into account the water balance within the hypolimnion. This may be due to errors of calculation because of scarcity of data, and potentially strong chemical oxygen demand by sediments in some of the reservoirs. Those reservoirs undertaking a drastic increase of hydraulic residence time because of severely dry periods do not fit well the above relationships during such periods. (Baker-IVI)
W85-05637

PHOSPHORUS COMPOUNDS IN THE SEDIMENT OF THE SAU RESERVOIR (BARCELONA, NE SPAIN) THROUGHOUT ITS TWENTY-YEAR EXISTENCE,
Barcelona Univ. (Spain). Dept. de Ecologia.
J. Armengol, M. Crespo, and J. A. Morgui.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1536-1540, December, 1984. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Reservoirs, *Sau Reservoir, *Ter River, *Spain, *Phosphorus, Diagenesis, Erosion, Sedimentation, Organic compounds, Apatite, Rainfall.

The reservoir of Sau, located on the Ter River, was filled for the first time in the autumn of 1963. It has been studied limnologically on a monthly basis since 1963. The concentration of the three groups of P compounds (organic, apatite and inorganic non-apatite) was determined at the different levels of the sediment in the reservoir and their relationship with the different stages in the evolution of the reservoir was investigated. The mean concentration of the whole column is 35.02 micro-g at P of sediment. This represents an abundance by weight of 1.08% with oscillations from 1.47% to 0.68%. The sediments are of recent deposition. The non-apatite is the largest fraction, 35.37%, suggesting that the process of diagenesis has not been very important. Apatite is the P compound next in abundance at 32.12%. Finally, organic P is found in the smallest concentration, 14.5% and at the same time has the largest coefficient of variation, 38.29%, and a tendency to decrease as one goes deeper from the surface of the sediment. Apatite may come from erosion and not from diagenesis. Accepting this relationship between the apatite maxima and the periods of greater water flow in the Ter basin, the sedimentation rate can be estimated as having fluctuated between 3-4.5 cm in years of heavy rainfall and less than 1.5 cm in dry years. (Baker-IVI)
W85-05638

COMPOSITION AND DYNAMICS OF PHYTOPLANKTON IN THE CUBER RESERVOIR, SPAIN,
Palma de Mallorca Univ. (Spain). Facultad de Ciencias.
G. Moya, and G. Ramon.
Verhandlung Internationale Vereinigung Limnologie Vol. 22, No. 3, p 1541-1545, December, 1984. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Phytoplankton, *Population dynamics, *Reservoirs, *Cuber Reservoir, *Spain, Biological succession, Algae, Nutrients, Mixing, Chlorophyll a, Species composition.

Phytoplankton composition, dynamics and physiological characteristics were measured in the Cuber Reservoir. Observations suggest three principal periods in the phytoplankton succession. The first period of the succession comprises the phases I and II. The I group is distinguished by the presence of persistent species Cryptomonas spp. and Rhodomonas spp. as well as many Chrysophyceae and Oscillatoria rubescens. This phase represents the initial phase of the succession with the water completely mixed and an important amount of nutrients in the surface layers. The second period corresponds to the group III and is represented by the abundance of Chrysophyceae, the presence of the Dinophyceae Ceratium hirundinella, the persistence of different populations of Cryptophyceae and the accumulation of Oscillatoria rubescens at the depth. The third period of the succession returns everything to the initial conditions. The pattern of succession proposed for the Cuber reservoir is similar to that proposed for freshwater ecosystems. In spring they have all the characteristics of eutrophic lakes, with green and blue green algae, very high phytoplankton density and much chlorophyll a. Later, the reservoir shows a decrease in the number of cells and chlorophyll a, and the specific diversity increases: typical features of an oligotrophic lake. (Baker-IVI)
W85-05639

SEASONAL VARIATIONS IN THE VERTICAL DISTRIBUTION OF OSCILLATORIA RUBESCENS D.C. IN THE GORG BLAU RESERVOIR, SPAIN,
Palma de Mallorca Univ. (Spain). Facultad de Ciencias.
G. Ramon, and G. Moya.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1546-1549. December, 1984. 3 Fig, 15 Ref.

Descriptors: *Vertical distribution, *Seasonal variation, *Gorg Blau Reservoir, *Spain, *Plankton, Primary production, Population dynamics, Nitrates, Thermal stratification, Solar radiation.

Studies of the phytoplankton population density and dynamics in the Gorg Blau Reservoir show the predominance of Oscillatoria rubescens and the relationship of its seasonal variation with environmental factors. During autumn, winter and early spring the density of the Oscillatoria rubescens population increases and no differences in density through the water column can be detected. This period belongs to the interval of vertical mixing with comparable temperatures for the whole water column and a lessened underwater light intensity. During the second period the Oscillatoria rubescens population stratifies and decreases in the surface layers. This period belongs to the interval of thermal stratification in the reservoir which sees the development of an unstable thermocline at about 10-12 m and great underwater light intensity. These seasonal variations are due to the influence of light and the adaptation of the species to low illuminance conditions. Concentration of nitrate is the main determinant of growth and density of the population. (Baker-IVI)
W85-05640

LIMNOLOGY OF SUVIANA-BRASIMONE MAN-MADE LAKES: INFLUENCE OF PUMPED STORAGE OPERATIONS ON PHYSICAL, CHEMICAL AND BIOLOGICAL CHARACTERISTICS,
Bologna Univ. (Italy). Ist. di Zoologia.
For primary bibliographic entry see Field 6G.
W85-05641

OBSERVATIONS ON PHOSPHORUS DYNAMICS AND ORTHOPHOSPHATE TURNOVER IN A TROPICAL LAKE - PARAKRAMA SAMUDRA, SRI LANKA,
Vienna Univ. (Austria). Limnologische Lehrkanzel.
A. Gunatilaka.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1567-1571, December, 1984. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Limnology, *Reservoirs, *Parakrama Samudra Reservoir, *Sri Lanka, Nutrients, Temperature, Phosphates, Nitrogen, Diurnal variations, Cycling nutrients.

Parakrama Samudra in Sri Lanka is one of the larger reservoirs of an ancient irrigation system. The reservoir is located in the north central province at Polonnaruwa within the dry zone. The seasonal hydrological regime reflects the monsoonal cycle and the irrigation demands for rice cultivation in the area. The diurnal P dynamic patterns observed were very similar to the ones recorded during the high water situation in the early post-monsoonal period, but the diel changes were more distinct during the dry period. The soluble reactive P (SRP) concentration in the water column slightly increased with the increase of light intensity, but recorded a drop during the mid-day. In the late afternoon, the SRP level in the whole water column registered a slight increase The peak values ranging from 17-26 micro g/ were observed at midnight. The soluble P (SP level fluctuated between 10-38 micro-g/l. During the day SP indicated a gradual decrease in th water column and a minimum was recorded during the period of maximum SRP demand. The highes concentrations were noted during midnight. Phos phatase activity showed pronounced diel changes Much of the dissolved P in lake water is colloidally bound and thus not readily available to the plank ton. (Baker-IVI)
W85-05642

LIMNOLOGICAL ASPECTS OF PLANKTON VARIATION AND WATER CHARACTERISTICS OF A TROPICAL WEST AFRICAN RESERVOIR,
Jos Univ. (Nigeria). Dept. of Botany.
M. A. Khan, and C. Ejike.
Verhandlung Internationale Vereinigung Limnolo gie, Vol. 22, No. 3, p 1584-1589, December, 1984. Fig, 14 Ref.

Descriptors: *Liberty Dam, *Nigeria, *Reservoir *Limnology, Plankton, Phytoplankton, Populatio dynamics, Monsoons, Seasonal variation, Tran parency, Algae, Primary productivity.

The Liberty Dam is situated within Jos biotit granite area, which is a cooler upland site in Nige ria. The limnology of the water body was in fuenced by dynamic environmental factors. Th rainy season was characterized by low records o Secchi depth, which corroborated with high vert cal extinction coefficients. Poor ionic composition influenced among other factors by insoluble natur of granite in the catchment, fits the water body i Class I series of Talling and Talling African lake Planktonic microflora constituted principal plan life of the reservoir and well established macro phytic vegetation was lacking. The phytoplankto community was dominated by Chlorophycea (44%) followed by Bacillariophyceae (39%) an Dinophyceae (15%). Staurstrum and Cosmarium numerically abundant with high species diversity were important desmid elements. Synedra was common diatom. Peridinium, the only dinoflage late identified, showed typical upsurge in earl rainy season. Phytoplankton photosynthes showed distinct seasonality with higher rates o tained for the rainy season corresponding to lo water transparency and high plankton biomas Seasonal variation of phytoplankton productivi approximated pattern A group of Melack's Africa lakes. Phytoplankton composition, abundance, an productivity rates are suggestive of oligo mesotr phic status for the ecosystem. (Baker-IVI)
W85-05643

PHYTOPLANKTON GRADIENTS DURIN THE RAINY SEASON IN LAKE KARIBA,
Zimbabwe Univ., Harare. Lake Kariba Researc Station.
L. Ramberg.
Verhandlung Internationale Vereinigung Limnol gie, Vol. 22, No. 3, p 1950-1953, December, 1984 Fig, 9 Ref.

Descriptors: *Lake Kariba, *Zambia, *Zimbabw *Phytoplankton, *Monsoons, Sediment transpo Plumes, Turbidity, Population dynamics, Silt, Bi mass, Seasonal variation, Rainfall, Spatial distrib tion, Temporal distribution.

The total phytoplankton biomass in Lake Karib which lies between Zambia and Zimbabwe, has grand mean of 290 mg/cu m and a more irregul distribution both in time and space than usual found in temperate lakes. In December the biom varied between 690 and 0. Such low values we usually correlated to a high content of silt in t water. During the rainy season the rivers transpo large amounts of silt into the lake visible as plum several kilometers from the outlet and causing general decrease in the euphotic depth to about m in Lake Kariba. Simultaneously the thermocli sinks from 10 m in the warm-rainy season to 30 in the cool-dry season. The turbid river water m also explain the larger variations in plankton b

ss during the rainy season. The rivers respond y suddenly on rainfalls and decline as fast after rains causing the river waters to enter the lake distinct silty water packages. Typical for the ytoplankton community in Lake Kariba is that mean temporal variation was small as well as mean difference between sampling stations. e quantitative composition was comparatively ble with the same 15-20 species making up the mass in all samples. The relations between the minating species varied a lot in both space and e with resulting large variances in the total mass. (Baker-IVI)
5-05644

TYTOPLANKTON PRODUCTIVITY IN A ALLOW TURBID IMPOUNDMENT, URAS DAM,
ange Free State Univ., Bloemfontein (South rica). Inst. of Environmental Sciences.
J. Grobbelaar.
rhandlung Internationale Vereinigung Limnolo-, Vol. 22, No. 3, p 1594-1601, December, 1984. 5 , 2 Tab, 14 Ref.

scriptors: *Phytoplankton, *Primary productiv- *Turbidity, *Reservoirs, *Wuras Dam, *South rica, Turbidity, Light intensity, Phytoplankton, spended solids, Euphotic zone.

e turbid impoundment, Wuras Dam has a eu- otic depth of between 0.3 and 1.3 m and the enuation of light is caused mainly by large ounts of suspended inorganic particles. Primary oductivity was measured over a two year period ring intensive short term investigations. Several aracteristics of primary productivity in a shal- turbid impoundment could be identified, ich have a direct influence on the structure and ctioning of the system. Phytoplankton produc- ity follows essentially the same pattern in turbid ters as in clear waters. The euphotic zone is rely compressed in turbid waters, which would cessitate experimental care, not to miss P-max. e shallow euphotic depth results in large notic:euphotic ratios. Losses due to dark metab- sm will become progressively more pronounced the mixed layer becomes deeper. This could ult in considerable production losses. Indica- ns of shade adaptation were found, where the cific activity and light utilization index of the ytoplankton increased with an increase in tur- lity. Such adaptation would be most important, pecially in systems such as Wuras Dam where phytoplankton is responsible for the major ut of organic carbon into the system. Small stems are also subject to pronounced variation er short periods of time. (Baker-IVI)
85-05645

LIGOMICTIC MAN-MADE LAKE IN OUTHEASTERN BRAZIL,
o Paulo Univ. (Brazil). Dept. de Ecologia.
G. Froehlich, and M. S. Arcifa.
erhandlung Internationale Vereinigung Limnolo-, Vol. 22, No. 3, p 1620-1624, December, 1984. 7 g, 3 Ref.

escriptors: *Brazil, *Paraibuna Reservoir, *Oli- mictic lakes, Water circulation, Temperature ef- cts, Dissolved oxygen, Conductivity, Stratifica- n, Reservoirs, Dissolved oxygen.

ne Paraibuna Reservoir (Brazil) is generally bly stratified with a main thermocline mostly tween depths of 13 and 20 m. Bottom tempera- res are stable, rising very slowly between circu- ion periods. They are lower in the Paraitinga sin. Circulation to the bottom, which is accom- nied by a marked decrease in transparency due resuspension of sediments, took place in 1979 d 1981, while it did not occur in the milder nter of 1980, and probably also in 1982, because this year no resuspension of sediments was ted. At each circulation to the bottom, a sensible crease in bottom temperatures took place. Con- dering that the reservoir is young there is clearly trend for bottom temperatures to get colder at ch strong winter, increasing the stability of the ater column in the intervening years with milder nters. The trend is clearly toward longer periods of no holomixis. The dissolved oxygen isopleths show that during circulation to the bottom there is an increase in bottom dissolved oxygen values, while at intermediate depths the absence of oxygen may be maintained. The electrical conductivity isopleths show a progressive increase in conductivity with depth and with the duration of the stratification. In 1980 there was evidence of a downward migration of surface water during the winter, slightly lowered bottom temperatures in both basins, and in Paraitinga basin, a small lowering of conductivity and, in September, a very small amount of dissolved oxygen at the depth of 70 m. (Baker-IVI)
W85-05647

FURTHER STUDIES ON THE ZOOPLANKTON COMMUNITY OF A EUTROPHIC RESERVOIR IN SOUTHERN BRAZIL,
Inst. de Pesca, Agric. of Sao Paulo State, Brazil.
S. Sendacz, E. Kubo, and L. P. Fujiara.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1625-1630, December, 1984. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Water pollution effects, *Eutrophication, *Billings Reservoir, *Brazil, *Zooplankton, Dissolved oxygen, Chlorophyll, Reservoirs, Wastewater pollution, Transparency, Water quality, Copepods.

Billings Reservoir is located near the city of Sao Paulo, Brazil and receives a great part of its domestic and industrial wastes. Water samples were taken from the reservoir at monthly intervals, from April 1981 to March 1982 at one station located 1 km approximately from the dam, with a mean depth of 9 m. As the dam constructed to isolate this branch of the reservoir is rather new, completed in December of 1981, some changes in the physical, chemical and biological characteristics of the water were noted. Secchi disc transparency values have increased. The median transparency in the dry season increased from 1.10 m in 1978 to 1.55 m in 1981. A slight decrease in the chlorophyll a content was also noted and in the standing stock of zooplankton. These finding may indicate modification in the ecosystem, since an increase in those parameters serves as an evidence of eutrophication. No major differences were noted both concerning the zooplankton numbers and the relative abundance of the zooplanktonic groups. The only noticeable feature is the occurrence of calanoid copepods, although in few numbers, which were registered for the first time in this reservoir. (Baker-IVI)
W85-05648

CONTRIBUTION OF TWO AQUATIC MACROPHYTES TO THE NUTRIENT BUDGET OF LOBO RESERVOIR, SAO PAULO, BRAZIL,
Universidade Federal de Sao Carlos (Brazil). Lab. of Limnology.
R. Barbieri, F. A. Esteves, and J. W. Reid.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1631-1635, December, 1984. 4 Tab, 8 Ref.

Descriptors: *Nutrients, *Lobo Reservoir, *Brazil, *Macrophytes, Aquatic plants, Water level, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Proteins, Cycling nutrients.

The relative contribution of some nutrients and compounds by the dominant macrophyte species Nymphoides indica and Pontederia cordata was studied during normal and dry periods in the littoral zone of the tropical reservoir Represa do Lobo, State of Sao Paulo, Brazil. During the study period. N. indica covered 27.3 ha or 4.0% of the reservoir and P. cordata covered 3.6 ha or 0.5%. In August of 1980 the water level fell 2 m due to a break in the dam, resulting in the death of most aquatic macrophytes. From September onwards the leaf blades and petioles of individuals of N. indica showed a definite decrease in diameter and size. New individuals growing in the littoral zone differed in the concentration of most substances analyzed from those existing before the break. N content of N. indica varied from a mean of 1.6% before to 2.3% afterwards. N content in P. cordata increased only slightly over the same period. Protein content showed the same tendencies in each species. Standing stocks of all elements and compounds analyzed underwent substantial reduction during the low water period in each species. Standing stocks of the nutrients N and P in N. indica were 6 and 13 times higher, respectively, than in the water of the littoral and pelagic zones. K, Ca, Mg, and protein standing stocks were proportionately greater in P. cordata than in N. indica, but the contribution of the latter species to the reservoir was substantially greater due to the larger area inhabited by it. Thus, N. indica is the most important of the aquatic macrophyte species in the cycling of organic material and nutrients, especially N and P, in this reservoir. (Baker-IVI)
W85-05649

SOME LIMNOLOGICAL CHARACTERISTICS OF A TEMPERATE FOREST POND,
Vrije Univ., Brussels (Belgium). Lab. voor Algemene Plantkunde en Natuurbeheer.
L. Deronde, T. Lomema, I. van Elslande, D. Van de Gucht, and H. Borgoo.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1663-1671, December, 1984. 5 Fig, 21 Ref.

Descriptors: *Ponds, *Forest watershed, *Litter, *Decomposition, Limnology, Potassium, Humic acids, Phytoplankton, Algae, Zooplankton, Humic compounds, Leaching, Potassium.

Data are summarized from limnological observations made mainly during the period 1974-1978 in a pond greatly influenced by its forest surrounding, by the yearly litter fall and by litter decomposition. The pond examined is the first in a series of four ponds receiving water from a brooklet originating in a spring area about 100 m above. The water temperature varied from 0 to 24.2 C. Diurnal variations of the surface temperature could reach 4 C. Secchi disk transparency in the pond was found equivalent to the depth of 25% light penetration. Water pH is mostly between 7 and 8. Oxygen depletion near the bottom was occasionally observed in summer. A total of 202 algal taxa were identified in the plankton of the pond. The winter plankton consists mainly of Cryptomonas and Trachelonmonas. In spring, Peridinium and the Chrysophyceae develop. The diatoms reach their maximum in March or April; the Chlorococcales somewhat later. The total volume of the phytoplankton showed distinct maximum values in July. The species composition of the zooplankon was followed from 22 July 1974 to 11 July 1975 with 19 species of Rotifera, 9 of Cladocera and 7 of Copepoda being identified. The zooplankton showed peaks numerically dominated by Rotifera. High zooplankton biomass values were found only in summer, from June to September. Total annual litterfall falling into the pond was estimated at 1000 kg dry weight in 1976-77, 880 kg in 1977-78, and 730 kg in 1978-79. These figures correspond to an average fall of 0.35-0.46 kg/sq m. This litterfall consists mainly of beech leaves. Leaching of the major cations from the leaves is particularly rapid for potassium ions which is reflected in a distinct peak in potassium concentration occurring yearly after leaf fall. This litterfall of forest origin represents an important input of POM and DOM to the pond, and results in its non negligible humic content. Three fractions of soluble humic compounds were isolated. (Baker-IVI)
W85-05651

LIMNOLOGICAL CHARACTERISTICS OF SOME SMALL EUTROPHICATED LATE-GLACIAL POOLS,
Department of Public Works, Leeuwarden (Netherlands).
T. H. L. Claassen.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1681-1686, December, 1984. 3 Tab, 10 Ref.

Descriptors: *Pools, *Friesland, *Netherlands, *Limnology, *Eutrophication, Water quality, Chloride, Conductivity, Acidity, Oxygen, Invertebrates, Cations, Anions.

Many pools in the eastern part of Friesland are regarded as valuable elements in the landscape. Nowadays most pools are surrounded by grassland. A few remnants of pingos are still situated in moorland. Five pingo-remnants were selected for a closer investigation. The chloride concentration is roughly the same in the pools. The annual fluctuation was greatest in the most shallow pool in which the chloride concentration varied from 12 mg Cl(-)/l in February to 101 mg Cl(-)/l in June. The mean cation concentration showed the following order of quantitative importance: Ca(++) > Na(+) > Mg(++) > K(+). The sequence for the anions was HCO3(-) > Cl(-) > SO4(--). The sampled pools had a well developed littoral overgrowth. The macroinvertebrates mainly consisted of Diptera, both regarding the number of taxa and the number of individuals, ranging from 36 to 51% and from 41 to 89%, respectively. (Baker-IVI)
W85-05652

PRELIMINARY GROUPING OF THE SMALL EPICONTINENTAL WATER BODIES IN SPAIN AND DISTRIBUTION OF CRUSTACEA AND CHAROPHYTA,
Barcelona Univ. (Spain). Dept. de Ecologia.
M. Alonso, and M. Comelles.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1699-1703, December, 1984. 1 Tab, 10 Ref.

Descriptors: *Spain, *Limnology, *Crustacea, *Charophyta, Climate, Topography, Turbidity, Lakes, Ponds, Salinity, Geology, Population dynamics.

Some 500 lakes and ponds throughout Spain were studied. The environmental parameters examined included periodicity, mineralization and turbidity due to clay. These are conditioned by the climate, the depth of the depressions, the nature of the substrate and the kind of drainage. Four groups of water bodies are recognized, and the frequency of appearance of the species corresponding to each one was calculated. The Iberian Peninsula is a very suitable area for regional limnlogical studies. The N and NW silicious and wet region contain abundant clean fresh water in which ubiquitous and cosmpolitan species can be found with species of Central European distribution being common. Communities of athalasohaline, muddy and mineralized waters occur in the semiarid landscape. Arctodiaptomus wierzejskii and Daphnia magna are characteristics of clean, mineralized, but not saline waters. The charophytes constitute a group widely distributed in continental waters, with species of varied ecology. (Baker-IVI)
W85-05653

PATTERNS OF DIEL OXYGEN CHANGE IN PONDS OF TROPICAL INDIA,
Kansas State Univ., Manhattan. Div. of Biology.
G. R. Marzolf, and G. W. Saunders.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1722-1726, December, 1984. 3 Fig, 1 Ref.

Descriptors: *Dissolved oxygen, *India, *Ponds, *Diel variation, Oxygen, Respiration, Diurnal variation, Productivity, Water temperature, Photosynthesis, Macrophytes, Biomass, Carbon.

Diel changes in oxygen concentration were measured in a few water bodies of tropical India and are presented as an indication of the intensity of production and respiration processes and the diverse conditions under which high productivity occurs. All of the basins are shallow, on the order of 4 m deep. The basins are filled by the monsoon rains and the water evaporates during dry seasons, sometimes to dryness. The Microcystis Pond was the most productive of the three studied. The peak oxygen concentration was reached in the early afternoon at 1:30 PM, probably due to apparent cessation of photosynthesis due to nearly complete depletion of inorganic carbon from the water. The temperature of the pond water at the peak oxygen concentration on this day was 31 C, thus oxygen concentration at this time was about 376% of saturation. The diel changes in oxygen concentration in the Swamy Pond were smaller in magnitude, the increase started later because of the shadow cast by its deep walled basin, and the saturation, about 153%, was lower at the peak concentration. The time of peak concentration was 3:30 PM. The changes in oxygen concentration in Melakkal Lake waters were the lowest in magnitude and the peak concentrations were reached latest in the day. The difference was more likely due to differences in nutrient concentration, and macrophyte biomass than to the difference in light intensity. The vertical profile of dissolved oxygen changed through time in Microcystis Pond. The changes during the daylight hours are illustrated. The peak concentration was about 5 cm below the surface at 4 PM. This is probably due to carbon limitation in the surface layer and to diffusion than to photoinhibition of photosynthesis. Oxygen concentration a few centimeters from the bottom of the pond remained below 0.75 mg of oxygen/l, more than 10% saturated. Increases in oxygen concentration during the day were negligible at depths greater than 25 cm; a very shallow euphotic zone. (Baker-IVI)
W85-05654

TROPICAL AUSTRALIA, A DYNAMIC LIMNOLOGICAL ENVIRONMENT,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
T. Walker, and P. Tyler.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22 No. 3, p 1727-1734, December, 1984. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Limnology, *Alligator River, *Arnhem Land, *Australia, Monsoons, Flood plains, Stratification, Billabongs, Acidity, Turbidity, Sodium, Magnesium, Carbonates, Sulfates, Light penetration, Primary productivity, Algal growth.

The Alligator Rivers and their tributaries rise on the sandstone plateau of Arnhem Land. The dominating climatic feature is the sharp distinction between wet season and the dry. Mean water temperature varies from about 24 to 32 C. The billibongs of the ARR (Alligator River Region) exhibit a continuum of stratification behavior, defying classification. At one end is Kulukuluku with several months of de facto stratification, at the other the shallow backflow billabongs where, at best, thermal gradients are ephemeral. During the wet season the billabongs are all inundated and flushed, to enter the dry season with a common water which is dilute, near neutral and dominated by Na/MgHCO3. Nutrient levels are at their lowest, but on a world scale total phosphorus levels are high and the billabongs are meso- to hyper-eutrophic. By the end of the dry season the three main groups can be distinguished by the nature and extent of ionic change they have undergone. Of the three parameters likely to affect light conditions, gilvin (organic color), chlorophyll and turbidity, the last one is overwhelmingly dominant, exerting its influence through adsorption rather than scattering. About 700 taxa of freshwater algae, mostly desmids, have been recognized with obvious tropical affinities. Light and nutrients commonly control primary productivity. (Baker-IVI)
W85-05655

STREAM ECOSYSTEM THEORY,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2E.
W85-05662

UPTAKE OF DISSOLVED ORGANIC CARBON IN MOUNTAIN STREAMS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
C. N. Dahm.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1842-1846, December, 1984. 2 Fig, 1 Tab, 19 Ref. NSF grants DEB 7923444 and DEB 8112455.

Descriptors: *Streams, *Organic carbon, *Dissolved solids, *Mountain streams, Oregon, Organic matter, Carbon radioisotopes, Stream order, Riparian vegetation, Forest watersheds.

To study the rates and mechanisms for conversion or transfer within the labile subfractions of organic matter in streams, it is often necessary to devise experimental procedures which focus upon processes affecting known labile components of this material. Three factors potentially affecting the rate and efficiency of uptake of dissolved organic carbon (DOC) in mountain streams are examined. They include the source of the DOC, the order of stream, and the vegetational structure of the riparian zone. The study streams were located in forested watersheds on the Coast and Cascade Ranges of western Oregon. Three sources of C-14 labeled DOC were tested for the rate and efficiency of uptake using first and third order stream sediment and water. The three sources included an algal lysate, alder leaf leachate, and Douglas fir needle leachate. The rate of C-14 uptake was clearly dependent upon the source of the soluble material. The overall conclusion that DOC uptake is more rapid in smaller order sreams must be made cautiously. It is possible that the more direct linkage between the watershed and small streams results in a microbial population better able to utilize allochthonous sources of DOC such as alder leaves. Differences in sediment characteristics used in the experiment may also explain these trends. (Baker-IVI)
W85-05665

FACTORS RELATED TO ALGAL BIOMASS IN MISSOURI OZARK STREAMS,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
J. R. Jones, M. M. Smart, and J. N. Burroughs.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1867-1875, December, 1984. Fig, 3 Tab, 22 Ref.

Descriptors: *Missouri, *Mountain streams, *Algal growth, *Biomass, Eutrophication, Streams, Nutrients, Periphyton, Land use, Chlorophyll.

Both physical characteristics and nutrient concentration determine suspended algal biomass in Missouri Ozark streams. While it is likely that both physical characteristics and nutrients have a continual effect on stream algal biomass, there is probably a shift in their relative importance over time. Flow is a major factor determining both benthic and suspended values. During periods of high flow, frictional shear stress removed periphyton from the streambed. These cells were subsequently concentrated during downstream transport so that the area of watershed upstream for the sampling point explained a significant portion of the variance in suspended chlorophyll a concentration among the 12 sites. Nutrients were not limiting during high flow. In contrast, during the lower flows of summer, all differences in suspended algal chlorophyll were significantly correlated with nutrient concentrations. Differences in benthic chlorophyll among sites did not show these nutrient relations. Averaged over time, an increase in nutrient concentration may stimulate growth and cell loss from the periphyton. Nutrient concentrations in Ozark streams are highly correlated with urban areas and agricultural practices. As these landuse practices expand in the region suspended chlorophyll a values will increase to a point where nutrients will become less important in limiting algal denisities and physical characeritics will be the major factors determining algal chlorophyll in these settings. (Baker-IVI)
W85-05667

SIZE DISTRIBUTION AND LIGNIN CONTENT OF FINE PARTICULATE ORGANIC MATTER (FPOM) FROM MICROBIALLY PROCESSED LEAVES IN AN ARTIFICIAL STREAM,
Alabama Univ. in Birmingham. Dept. of Biology.
G. M. Ward.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1893-1898, December, 1984. Fig, 2 Tab, 14 Ref. NSF grant DEB-8112455.

Descriptors: *Streams, *Leaf litter, *Organic matter, *Particulate matter, *Lignin, Decomposition, organic matter, Leaves, Microbial degradation, Litter, Seasonal variation, Aquatic insects.

For a period of 21 weeks leaves of pignut hickory were incubated in a recirculating, plexiglass chamber containing 70 L of streamwater held at 10 C. The study was designed to estimate from these lab experiments the amount of leaf litter which could be expected to enter the fine particular organic matter (FPOM) pool during microbial processing; to document the particle size distribution of microbially produced FPOM; and to determine the content of lignin present in microbially produced FPOM. After 142 days of processing, only 13% of the original leaf material remained, and consisted mainly of veins and veinlets. Leaching losses accounted for 21% of the original dry weight, coarse particulate organic matter (CPOM) fragmentation 4%, FPOM sloughing 33%, and mineralization 29%. Production of FPOM was slow during the first seven weeks, as was total weight loss. Weight loss rates increased greatly in the latter stages of processing when most of the FPOM was released. Peak FPOM release occurred during the 13th week of incubation, while relatively large amounts of release occurred between day 80-101, when 50% of all FPOM accumulated. The majority of FPOM released was < 53 micro-m > 0.45 micro-m in diameter. Particles > 0.25 mm diameter contained a higher proportion of lignin than did leaves, while particles < 0.125 mm contained much less lignin than either leaves or the larger particles. Smaller FPOM contained much less lignin, and consisted mainly of macerated mesophyll cells. Because of the seasonal nature of leaf fall, the timing of mesophyll derived inputs of FPOM should also be pulsed. It is possible that if after months of microbial processing native FPOM may become too refractory to support insect development. If so, these fall inputs of FPOM from leaf liter represent an annual renewal of high quality detritus, necessary, in part, for completion of some insect life cycles. (Baker-IVI)
W85-05669

PHOSPHORUS UPTAKE BY DECOMPOSING LEAF DETRITUS: EFFECT OF MICROBIAL BIOMASS AND ACTIVITY,
Oak Ridge National Lab., TN. Environmental Sciences Div.
P. J. Mulholland, J. W. Elwood, J. D. Newbold, J. R. Webster, and L. A. Ferren.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1899-1905, December, 1984. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Phosphorus, *Absorption, *Leaves, *Microbial degradation, Biomass, Decomposition, Organic matter, Nutrients, Detritus, Organic carbon.

Temporal patterns of P uptake were examined during the early stages of leaf decomposition in streams. Patterns of P uptake were compared to patterns of other measurements of microbial activity to identify the effect of microbial succession or conditioning of leaves on P uptake. Results suggest that P utilization, and hence uptake length of P in streams, may follow a predictable pattern after input of autumn-shed leaves. As the microflora develops on leaf detritus, the uptake length of P should decrease, reaching a minimum as early as 3 weeks after peak leaf fall. Thereafter, if new inputs of leaves are not great, uptake length should increase. Consequently, in addition to the quantity of leaf detritus, the level of microbial activity on leaves should influence stream P utilization and uptake length. The results also imply that the quality of organic carbon substrate, or quantity of readily utilizable organic carbon, may at times limit microbial productivity and nutrient uptake in streams. Alternatively, if lower microbial activity is the result of self-limitation at high microbial biomass, shredder organisms may modify the temporal pattern somewhat by cropping microbial biomass, thus maintaining high rates of microbial metabolism for longer periods. (Baker-IVI)
W85-05670

TEMPORAL CHANGES IN NUMBERS OF SUSPENDED BACTERIA IN A SMALL WOODLAND STREAM,
Center for Energy and Environment Research, San Juan, PR.
W. H. McDowell.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1920-1925, December, 1984. 5 Fig, 20 Ref.

Descriptors: *Bear Brook, *New Hampshire, *Bacteria, *Streams, *Temporal distribution, Energy, Nutrients, Rivers, Plankton, Stream discharge, Organic carbon, Dissolved solids.

Temporal changes in total numbers of bacteria in the water column of Bear Brook, New Hampshire were examined. Concentrations of planktonic bacteria ranged from 26,900 to 889,000/ml with highest values observed during spring runoff and lowest values during summer. No seasonal trends were noted. Bacterial concentrations less than 100,000 were found in all seasons, and concentrations rose consistently during periods of increasing discharge in all seasons. Bacteria were commonly small cocci and rods estimated to be 0.2 to 0.8 micro-m in size. Chains or actively growing colonies were found infrequently. Bacterial concentrations peaked at or before peak discharge during spates. Bacterial concentrations showed a linear relationship with stream discharge when both were normalized using a logarithmic transformation. The logarithm of bacterial concentration is also linearly related to dissolved organic carbon (DOC) concentration. Dissolved organic carbon concentration and the logarithm of discharge together accounted for 61% of the variance in bacterial concentration. DOC concentration accounted for 54% of total variance, with an additional 7% explained by stream discharge. (Baker-IVI)
W85-05672

DETRITUS DECOMPOSITION IN ENDOGENOUS AND EXOGENOUS RIVERS OF A TROPICAL WETLAND,
Lund Univ. (Sweden). Limnological Inst.
R. C. Petersen.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1926-1931, December, 1984. 6 Tab, 13 Ref.

Descriptors: *Riparian vegetation, *Wetlands, *Detritus, *Decomposition, Rivers, Tropical regions, Decomposing organic matter, Macroinvertebrates, Microbial degradation, Aquatic plants, Invertebrates.

A study of the decomposition process was undertaken in several of the streams and rivers in order to increase the understanding of the ecology of the wetlands. The Lower Morass of the Black River is a freshwater wetland area in western Jamaica comprising an area of about 68 sq km. The major habitat is a sedge marsh dominated by sawgrass and to a lesser extent by other Cyperaceae. The riparian vegetation is dominated by Typha domingensis, Thalia geniculata, Alpina allughas and the fern Acrostichum sp. The overall rate of decomposition, microbial consumption and the effect of macroinvertebrates was greater in streams coming from outside the wetland compared to the streams which arise within the system. Macroinvertebrates were shown to be more responsive to the between system differences. (Baker-IVI)
W85-05673

CLASSIFICATION OF SITES ON BRITISH RIVERS USING MACROINVERTEBRATES,
Freshwater Biological Association, River Laboratory, Dorset, England.
J. F. Wright, P. D. Armitage, M. T. Furse, and D. Moss.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1939-1943, December, 1984. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *England, *Scotland, *Wales, *Rivers, *Invertebrates, Geology, Topography, Sediments, Silt, Clay, Pebbles, Habitats, Population dynamics, Species diversity, Substrates.

The species richness of the 268 sites used in the classification of rivers in England, Scotland and Wales was examined in relation to substratum and distance of site from source. All available habitat types at each site were sampled with a pond-net for a period of three minutes in the spring, summer and autumn. Sites with a coarse substratum (cobbles, pebbles and gravel) are better represented than sites where sand or silt predominate. At sites close to the source (0-5 km) the number of taxa recorded did not exceed 100. Further downstream about 10% of the site exceeded this value and the number of taxa increases downstream to about 40 km after which there is a slight decrease. Sites with a coarse substratum dominated by cobbles or pebbles were less species-rich than sites where gravel was predominant, but on sandy and silty substrata no consistent pattern emerged. (Baker-IVI)
W85-05674

INFLUENCE OF CURRENT VELOCITY ON PERIPHYTON DISTRIBUTION AND SUCCESSION IN A NORWEGIAN SOFT WATER RIVER,
Norsk Inst. for Vannforskning, Oslo.
E.-A. Lindstrom, and T. S. Traaen.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1965-1972, December, 1984. 6 Fig, 3 Tab, 21 Ref.

Descriptors: *Rivers, *Velocity, *Norway, *Periphyton, *Succession, Water quality, Monitoring, Algae, Floods.

Current velocity must be considerd when sampling periphyton for water monitoring purposes. Current velocity influences the patchy distribution at a particular time and even the growth period of particular species. Water chemistry may alter the velocity range of a species. Of the three velocity ranges investigated, the intermediate one (about 50 cm/sec) seems most suitable. At this velocity, the highest number of the characteristic species and few occasional species appeared. More of the occasional species were present at low current velocities. Furthermore, algae growing at low velocity were extremely susceptible to sloughing during floods. In the high velocity range, species richness was reduced due to mechanical stress. (Baker-IVI)
W85-05677

FUNCTIONAL ASPECTS OF A LAKE OUTLET VERSUS A SPRINGFED STREAM ECOSYSTEM,
Lund Univ. (Sweden). Dept. of Animal Ecology.
B. Malmqvist, and C. Bronmark.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1992-1996, December, 1984. 2 Fig, 13 Ref.

Descriptors: *Ecosystems, *Streams, *Lake outlets, *Springfed streams, Streamflow, Temperature, Carbon, Trophic level, Springs, Lakes, Aquatic animals, Benthos, Seasonal variation.

Temperature, water flow, carbon transport, and the trophic guilds of the benthos are compared for two ecosystems, a lake outflow draining a small eutrophic lake and a springfed stream. Summer temperature was higher in the lake outlet than in the stream. In winter the situation was reversed with higher temperatures in the springfed stream. The lake outlet had a higher number of degree days and the annual mean temperature was 1.7 C higher and in summer the average temperature exceeded that of the springfed stream by about 5 C. The lake was ice-covered between 7 January and 7 April 1980. Neither the lake outlet nor the stream was ice covered during the study period. The water level showed a winter peak in both systems. There was a large difference between high and low water in the lake outlet and the duration of the winter high water was longer. The lake outlet had one winter peak and one summer peak in dissolved organic carbon concentration, while the stream had only a summer maximum. No correlations between carbon parameters and discharge were statistically significant. Benthic organic matter in the top 3 cm was much higher in the lake outlet. The lake outlet always had a high number of scrapers. In quantitative terms, biomass was considerably higher in the lake outlet, to a large extent due to the mass of mussels. The percentage of holoaquatic animals was at all dates higher in the lake outlet than in the springfed stream. By weight holoaquatic animals averaged

>97% in the lake outlet because of high mollusk weights. (Baker-IVI)
W85-05680

SEASONAL DYNAMICS OF WATER MOVEMENTS AND OF SUSPENDED MATTER IN A LARGE RIVER (DYNAMIQUE SAISONNIERE DES MOUVEMENTS DE L'EAU ET DES PARTICLES EN SUSPENSION DANS UN FLEUVE),
Lyon-1 Univ., Villeurbanne (France). Section of Freshwater Ecology.
For primary bibliographic entry see Field 2E.
W85-05681

STABILITY AND CHANGES OF BIOMASS OF EMERGING INSECTS AND THEIR POSSIBLE CAUSES,
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
P. Zwick.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22. No. 3, p 2037-2041, December, 1984. 2 Fig, 15 Ref.

Descriptors: *Breitenbach, *Germany (Federal Republic), *Biomass, *Aquatic insects, Population dynamics, Temperature effects, Thermal gradients, Species diversity.

In Breitenbach, Federal Republic of Germany there is a downstream increase of daily as well as annual temperature amplitudes on the 2 km stretch between a large spring entering the stream and its mouth into the Fulda River. The importance of this thermal gradient for longitudinal zonation of Ephemeroptera, Plecoptera and Trichoptera is re-evaluated. Less species than previously suggested are actually affected. A regular upstream increase of abundance is observed only in 3 species, but these include 2 of the most important secondary producers of the stream community, which is dominated by oligo-stenothermal species. More species exhibit a downstream increase of abundance, but none of these more polyeurythermal ones is among the numerically important species in the stream. Distribution and abundance of most species in the stream are irregular and apparently determined by other factors such as substrate composition at the stream bottom. (Baker-IVI)
W85-05684

VEGETATION PATTERNS IN THE NORTH BLACK RIVER PEATLAND, NORTHERN MINNESOTA,
Minnesota Univ., Minneapolis. Limnological Research Center.
P. H. Glaser.
Canadian Journal of Botany, Vol. 61, p 2085-2104, 1983. 9 Fig, 4 Tab, 52 Ref. DOE contract DOE ACO1-80EV10414, NSF grant DEB-7922142.

Descriptors: *North Black River peatland, *Minnesota, *Vegetation, *Peatlands. Bogs, Fens, Wetlands, Topography, Water chemistry, Remote imagery, Ecological distribution.

Raised bogs and water tracks in the 193-sq km North Black River peatland in northern Minnesota were examined in relation to the vegetation, water chemistry, and surficial water movements as inferred from infrared aerial photographs, LANDSAT imagery, and orthophoto topographic maps. Two noda of bog vegetation were distinguished by the Braun-Blanquet system; both bog noda are associated with relatively dilute, acidic waters (pH range 3.9-4.1; Ca(2+) concentration range 0.6-1.6 mg/L; specific conductivity, K corr range 1.3-83 micro-S/cm). Rich-fen vegetation in contrast is more variable within this peatland and generally occurs in water tracks with a correspondingly wide range of pH (range 5.0-6.2), Ca(2+) concentration (range 3.6-30.4 mg/L), and K corr (range 31 to 182 micro-S/cm). Poor-fen vegetation was most distinguishable by the transitional nature of its vegetation and water chemistry with at least a few minerotrophic indicator species present in all cases and intermediate ranges in pH (3.7-5.2), Ca(2+) concentration (0.6-5.5 mg/L), and K corr (16-72 micro-S/cm). Bog and fen patterns in this peatland are consistently related to topographic features along the upland crest of each peatland watershed, indicating the topography controls the path of minerotrophic runoff draining onto the peatland, and thus creating zones with either enriched minerotrophic flow (in which water tracks develop) or stagnation zones (where bogs develop) on the peatland downslope. (Author's abstract)
W85-05685

ECOLOGY OF LAKE NAKURU; VI. SYNOPSIS OF PRODUCTION AND ENERGY FLOW,
Munich Univ. (Germany, F.R.). Zoologisches Inst.
E. Vareschi, and J. Jacobs.
Oecologia, Vol. 65, No. 3, p 412-424, February, 1985. 5 Fig, 66 Ref.

Descriptors: *Lake Nakuru, *Kenya, *Productivity, *Trophic level, Saline lakes, Alkaline lakes, Eutrophication, Algae, Rotifers, Flamingoes, Pelicans, Fish, Copepods, Aquatic insects, Biomass, Photosynthesis, Food chain.

Lake Nakuru in the Eastern Rift Valley of Kenya is an alkaline-saline lake. During a five year study, the lake had a bloom of Spirulina platensis that persisted at least two years, periods with low algal densities and various transitional phases with dramatic fluctuations of species composition and density. The bloom was characterized by a rich and almost unialgal bloom of the cyanophyte S. platensis minor, with a mean biomass of 3,500 kJ/cu m (20 kJ approximately = 1 g dry weight). Net photosynthetic rates were very high at depths with optimal light conditions (230 kJ/cu m/h), but algal self-shading made integrated rates modest (45 kJ/cu m/24 h) relative to the high biomass. Of the eight primary consumers only five species contributed significantly to the consumer biomass of 220 kJ/cu m: the flamingo Phoeniconaias minor, the cichlid fish Sarotherodon alcalicus grahami, the copepod Lovenula africana, the dipteran larva Leptochironomus deribae, and the rotifer Brachionus dimidiatus. Consumption rates were about 50% of net photosynthetic rates, production rates about 10%. Secondary consumers (90% being the pelican Pelecanus onocrotalus and the Greater Flamingo Phoenicopterus ruber) had a biomass of about 6.8 kJ/cu m. Pelicans consumed almost the whole fish production (7.5 metric tons wet weight/day). At low algal densities the lake had a more diverse algal population but a reduced mean biomass of 1,500 kJ/cu m and mean net photosynthetic rates of 12 kJ/cu m/24 h. Primary consumer species diversity and biomass were also reduced. Consumption rates sometimes exceeded primary production rates. Rotifers probably contributed about 50% to total consumption and about 75% to total secondary production. Transitional phases are characterized by rapidly changing abiotic and biotic conditions with algal breakdowns and sudden population peaks at all levels. Rotifers dominated secondary consumers, they contributed 25% to the total biomass 380 kJ/cu m, 90% to the total consumption rate of 290 kJ/cu m/d and 95% to the total production of 41 kJ/cu m/d. (Moore-IVI)
W85-05704

DISTRIBUTION OF FISH IN THE VIRGIN RIVER, A TRIBUTARY OF THE LOWER COLORADO RIVER,
Southern California Coastal Water Research Project Authority, Long Beach.
J. N. Cross.
Environmental Biology of Fishes, Vol. 12, No. 1, p 13-21, January, 1985. 4 Fig, 3 Tab, 49 Ref.

Descriptors: *Fish, *Spatial distribution, *Virgin River, LaVerkin Springs, Deserts, Exotic fish, Aquatic habitats, Reservoirs, River flow, Water quality.

Large perennial rivers that flow through climatic deserts are comparatively few in number and their ichthyofaunas are impoverished relative to rivers in more equable climates. The Virgin River, a major tributary of the lower Colorado River, contains a unique, though impoverished, native ichthyofauna (six species) that is largely intact despite the introduction of exotic fishes (13 species) and alterations of the river (loss of habitat, water diversion, and pollution). The climate over most of the Virgin River basin is arid to semiarid with mild winters, hot summers, and high evaporation rates. The longitudinal distribution pattern of the native species does not follow theoretical expectations of a downstream increase in species richness. In the Virgin River, there is an absolute increase of available habitat downstream, but flow variability does not decrease, and habitat heterogeneity does not increase. No fish were collected in the river where LaVerkin Springs emerge and for more than 1 km downstream. For the size of the basin (> 15,000 sq km), the native ichthyofauna is extremely depauperate. The river is well isolated from other drainage basins. Most of the exotic fish are not established in the river, but persist through repeated invasions from downstream reservoirs. The persistence of the native fish in the Virgin River is dependent on the maintenance of sufficient discharge and reasonable water quality. (Moore-IVI)
W85-05710

MODEL FOR RAPID GROWTH EVALUATION IN FISHES: THE CASE OF THE CYPRINIDS OF SOME LARGE FRENCH RIVERS,
Ecole Nationale Superieure Agronomique de Toulouse (France). Lab. d'Ichthyologie Appliquee.
J. Moreau, A. Belaud, F. Dauba, and A. Nelva.
Hydrobiologia, Vol. 120, No. 3, p 225-227, January, 1985. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Fish, *Growth, *Mathematical models, *France, Africa, Rivers, Reservoirs, Photoperiod, Water temperature, Life span, Climate.

Within a fish population, individual growth is assumed to be a continuous phenomenon when fitted to the equation of Von Bertalanffy. The relationship between mean maximum observed length (LMMO) and the Von Bertalanffy factors L sub OO and k was studied in 42 populations of cyprinids from the following French rivers and their associated artificial lakes: Ain, Allier, Dordogne, Garonne, Lot, Rhone, Saone, and Tarn. The populations studied seem to conform to the model developed for African fish. For the same value of LMMO, L sub OO is higher in France than in Africa, and k has a lower value. The high temperatures and photoperiod in African waters may incude a higher food producrtion. This causes an important initial growth rate, but such a fast growth, not observed in temperate waters, may also stimulate ageing and thus produce a shorter life span for the same value of k than in temperate climates. (Moore-IVI)
W85-05717

ALTO SINU HYDROELECTRIC PROJECT IN COLOMBIA: POSSIBLE CONSEQUENCES FOR THE ENVIRONMENT,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
P. Leentvaar.
Hydrobiologia, Vol. 120, No. 3, p 241-248, January, 1985. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Chemical properties, *Dam effects, *Alto Sinu, *Sinu River, *Colombia, Dam effects, Turbidity, Eutrophication, Reservoirs, Environmental effects, Suspended solids, Dissolved oxygen, Algae, Fish, Trees, Flooding, Water pollution.

There are plans to construct two reservoirs in the upper Sinu River in the area known as Alto Sinu in Western Colombia. As a result, about 600 su km of tropical rainforest will be inundated. As very little is known about the ecology of this area, an attempt is made to summarize the available information on the chemical composition of the water and biological life, especially fish, in the Sinu River system. The Sinu rises in the northern Andes and flows into the the Caribbean Sea. The concentration of chemicals in the water varies with the discharge in the wet and dry seasons. There is a considerable amount of suspended material in the water, and turbidity is high in some areas. The river is well oxygenated, and BOD is low. The upper Sinu is eutrophic, but development of algae or submerged vegetations is limited because of the high turbidity

and fast-flowing water. In the lower Sinu and the cienagas, the flow of water is slow and the growth of algae is favored. Coliforms are present in large numbers, indicating pollution. The swift flowing water and the turbidity of the water prevents the growth of plankton in the main stream. About 148 fish species have been observed in the river system. As a consequence of flow regulation by the Alto Sinu Project, water may not reach the ciengas; the ciengas may dry up in places. Fisheries and navigation will be hampered if trees remain underwater in the reservoir area after inundation. The increase in transparency of the water as a result of sedimentation in the reservoir will be counteracted by the development of algae in the stagnant water. The hypolimnion may produce low oxygen levels during stratification. (Moore-IVI)
W85-05718

IN SITU METHANE PRODUCTION FROM ACID PEAT IN PLANT COMMUNITIES WITH DIFFERENT MOISTURE REGIMENS IN A SUBARCTIC MIRE,
Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Mikrobiologi.
For primary bibliographic entry see Field 2K.
W85-05720

VERTICAL DISTRIBUTION OF PRIMARY PRODUCTION AND PHYTOPLANKTON IN TWO SMALL LAKES WITH DIFFERENT HUMUS CONCENTRATION IN SOUTHERN FINLAND,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
L. Arvola.
Holarctic Ecology, Vol. 7, No. 4, p 390-398, December, 1984. 14 Fig, 4 Tab, 30 Ref.

Descriptors: *Vertical distribution, *Primary productivity, *Phytoplankton, *Humus, *Lakes, *Finland, Nitrogen, Phosphorus, Biomass, Chlorophyll a, Algae, Bacteria, Stratification.

Vertical distribution of primary production and phytoplankton was studied in a polyhumic brownwater lake and in an oligo-mesohumic lake. During summer both lakes were thermally, chemically and biologically stratified. In the brownwater lake primary production was restricted to the uppermost layer of 1-1.5 m of epilimnion. In the oligo-mesohumic lake noticeable primary production was detected down to depths of 2-3 m. The ice-free period primary production was about 20% higher in the oligo-mesohumic lake, though occasionally the surface production was 2-3 times higher in the brownwater lake. Epilimnetic total phosphorus and total nitrogen concentrations were higher in the brownwater lake, while nitrate-nitrite, ammonium and phosphate concentrations were very low in both lakes. Phytoplankton was confined to the uppermost productive layer in the brownwater lake. In the oligo-mesohumic lake phytoplankton was distributed more evenly, though the mean maximum biomass was at the depth of 3-4 m. Below the oxic water layer biomass decreased abruptly in both lakes. In the oligo-mesohumic lake chlorophyll concentration was extremely high (max. 230 mg chl a/cu m) in the anoxic hypolimnion, due to green sulfur bacteria. Flagellated chlorophytes and chrysophytes dominated in the brownwater lake; in spring Chlamydomonas species, followed by Mallomonas caudata. In the oligo-mesohumic lake small coccal green algae, such as Oocystis, Scenedesmus and Westella-like species, dominated in mid-summer, and chrysophytes and cryptomonads in autumn. (Author's abstract)
W85-05721

WATER QUALITY AND WATERSHED LAND USED OF JOHNSON SAUK TRAIL LAKE,
Illinois State Water Survey Div., Peoria. Water Quality Section.
For primary bibliographic entry see Field 6G.
W85-05722

DIATOMS OF THE SHATT AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Marine Science Centre.
R. A. M. Hadi, A. A. Al-Saboonchi, and A. K. Yousuf Haroon.
Nova Hediwgia, Vol. 39, No. 3/4, p 513-557, 1984. 245 Fig, 32 Ref.

Descriptors: *Diatoms, *Shatt al-Arab, *Iraq, Distribution, Species composition, Algae, Habitats.

The Shatt al-Arab River is the most important river and only source of water supply in the arid surrounding region of southern Iraq. This contribution is a part of an extensive survey to study the species composition, the distribution pattern of algal flora and to assess the effect of pollution, mainly organic, on the environment and algal populations in the Shatt al-Arab River and some of its canals. A 30 km stretch of the Shatt al-Arab River, from its beginning near Garmat Ali in the north to Abu al-Khasib in the south was chosen for study. Diatoms of the Shatt al-Arab River were collected monthly from April 1982 to June 1983 from different habitats (planktonic, epiphytic, epilithic and epipelic). A total of 116 taxa have been recorded, of which 22 taxa were new records for Iraq. (Moore-IVI)
W85-05724

STEADY WINTER CIRCULATIONS IN LAKES CONSTANCE AND KINNERET DRIVEN BY WIND AND MAIN TRIBUTARIES,
Israel Oceanographic and Limnological Research Ltd., Haifa.
S. Serruya, E. Hollan, and B. Bitsch.
Archiv fur Hydrobiologie, Supplement 70, No. 1, p 33-110, December, 1984. 40 Fig, 3 Tab, 44 Ref.

Descriptors: *Wind, *Tributaries, *Water circulation, *Lake Constance, *Lake Kinneret, Mathematical studies, Water currents, Stratification, Advection, Forcing.

The steady state circulation in Lakes Constance and Kinneret was studied mathematically to predict the large-scale advection of water masses, which is caused by wind forcing and the discharges of the main tributaries. Since the homogeneous distribution of mass involves a relatively simple mathematical formulation, the investigations concentrates on the conditions during the winter season when both lakes are not stratified. The modifications caused by a weak density stratification in the interim season of warming in spring and of strong cooling in autumn are also considered. A mathematical approach is used to describe the features of the two-dimensional, vertically integrated flow in the homogeneous lakes, a condition which is typical of a winter situation. Subsequently, the horizontal circulation is resolved locally for the vertical dependency of the current according to the system of drift and gradient currents. The additional calculation of the vertical component of motion provides complete information for the Lagrangian description of the field of motion, which is computed in several examples to illustrate the forecast in terms of three-dimensional trajectories. The considerations are supplemented by calculations of the equilibrium elevation of the surface and by a discussion on the limitations of the theoretical approach as well as on the modification due to the density stratification during the warm season. In the presence of a weak stratification, the steady current field does not undergo radical changes. (Moore-IVI)
W85-05727

FRACTIONATION OF ORGANIC AND INORGANIC PHOSPHORUS COMPOUNDS IN LAKE SEDIMENTS, AN ATTEMPT TO CHARACTERIZE ECOLOGICALLY IMPORTANT FRACTIONS (DIE FRAKTIONIERUNG ORGANISCHER UND ANORGANISCHER PHOSPHORVERBINDUNGEN VON SEDIMENTEN, VERSUCH EINER DEFINITION OKOLOGISCH WICHTIGER FRAKTIONEN),
Innsbruck Univ. (Austria).
R. Psenner, R. Pucsko, and M. Sage.
Archiv fur Hydrobiologie, Vol. 1, No. 1, p 111-155, December, 1984. 6 Fig, 10 Tab, 71 Ref.

Descriptors: *Phosphorus, *Lake sediments, *Organic compounds, Sediments, Phosphates, Sediment analysis, Iron oxides, Aluminum, Manganese oxides, Hydrogen ion concentration, Apatite, Redox potential.

An attempt was made to develop a procedure for fractionating sedimentary phosphorus compounds, to obtain a better chemical definition of several organic and inorganic phosphorus fractions. This aim was partially achieved by: testing the effect of single reagents upon the solubilization of pure substances and P fractions; avoiding the combination of extractants which act in different ways (reduction-chelation-complexation); excluding digestion steps for the determination of inorganic phosphorus; correlating phosphorus fractions with other sediment characteristics such as dissolved pore water phosphate, release rates, uptake capacity, redox potential and depth. This method is able to distinguish between phosphorus fractions which normally are treated together: Fe-P and Al-P = non apatite inorganic phosphorus. Iron and aluminum bound phosphates, having similar properties at very high pH values, react in a completely different way to changing environmental conditions such as temperature, pH and redox potential. By distinguishing between these two important inorganic compounds, other sediment qualities (such as release and uptake mechanisms) can be understood. The difference between total and inorganic phosphorus bound to iron and manganese oxides can amount to more than 100%. The fractionation procedure is useful for distinguishing between dissolved or water soluble phosphorus, reductant soluble phosphorus (bound to Fe and Mn oxides), NaOH-extractable P (Al-P and ligand exchangeable phosphate, mineral FePO4 humic acid bound phosphorus), apatite phosphorus and refractory phosphorus. In each fraction, total and inorganic phosphorus was determined. The sum of all fractions correspond well with the total phosphorus content of the sediment, measured by different digestion methods. (Moore-IVI)
W85-05728

LONG-TERM WETLAND-WATERFOWL TRENDS IN SASKATCHEWAN GRASSLAND,
Ducks Unlimited Canada, Winnipeg (Manitoba).
W. G. Leitch, and R. M. Kaminski.
Journal of Wildlife Management, Vol. 49, No. 1, p 212-222, January, 1985. 2 Fig, 9 Tab, 32 Ref.

Descriptors: *Wetlands, *Waterfowl, *Grasslands, *Saskatchewan, Ducks, Reproduction, Prairies, Drought, Wildlife habitats, Wildlife conservation.

Wetland numbers, breeding duck populations, and brood production were monitored on a relatively pristine tract of grassland in south-central Saskatchewan from 1950 to 1975. Yearly number of wetlands (an index of wetland conditions) decreased an average of 55% between May and August 1950-75, but yearly numbers of May and August wetlands were positively correlated. Correlations among yearly numbers of adult ducks, their production, and yearly wetland numbers suggested that waterfowl recruitment from prairie environments with dynamic wetland regimes is a consequence of breeding population size, individual reproductive performance, and the persistence of suitable wetland conditions between spring and late summer. Duck populations that exploit variable prairie environments may exemplify temporally dynamic reproductive strategists and perhaps should not be labeled as either r- or K-strategies. Long-term duck population trends for the grassland site were compared with those from parkland areas in Alberta, Saskatchewan, and Manitoba. Both grassland and parkland populations increased with favorable wetland conditions during the 1950's but decreased during the drought of the early 1960's. Wetland conditions improved markedly during the late 1960's and early 1970's at the grassland site, and pair densities of most duck species were higher in the early 1970's than in the 1950's. In contrast, parkland populations generally decreased between the 1950's and 1970's. Relative abundances of mallard (Anas platyrhynchos) and blue-winged teal (A. discors) were similar during the 1950's and 1970's at the grassland site, whereas blue-winged teal outnumbered mallard at the parkland sites. The relatively pristine upland and wet-

land habitat of the grassland site, unlike the agriculturally impacted parkland sites, may have positively influenced duck populations in the grassland site, implicating increased need for complexes of quality wetland and upland habitat for enhancement of duck production. (Author's abstract)
W85-05734

NITROGEN FIXATION IN SUBARCTIC STREAMS INFLUENCED BY BEAVER (CASTOR CANADENSIS),
Woods Hole Oceanographic Institution, MA.
M. M. Francis, R. J. Naiman, and J. M. Melillo.
Hydrobiologia, Vol. 121, No. 3, p 193-202, February, 1985. 2 Fig, 4 Tab, 34 Ref.

Descriptors: *Nitrogen fixation, *Beavers, *Streams, Subarctic region, Wood, Sediments, Microorganisms, Beaver ponds, Riffles.

Nitrogen fixation was measured in four subarctic streams substantially modified by beaver (Castor canadensis) in Quebec. Acetylene-ethylene (C2H2 to C2H4) reduction techniques were used during the 1982 ice-free period (May-October) to estimate nitrogen fixation by microorganisms colonizing wood and sediment. Mean seasonal fixation rates were low and patchy, ranging from zero to 0.0023 micro-mol C2H4/sq cm/h for wood, and from zero to 0.0070 micro-mol C2H4/gAFDM/h for sediment; 77% of all wood and 63% of all sediment measurements showed no C2H2 reduction. Nonparametric statistical tests were unable to show a significant difference ($p > 0.05$) in C2H2 reduction rates between or within sites for wood species or by sediment depth. Nitrogen contributed by microorganisms colonizing wood in riffles of beaver influenced watersheds was small (e.g., 0.207 g N/sq m/y) but greater than that for wood in beaver ponds (e.g.., 0.008 g n/sq m/y) or for streams without beaver (e.g., 0.003 g N/sq m/y). Although mass specific nitrogen fixation rates did not change significantly as beaver transform riffles into ponds, the nitrogen fixed by organisms colonizing sediment in pond areas (e.g., 5.1 g N/sq m/y) was greater than that in riffles (e.g., 0.42 g N/sq m/y). The annual nitrogen contribution is proportional to the amount of sediment available for microbial colonization. It is estimated that total nitrogen accumulation in sediment, per unit area, is enhanced 9 to 44 fold by beaver damming a section of stream. (Author's abstract)
W85-05737

INFLUENCE OF THE SURFACE MICROLAYER ON NUTRIENTS, CHLOROPHYLL AND ALGAL DIVERSITY OF A SMALL EUTROPHIC BOG POND,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
K. W. Estep, and C. C. Remsen.
Hydrobiologia Vol. 121, No. 3, p 203-213, February, 1985. 4 Fig, 3 Tab, 46 Ref.

Descriptors: *Surface microlayers, *Nutrients, *Chlorophyll, *Algae, *Ponds, Bogs, Diatoms, Species diversity, Solar radiation, Eutrophication.

Samples were collected on 14 dates between May and October 1981 from a small, experimental pond near the edge of a bog in Wisconsin. A total of 71 species of algae in 45 genera were identified. Flagellates comprised the majority of cells on all dates and diatoms were often second in abundance. The nutrient chemistry analyses indicate that the surface microlayer of the experimental pond provided algae with conditions different from those at subsurface depths. Nutrient levels were consistently higher in a microlayer while algal abundance was sometimes higher but sometimes lower in the microlayer than at near subsurface depths. Algal diversity values were strongly influenced by the depth of flagellate blooms, and diversity in the microlayer was higher than at near subsurface depths. No correlation was found between algal enrichment and wind speed, sky cover or minutes of daylight for the time periods 6, 12 and 24 h before each sample collection. The microlayer community as a whole was dominated by healthy cells, although there was evidence of some damage due to solar radiation. The precipitous blooms which occurred at the surface indicate that the neuston can, under certain conditions, represent the site of maximum abundance for the entire water column. (Moore-IVI)
W85-05738

PLANKTON AND MATERIALS BUDGET OF THE MOSEL AT THE ENKIRCH STORAGE BASIN 1981 (PLANKTON UND STOFFHAUSHALT DER MOSEL BEI DER STAUHALTUNG ENKIRCH 1981),
Technische Hochschule Darmstadt (Germany, F.R.).
W. Rech, and R. Kinzelbach.
Hydrobiologia, Vol. 21, No. 3, p 215-235, February, 1985. 22 Fig, 17 Ref.

Descriptors: *Plankton, *Mosel River, *Nutrients, Nitrogen, Phosphorus, Oxygen depletion, Velocity, Water temperature, Solar radiation.

River plankton becomes an important factor in rivers affected by man, as a result of a permanent abundance of P and N, and of a lowering of current velocity transforming a river into a chain of storage basins. This process is demonstrated by means of data from the storage basin of Enkirch on the river Mosel, where in summer the growth of plankton leads to an oxygen deficiency. The mechanisms involved are shown. They are controlled by flow, global radiation, and temperature. (Author's abstract)
W85-05739

CARBON FLOW IN A SMALL TURBID MAN-MADE IMPOUNDMENT,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
J. U. Grobbelaar, and D. F. Toerien.
Hydrobiologia, Vol. 121, No. 3, p 237-247, February, 1985. 1 Fig, 7 Tab, 26 Ref.

Descriptors: *Carbon, *Reservoirs, *Nutrient budget, Turbidity, Model studies, Phytoplankton, Fish, Bacteria, Zooplankton, Benthos, Detritus, Particulate matter, Dissolved solids, Primary productivity, Organic matter, Cycling nutrients.

A shallow turbid man-made impoundment was studied intensively for five years. The carbon (C) budget indicated a well balanced system, where phytoplankton productivity and respiratory losses accounted for the major inputs and outputs. The carbon content was dominated by dissolved organic carbon, followed by detritus > fish > phytoplankton > bacteria > zooplankton > zoobenthos. From an analysis of a matrix flow model, three dominant components of C-flow in the system were identified, i.e. dissolved inorganic carbon (DIC), particulate organic carbon (POC) and fish. Phytoplankton and detritus were the important components of POC. The largest flow of C was through the largest pool, dissolved inorganic carbon (DIC), while the second largest flow through the fifth largest pool, the phytoplankton. Phytoplankton was very important in determining the structure of the system, and variations in phytoplankton primary productivity influenced the entire system. This also applied to the input of organic material from macrophytes, but not to variations in the inflow of water from the impoundment. The input of detrital material from a littoral macrophyte community also markedly influenced the system. DOC was identified as a carbon buffer in the system, and differential flow occurred through this component upon variations in phytoplankton productivity. (Author's abstract)
W85-05740

LIMNOLOGY OF THE LAGO GRANDE DE ESTANYA (HUESCA) (LIMNOLOGIA DEL LAGO GRANDE DE ESTANYA (HUESCA)),
Barcelona Univ. (Spain). Dept. de Ecologia.
A. Avila, J. L. Burrel, A. Domingo, E. Fernandez, and J. Godall.
Oecologia Aquatica, Vol. 7, p 3-24, July, 1984. 11 Fig, 6 Tab, 23 Ref.

Descriptors: *Limnology, *Phytoplankton, *Zooplankton, *Chemical properties, *Lago Grande de Estanya, *Spain, Monomictic lakes, Thermal stratification, Nutrients, Alkalinity, Chlorophyll, Algae, Principal component analysis.

Phytoplankton, zooplankton and chemistry of the Lago Grande de Estanya in northwest Spain were studied between February, 1979, and March 1980. The lake is almost certainly fed by groundwater. The lake is monomictic, with thermal stratification extending from March to September. Surface temperature ranged from 6 C in February to 26.5 C in August. Judging from Secchi disk readings, light penetration was at a maximum (6.8 m) between November and February, and at a minimum in August (2.7 m) during a period of maximum phytoplankton abundance. Anaerobic conditions prevailed below the thermocline from June to October. Alkalinity ranged from 2 to 3.5 meg/l, with maximum values near the bottom in late October due to redissolution of carbonate sediments under anaerobiosis. Phosphate was very low (0 to 1 micro-g-at/l) in all samples. Nitrate ranged from 0 to 8.5 micro-g-at/l, with low values in summer. Vertical profiles of chlorophyll-a were quite homogeneous, but chlorophyll concentration was higher in spring and autumn than in summer. Phytoplankton abundance reached a maximum in the epilimnion in summer, with dominance of Planctonema lauterbornii and other Chlorococcales. A total of 90 phytoplankton taxa were identified. An annual succession of the phytoplankton groups was observed: Chlorophyceae dominated in the epilimnion in summer followed by dominance by dinoflagellates at the end of the season. Diatoms appeared with the onset of vertical mixing and remained abundant all through the winter. Chrysophyceae showed sporadic blooms in spring and autumn. Cryptophyceae developed mainly in winter and spring. Zooplankton is relatively species-poor. Principal component analysis was performed with 27 phytoplankton species and 8 zooplankton species. (Moore-IVI)
W85-05746

LIGHT ATTENUATION IN SPANISH RESERVOIRS. RELATIONSHIP WITH CHLOROPHYLL AND SUSPENDED PARTICULATE MATERIAL (EXTINCION DE LA LUZ EN LOS EMBALSES ESPANOLES. RELACIONES CON LA CONCENTRACION DE CLOROFILA Y LAS PATICULAS EN SUSPENSION),
Barcelona Univ. (Spain). Dept. de Ecologia.
V. Rulli, T. Vegas, and J. Navarro.
Oecologia Aquatica, Vol. 7, p 25-36, July, 1984. 13 Fig, 4 Tab, 13 Ref.

Descriptors: *Light attenuation, *Chlorophyll, *Suspended solids, *Reservoirs, *Spain, Opacity, Prediction, Multiple regression analysis.

Secchi disc depths (Ds), and extinction coefficients of total visible light (Kt) and of light transmitted by three different kinds of filters Ka, Kv, Kr, were obtained in 63 Spanish reservoirs. The best estimate of the constant relating Ds and Kt is given by $Kt = 1.75/Ds$. Light attenuation of green light (Kv) is low and regular, as expected. A multiple regression has been computed to relate Secchi disc depth to the extinction coefficients for total light using the different filters (table I). Once again Kv has more weight and is the best predictor. A number of types of water are identified, according to the relative values of the different partial extinction coefficients. The relation between Secchi disc depth and chlorophyll concentration is, in general, $Ds \cdot Cl0.17 = 3.5$ and, in spring, $Ds \cdot Cl0.44 = 1.72$. The prediction of chlorophyll concentration from Secchi disc readings is reliable only for $Ds > 4$ m. (Author's abstract)
W85-05747

ANNUAL CYCLE AND SPATIAL HETEROGENEITY OF THE ZOOPLANKTON IN A SERIES OF RESERVOIRS ON THE GUADIANA RIVER (CICLO ANUAL Y HETEROGENEIDAD ESPACIAL EN EL ZOOPLANCTON DE UNA CADENA DE EMBALSES DEL RIO GUADIANA),
Barcelona Univ. (Spain). Dept. de Ecologia.
J. Armengol.

Ecologia Aquatica, Vol. 7, p 43-72, July, 1984. 30 Fig, 4 Tab, 23 Ref.

Descriptors: *Zooplankton, *Reservoir operation, Guadiana River, *Spain, Spatial distribution, Temporal distribution, Protozoa, Rotifers, Cladocera, Copepods, Flow discharge.

From October, 1976, to December, 1977, a chain of three reservoirs on the Guadiana River (SE Spain) was studied. The spatial and temporal variations of the zooplankton communities have been determined through bimonthly sampling at 10 stations. A total of 21 species were recorded: 4 protozoa, 11 rotifers, 4 cladocerans and 2 copepods. The temporal and spatial distribution of these species shows a number of regularities that have been studied using principal component analysis, analysis of variance and diversity indices. The zooplankton communities of these reservoirs are similar, but each reservoir retains a certain measure of individuality. The annual changes in the community composition show synchronic maxima for groups of species. Their sequence can be related to the environmental changes that take place during the year. Spatial heterogeneity was studied at two levels: changes within and between the sampling stations of each reservoir, especially between those located near the dam and in the river. In general, the heterogeneity is higher near river stations. In periods of high water discharge, the species with a high rate of reproduction (rotifers, protozoans) are dominant at these stations. On the contrary, when low rate drops, cladocerans show characteristic pattern in relation to particular environmental conditions. The differences in the community composition between reservoir increase when discharge is at a minimum. (Author's abstract)
W85-05748

AQUATIC MACROPHYTE FLORA OF SALINE WETLANDS IN WESTERN AUSTRALIA IN RELATION TO SALINITY AND PERMANENCE,

Murdoch Univ. (Western Australia). School of Environmental and Life Science.

For primary bibliographic entry see Field 2L.
W85-05752

EPHEMERAL SALINE LAKES ON THE CANADIAN PRAIRIES: THEIR CLASSIFICATION AND MANAGEMENT FOR EMERGENT MACROPHYTE GROWTH,

Lethbridge Univ. (Alberta). Dept. of Biological Sciences.
W. J. Lieffers, and J. M. Shay.
Hydrobiologia, Vol. 105, p 85-94, November, 1983. 7 Fig, 2 Tab, 30 Ref.

Descriptors: *Saline lakes, *Lake management, *Macrophytes, *Saskatchewan, Ephemeral lakes, Emergent plants, Salinity, Lake sediments, Littoral zone, Water managment.

At two ephemeral saline lakes in Saskatchewan, changes in the physical and chemical features of water and sediments at various basin positions were monitored during a wet-dry cycle in 1978 and 1979. Water salinity fluctuated widely in response to changes in water volume and mass of solute in the water. When basins were dry, the soluble salt content of sediments 0-10 cm deep was higher then sediments 50-60 cm deep and sediments in the lake center were more saline than at the shoreline. Upon reflooding, there was a large immediate decrease in sediment salinity at the 0-10 cm depth, such that this layer was less saline than sediments 50-60 cm deep. Sediments in the lake center remained more saline than at the shoreline. Classification of lake salinity is necessary to assess the potential of a lake for emergent production. The large variances in ephemeral lake salinity due to water volume changes indicate that classification should be based upon the water volume-salinity cycle of these lakes rather than the salinity of any single water or sediment sample. Water management efforts to lower salinities, to improve these wetlands for emergent growth, should be aimed at reducing the salinity regime of the littoral zone. Flushing, dilution and drying and reflooding techniques are discussed as methods to decrease salinity. (Author's abstract)
W85-05753

PREDICTED EFFECTS OF INCREASING SALINITY ON THE CRUSTACEAN ZOOPLANKTON COMMUNITY OF PYRAMID LAKE, NEVADA,

Colorado Cooperative Fishery Research Unit, Fort Collins.
For primary bibliographic entry see Field 6G.
W85-05754

LIMNOLOGICAL CONTRASTS AND ANOMALIES IN TWO ADJACENT SALINE LAKES,

British Columbia Univ., Vancouver. Inst. of Animal Resource Ecology.
T. G. Northcote, and K. J. Hall.
Hydrobiologia, Vol. 105, p 179-194, November, 1983. 6 Fig, 5 Tab, 26 Ref. NSERC grants 67-3454 and 67-8935.

Descriptors: *Saline lakes, *Green Lake, *Limnology, *Mahoney Lake, *British Columbia, Stratification, Conductivity, Alkalinity, Calcite, Meromictic lakes, Dimictic lakes, Phytoplankton, Zooplankton, Bacteria, Geology, Topography.

Although closely situated saline lakes and ponds may show considerable variation in their physical-chemical and biological characteristics, few exhibit such striking differences as those found in two small permanent water bodies less than a kilometer apart in the southern Okanagan Valley of British Columbia. Mahoney Lake is strongly meromictic, while Green Lake is a more typical temperate dimictic lake. Surface waters of Mahoney Lake shortly after ice-out are over 4 times the conductivity of Green Lake and by mid-June, almost 6 times higher. The high alkalinity and a pH above 8.5 favor the formation of carbonate and precipitation of calcite in the water column of Green Lake and the surface waters of Mahoney. Although the lake basins are morphometrically similar, differences in their watershed geology and topography in large part may be responsible for the more saline lake showing severe and anomalous meromictic features while the less saline lake exhibits normal dimictic characteristics. Bacterial and phytoplankton biomass and productivity information suggest that Green Lake is dominated by phytoplankton carbon fixation while Mahoney is mainly dominated by a bacterial-detritus based system. In Mahoney Lake, zooplankton abundance was greatly reduced in the upper anoxic layer at 1.5 m, while there were two distinct concentration zones of phytoplankton, one in the uppermost meter and another between 2 and 7 m. (Moore-IVI)
W85-05755

SEASONAL CHANGES IN THE CHEMISTRY AND BIOLOGY OF A MEROMICTIC LAKE (BIG SODA LAKE, NEVADA, U.S.A.),

Geological Survey, Menlo Park, CA.
J. E. Cloern, B. E. Cole, and R. S. Oremland.
Hydrobiologia, Vol. 105, p 195-206, November, 1983. 5 Fig, 2 Tab, 32 Ref.

Descriptors: *Seasonal variation, *Chemical properties, *Big Soda Lake, *Nevada, Meromictic lakes, Alkaline lakes, Saline lakes, Phytoplankton, Chlorophyll, Nutrients, Dissolved oxygen, Water temperature, Bacteria, Photosynthesis.

Big Soda Lake is an alkaline, saline lake with a permanent chemocline at 34.5 m and a mixolimnion that undergoes seasonal changes in temperature structure. During the period of thermal stratification, from summer through fall, the epilimnion has low concentrations of dissolved inorganic nutrients (N, Si) and CH4, and low biomass of phytoplankton (chlorophyll a approximately 1 mg/cu m). Dissolved oxygen disappears near the compensation depth for algal photosynthesis (about 20 m). Surface water is transparent so that light is present in the anoxic hypolimnion, and a dense plate of purple sulfur photosynthetic bacteria (Ectothiorhodospira vacuolata) is present just below 20 m (Bchl a approximately 200 mg/cu m). Concentrations of NH4(+), Si, and CH4 are higher in the hypolimnion than in the epilimnion. As the mixolimnion becomes isothermal in winter, oxygen is mixed down to 28 m. Nutrients (NH4(+), Si) and CH4 are released from the hypolimnion and mix to the surface, and a diatom bloom develops in the upper 20 m (chlorophyll a > 40 mg/cu m). The deeper mixing of oxygen and enhanced light attenuation by phytoplankton uncouple the anoxic zone and photic zone, and the plate of photosynthetic bacteria disappears (Bchl a approximately 10 mg/cu m). Hence, seasonal changes in temperature distribution and mixing create conditions such that the primary producer community is alternately dominated by phytoplankton and photosynthetic bacteria: the phytoplankton may be nutrient-limited during periods of stratification and the photosynthetic bacteria are light-limited during periods of mixing. (Author's abstract)
W85-05756

LIMNOLOGY OF GALLOCANTA LAKE, ARAGON, NORTHEASTERN SPAIN,

Barcelona Univ. (Spain). Dept. de Ecologia.
F. A. Comin, M. Alonso, P. Lopez, and M. Comelles.
Hydrobiologia, Vol. 105, p 207-221, November 1, 1983. 12 Fig, 1 Tab, 57 Ref.

Descriptors: *Limnology, *Saline lakes, *Gallocanta Lake, *Spain, Salinity, Phosphorus, Nitrogen, Zooplankton, Phytoplankton, Macrophytes, Drought.

A limnological study was conducted from September 1980 to October 1981 to show the evolution of Gallocanta Lake (N.E. Spain) under very dry climatic conditions. It is the physical terminus within an endorheic basin of 500 sq km situated 1,000 m above sea level. In 1977 its maximum depth was 2.5 m but it decreased to 60 cm in 1981 as a consequence of several very dry years. It is 6 km long and 2.5 km wide, and its area is approximately 12 sq km. Salt concentration was quite constant (32-43 g/l) from September 1980 until June 1981. The equivalent ratio Cl(-):SO4(2-) varied between 2.2 and 2.8. From June through October 1981 salinity increased up to 105 g/l and Cl(-):SO4(2-) equivalent ratio varied between 2.5 and 3.4. The relative concentrations of ions were retained all year ordinated as follows: Cl(-) > SO4(2-) > HCO3(-) >. CO3(2-); Na(+) > Mg(2+) >> Ca(2+) > K(+). Total reactive phosphorus was less than 1.5 micro-g-at/l from September 1980 to January 1981. During the rest of the studied period it varied between 2 and 8 micro-g-at/l (the maximum, in February 1981). Nitrogen oxidized forms were relatively high in winter (4-8 micro-g-at N-NO-3/l; 0.5-2.5 micro-g-at N-NO-2/l), and early May 1981 (25 micro-g-at N-NO-3/l; 1 micro-g-at N-NO-2/l). Neither reached 1 micro-g-at/l from September through December 1980, or from June through October 1981. Planktonic algae increased in density during the period of the study from 1000 to 500,000 cells/ml. Chromulina sp. was the main species during autumm and winter (> 50% in number of cells/ml) while the copepod Arctodiaptomus salinus decreased its population. Lobocystis dichotoma increased its density from December 1980 to May 1981 and was dominant in spring (> 90%), when a typical reproductive activity was observed in the Arctodiaptomus population. This species disappeared in late spring. In June 1981 Brachionus plicatilis reached up to nearly 2,000 individuals/ml. This species was not observed after August 1981. Then the ciliate Fabrea salina was the only zooplankter staying in the free waters of the lake and Nannochloris sp. the dominant alga (> 90%). Dense macrophytic beds constituted of Lamprothamnium papulosum and Chara galioides covered the bottom of the lake in September 1980 and before that date since the observations began in 1977. The decreased in covered area since October 1980 and disappeared during summer 1981. Gallocanta Lake is in a very stressed situation produced by prolonged drought. The increased salt concentration together with the extremely cold and hot temperatures, and the lack of nitrogen relative to phosphorus are the main environmental factors that controlled the biological populations

during the period of the present study. (Author's abstract)
W85-05757

LARGE, DEEP SALT LAKES: A COMPARATIVE LIMNOLOGICAL ANALYSIS,
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack.
Hydrobiologia, Vol. 105, p 223-230, November, 1983. 1 Fig, 1 Tab, 58 Ref.

Descriptors: *Saline lakes, *Limnology, *Mono Lake, *California, *Qinghai Hu, *China, Altitude, Stratification, Dissolved oxygen, Supersaturation, Alkalinity, Phosphates, Nitrogen, Transparency, Algae, Aquatic animals.

Among athalassic salt lakes of the world large, deep lakes are rare. A comparative analysis of Mono (USA), Walker (USA), Qinghai Hu (China), Shala (Ethiopia), Van (Turkey), Panggong Tso (Indian Tibet) and Karakul (USSR) (with emphasis on Mono and Quighai Hu) reveals a number of ecological similarities. The criteria of selection were a mean depth greater than 15 m, an area greater than 100 sq km and a salinity greater than 10 g/l and less than 100 g/l. The Aral and Caspian Seas were excluded because of the relict marine affinities of their biota. Large, deep salt lakes are located at moderate to high altitude in mountainous terrain: they stratify and mix at least once per year, and dissolved oxygen is depleted in the hypolimnia of most. The lakes contain alkaline, sodium rich waters with considerable chloride, sulfate and carbonate plus bicarbonate. Phosphate concentrations are usually high while inorganic nitrogen varies widely. Secchi disk transparency ranged from < 1 m to ca. 20 m. Supersaturation of dissolved oxygen, abundant animals and seasonally high algal populations indicate that some of the lakes are productive. All except Mono contain fish. (Author's abstract)
W85-05758

AUSTRALIAN SALT LAKES: THEIR HISTORY, CHEMISTRY, AND BIOTA - A REVIEW,
Australian National Univ., Canberra. Dept. of Biogeography and Geomorphology.
P. De Deckker.
Hydrobiologia, Vol. 105, p 231-244, November 1, 1983. 3 Fig, 1 Tab, 107 Ref.

Descriptors: *Saline lakes, *History, *Chemical properties, *Aquatic life, *Australia, Crater lakes, Sodium, Chloride, Calcium sulfate, Sodium carbonate, Crustaceans, Distribution, Climate.

A vast number of large lakes (>> 100 sq km) are typically very old features of the Australian landscape; they occupy areas which have changed little tectonically (e.g., they occupy ancient drainage systems in Western Australia or lie in deep depressions such as the Great Artesian Basin: Lake Eyre) and have not been transgressed by the sea since at least the Paleogene. Other salt lakes, most of which are small (<< 50 sq km), have been affected morphologically during recurring glacial-interglacial cycles (e.g., lakes associated with gypsum or clay lunettes, sabkhas, pans, lakes near the coast behind barrier dunes as a result of sea-level changes) and their sedimentary records represent comparatively much shorter periods of time. Ther are also a number of unusually young (< 30,000 years) crater lakes, some of which are the best studied lakes in Australia. The major ions encountered today in Australian salt lakes consist of sodium and chloride although some lakes are also calcium sulfate rich. The origin of these ions is briefly discussed. Sodium carbonate lakes are rare in Australia today. Under past climatic/hydrological conditions the chemistry of a number of lakes was apparently different. The biota of Australian salt lakes is mostly endemic; it is highly diversified as witnessed by the crustacean fauna and is well adapted to the harsh conditions prevailing in saline water. This is the result of a long history of aridity in Australia. The characteristics of this biota are presented together with data on its distribution which is primarily related to climatic conditions. (Author's abstract)
W85-05759

SEDIMENTOLOGY AND GEOCHEMISTRY OF SALINE LAKES OF THE GREAT PLAINS,
Manitoba Univ., Winnipeg. Dept. of Earth Sciences.
W. M. Last, and T. H. Schweyen.
Hydrobiologia, Vol. 105, p 245-263, November, 1983. 15 Fig, 5 Tab, 54 Ref.

Descriptors: *Sedimentology, *Geochemistry, *Saline lakes, *Great Plains, Hypersaline lakes, Lake sediments, Playas, Chemical precipitation, Evaporation, Groundwater, Freeze-out, Detritus, Sedimentation.

Southern Saskatchewan and portions of adjacent Alberta, North Dakota and Montana are occupied by hundreds of saline and hypersaline lakes ranging from small prairie potholes (less than 1 sq km) to relatively large bodies of water (greater than 300 sq km). From a sedimentological perspective, distinction must be made between two basic types of saline lakes: playas and perennial lakes. Calcium, sodium and magnesium sulfates, carbonates and bicarbonates form as chemical precipitates in lakes with more concentrated brines. In addition, experimental data suggests mixed layer smectites may form authigenically in some lakes. Clastic sediments in the salt lakes consist mainly of silt and clay-sized quartz, feldspars, carbonates and clay minerals. The dominant physical and chemical processes which are responsible for and act upon the sediment vary widely, mainly in response to basin morphology and brine chemistry. Evaporative concentration and significant groundwater contributions affect all the saline lakes. However, other processes are different in the two basic types of basins. The playa lakes are influenced by: evaporitic pumping and the formation of efflorescent crusts and intrasedimentary crystals, cyclic wetting and drying, precipitation of highly soluble salt layers, and influx of clastic debris by sheetflood and wind. In contrast, in the permanent lakes, precipitation of sparingly soluble salts occurs due to the interaction of biological activity, seasonal temperature fluctuations and brine mixing. In addition, many of the permanent lakes undergo freeze-out precipitation of very soluble salts under a winter ice cover. Detrital sediments are distributed within the basins by normal lacustrine processes, including shoreline deposition and erosion, turbidity flow and pelagic fallout. (Author's abstract)
W85-05760

GEOCHEMISTRY OF GREAT SALT LAKE, UTAH I: HYDROCHEMISTRY SINCE 1850,
Calgary Univ. (Alberta). Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2K.
W85-05761

GROUND WATER AS A SILICA SOURCE FOR DIATOM PRODUCTION IN A PRECIPITATION-DOMINATED LAKE,
Wright State Univ., Dayton, OH. Dept. of Geology.
J. P. Hurley, D. E. Armstrong, G. J. Kenoyer, and C. J. Bowser.
Science, Vol. 227, No. 4694, March 29, 1985. 2 Fig, 1 Tab, 12 Ref. NSF contract DEB 8012313.

Descriptors: *Silica, *Groundwater, *Diatoms, *Crystal Lake, *Wisconsin, Seasonal variation, Oligotrophic lakes, Cycling nutrients.

To determine the importance of ground water as a silica source for diatom production, an investigation was made of the relation between changes in the biogenic silica content of the water column and the timing and magnitude of silica inputs and outputs at Crystal Lake, an oligotrophic lake in northern Wisconsin. Changes in the silica content of the lake were determined from measurements of the forms and concentrations of silica as a function of time and depth coupled with lake bathymetry. Silica originating in ground water is cycled in the lake approximately 2.5 times during the year, once through direct incorporation into diatom biomass and about 1.5 times through use of silica produced by regeneration. Analyses of bottom sediments indicate that the silica in the lake is approximately at steady state on an annual basis. The net accumulation of particualte biogenic silica in the deep h
sediments is about 4.6 g/sq m/yr and has
changed significantly over the last 175 years. T
corresponding lakewide sediment accumulati
rate (275 kg/year) is not significantly differe
from the ground water input (210 kg/year). Cle
ly, silica supplied from ground water is the u
mate control on silica cycling in Crystal La
(Baker-IVI)
W85-05775

**COMPUTER ANIMATION OF STORM SUR
PREDICTIONS,**
Ohio State Univ., Columbus. Dept. of Civil En
neering.
For primary bibliographic entry see Field 2E.
W85-05784

**CIRCULATION STRUCTURE IN A STRA
FIED CAVITY FLOW,**
Stanford Univ., CA. Dept. of Civil Engineeri
J. R. Koseff, and R. L. Street.
Journal of Hydraulic Engineering, Vol. 111, No.
p 334-354, February, 1985. 18 Fig, 27 Ref,
Append. NSF grant CME-7921324 and Division
Engineering, Mathematical and Geoscienc
Office of Basic Energy Sciences, DOE contr
DOE-DE-AT03-81-ER-10867.

Descriptors: *Circulation, *Stratification, *Cav
flow, *Mixing, *Lakes, Richardson numbers, Th
moclines, Water temperature.

Experiments were conducted to study the circu
tion patterns and mixing processes in a stratifi
lid-driven cavity flow. The ratio of the cav
depth to width used was 1:1 and that of span
width was 3:1. The flow is different from th
reported in the literature in up to four ways: Rec
culation is a dominant feature; temperature cont
is used to obtain the stratification; the upper a
lower boundaries are held at different const
temperatures; and the flows considered are,
most, only partially turbulent. For the geomet
configuration used, the following may be concl
ed about the flow. The flow is strongly thr
dimensional. The number of circulation cells
pected in this stratified flow can be estimated fo
the value of the bulk Richardson number, Ri sub
Given a local Richardson number, Ri, the entra
ment rate, E, is found to be proportional to Ri
the -1.4 power, indicating a shear-induced mix
process related to the recirculation. Tayl
Gortler-like vortices above the thermocline
significant contributors to the mixing process. (A
thor's abstract)
W85-05787

**PLANKTONIC AND BENTHIC BACTERI
POPULATIONS OF LOUGH NEAGH,**
New Univ. of Ulster, Coleraine (Northern I
land). Limnology Lab.
J. P. Quinn, M. B. Gillan, and H. McGrogan.
Journal of Applied Bacteriology, Vol. 58, No. 1
87-93, January, 1985. 4 Fig, 32 Ref.

Descriptors: *Bacteria, *Benthos, *Plankt
*Lough Neagh, *Northern Ireland, *Populat
dynamics, Species composition, Lakes, Ae
monas, Eutrophic lakes.

The planktonic and benthic bacterial populatio
of Lough Neagh, Northern Ireland, were studi
over a one-year period. Direct counts of bacte
in the water column averaged 60,000,000/ml w
limited spatial or temporal variation; viable cou
however, showed a pronounced late spring ma
mum of 1.7 x 10 to the 7th power/ml and w
consistently higher at a littoral sampling stati
Direct counts of bacteria in the profundal se
ments averaged 8 x 10 to the 9th power/ml wh
viable benthic counts rose steeply during spring
reach a June maximum of 1 x 10 to the 8th powe
ml. Direct:viable count ratios were much grea
in the more sandy littoral zone. The predomin
benthic isolate was an Aeromonas sp. which w
also common in samples from the water colum
These results confirm the eutrophic status

ough Neagh indicated by other biological and emical surveys. (Author's abstract)
85-05807

I. Water In Plants

GRICULTURAL DROUGHTS AND CROP LANNING - A CASE STUDY FOR WESTERN AJASTHAN,
entral Arid Zone Research Inst., Jodhpur (India).
or primary bibliographic entry see Field 2B.
85-05076

ESPONSE OF COTTON WATER STRESS IN-ICATORS TO SOIL SALINITY,
gricultural Research Service, Fresno, CA.
A. howell, J. L. Hatfield, J. D. Rhoades, and M. eron.
rigation Science, Vol. 5, No. 1, p 25-36, April, 984. 7 Fig, 2 Tab, 22 Ref.

escriptors: *Water stress, *Cotton, *Saline soils, ater deficit, Salinity, Soil properties, Canopy, emperature effects, Leaves, Water potentials, Irgation effects, Crop yield.

rop water stress results from water deficiencies in ant tissues that impair the plant's growth process. A field study was conducted on cotton to vestigate the effects of soil salinity on the reonse of stress indices derived from canopy temerature, leaf diffusion resistance and leaf water otential. The four salinity treatments used in this udy were obtained by mixtures of aqueduct and ell water to provide mean soil water electrical onductivities of 17, 27, 32, and 38 dS/m in the oper 0.6 m of soil profile. The study was conducted on a sandy loam saline alkali soil in the lower an Joaquin Valey of California on 30 July 1981. he soil profile was adequately irrigated to remove ny interference of soil matric potential on the ress measurements. The crop water stress index, hich requires measurements of canopy temperare, ambient vapor pressure deficit and ambient r temperature, does indicate the water stress in otton which develops when the soil salinity ineases in the absence of soil water matric stress. revious research has indicated the performance of ne crop water stress index to measure cotton erformance under soil water matric stresses in bsence of soil osmotic stress. The infrared ther-ometer offers a handy instrument for field use to ntegrate the crop stress over a larger area than can e accomplished by measurements of individual eaves. Although the results reported indicate a ood correlation between final lint yield of cotton nd the crop water stress index, additional research hould be conducted to determine if such relationhips are similar if the stress vectors are different nd to identify the effects of crop osmotic adjustnent on the relationship. (Baker-IVI)
V85-05164

TUDIES ON THE NITROGEN AND WATER RELATIONS OF WHEAT, II. EFFECTS OF VARYING NITROGEN AND WATER SUPPLY ON GROWTH AND GRAIN YIELD,
Vaite Agricultural Research Inst., Glen Osmond Australia).
C. V. M. Parameswaran, R. D. Graham, and D. Aspinall.
rrigation Science, Vol. 5, No. 2, p 105-121, April, 984. 5 Fig, 9 Tab, 26 Ref.

Descriptors: *Nitrogen, *Wheat, *Plant growth, Water demand, Irrigation, Fertilizers, Crop yield, Water stress, Water potential, Leaves, Tillering.

Wheat was grown in field and glasshouse experiments to assess the effect of nitrogen fertilizer on yield when water stress occurred in the latter half of the growth. The studies of nitrogen x water nteractions on grain yield of wheat were unable to associate variations in grain yield due to nitrogen causally to tillering per se, differential root development, post-anthesis plant water potential, leaf diffusive resistance or post-anthesis leaf area duration. Undoubtedly, grain yield is related to tiller survival but the mechanism may be linked to effects of nitrogen on the efficiency of retranslocation of substrates from senescing plant parts, a process which in itself is relatively insensitive to water stress. The thought that plants should be bred with a high post-anthesis leaf area duration in order to improve grain yield may be risky in an environment where water is a dominant factor late in the season. (Baker-IVI)
W85-05167

SIMULATION OF POSSIBLE ADAPTIVE MECHANISMS IN CROPS SUBJECTED TO WATER STRESS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
J. W. Jones, and B. Zur.
Irrigation Science, Vol. 5, No. 4, p 251-264, December, 1984. 6 Fig, 1 Tab, 26 Ref.

Descriptors: *Water stress, *Transpiration, *Soil-water-plant relationships, Drought resistance, Roots, Leaves, Water potentials, Photosynthesis, Crop yield, Diurnal variations, Stomatal resistance, Osmotic adjustment.

Water deficits develop in plants as a result of an imbalance between water loss from the leaves and water uptake by roots. Possible adaptive mechanisms in water spender and water saver crops subjected to drought have been simulated. These mechanisms (root extension, increased initial stomatal resistance, and osmotic adjustment) are examined for a range of soil, plant and atmospheric conditions using a dynamic soil-plant water model. Results suggest that for increased agricultural production in environments conducive to the development of severe water stresses, adaptive mechanisms associated with water spenders would be most effective. In particular, an effective mechanism would be root extension into deeper soil layers wetted by rain or irrigation but normally not penetrated by roots because of genetic, mechanical or chemical reasons. The additional soil volume penetrated by the roots would insure maintenance of a favorable crop water balance for longer times, which in turn would allow for longer periods of expansive growth and uninhibited photosynthesis. The price to be paid would be an increased water use of the crop. The additional water would be extracted from soil layers normally not effectively utilized by the crop. Increased root proliferation of agricultural crops could be achieved by proper breeding and by agro-technical practices which would enhance root penetration and proliferation into deeper soil layers. (Baker-IVI)
W85-05170

EFFECT OF SOIL MOISTURE REGIMES ON THE YIELD AND WATER USE OF LENTIL (LENS CULINARIS MEDIC),
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
S. N. Sharma, and R. Prasad.
Irrigation Science, Vol. 5, No. 4, p 285-293, December, 1984. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Soil water, *Irrigation, *Crop yield, *Lentils, Evaporation, Crop yields, Seasonal variations, Consumptive use.

Grain and straw yield, consumptive water use (Cu) and its relation with evaporation from free water surface (Eo), water use efficiency and soil moisture extraction pattern of lentil were studied under different soil moisture regimes. With an increase in irrigation frequency, the grain and straw yield, consumptive water use rate, Cu/Eo ratio and water use efficiency increased as well. As the crop season advanced and reached its peak value during flowering and grainfilling stages the consumptive water use rate increased. At 35 and 105 days after sowing, branching and grain filling stages, the Cu/Eo ratio attained its minimum values. The top soil layer, 0-30 cm, experienced the most severe depletion of soil moisture, followed by the 30-60 cm layer and moisture loss was least from the 90-120 cm layer. The pattern of soil moisture depletion was also influenced by soil moisture regime. The percent contribution from the top soil layer decreased and that from the lower soil layers increased during the vegetative and flowering stages with an increase in the soil moisture tension. The actual amount of moisture depleted from all the soil layers was always higher under low soil moisture tension regime than under high soil moisture tension regime. The soil moisture treatment had no significant effect on the relative contribution from different soil layers under low and high soil moisture tension during the grain development stages as the crop was irrigated at the same time under both these treatments. With no irrigation, the percent contribution from top soil layer continued to decrease, and to increase from lower soil layers, as the crop advanced from flowering stage to grain development stage. On coarse textured soils lentil crop irrigation at a soil moisture tension of 0.05MPa gave high grain yields. Reasonably good yields were obtained with irrigations at 0.25 MPa matrix potential. The branching and grain development stages of lentil were found to be most critical for water requirement. (Baker-IVI)
W85-05171

EFFECT OF DISTURBED SOIL THICKNESS ON SOIL WATER USE AND MOVEMENT UNDER PERENNIAL GRASS,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
S. D. Merrill, S. J. Smith, and J. F. Power.
Soil Science Society of America Journal, Vol. 49, No. 1, p 186-202, January-February, 1985. 6 Fig, 2 Tab, 23 Ref.

Descriptors: *Plant growth, *Soil thickness, *Grasses, *Water use, Permeability coefficient, Mine wastes, Soil properties, Soil water, Roots, Land reclamation, Water potentials, Evapotranspiration.

An understanding of plant growth response to soil thickness over sodic minespoils was sought by measurement of water movement, water use, and root growth. Soil water storage and use were measured in each of three growing seasons under crested wheatgrass grown on 0.25-, 0.5-, 0.75-, and 1.0-m thicknesses of disturbed soil. Forage yield was 2- to 3.5-fold greater on 1.0 m soil thickness than on 0.25 m. Both total soil water potentials and root weight densities were similar in minespoil and in subsoil at the same profile depths. Root water uptake was much less from the minespoil than from subsoil. Low hydraulic conductivity (HC) per se appeared to be the dominant factor limiting sodic minespoil as a plant growth medium. Low HC resulted in less use of stored soil water from minespoil compared to subsoil. Relative differences in evapotranspiration between the 0.25 m and 1.0 m soil thickness treatments were much less than yield differences, reflecting progressively reduced water use efficiency with less soil thickness. (Baker-IVI)
W85-05190

AGRICULTURAL DROUGHT ASSESSMENTS USING A CROP MODEL.
Texas Agricultural Experiment Station, Temple. Blackland Research Center.
For primary bibliographic entry see Field 2A.
W85-05332

CONSUMPTIVE USE OF WATER BY MAJOR CROPS IN THE SOUTHWESTERN UNITED STATES,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
L. J. Erie, O. F. French, D. A. Bucks, and K. Harris.
Conservation Research Report No. 29, Agricultural Research Service. 40 p, 11 Ref, 3 Append.

Descriptors: *Consumptive use, *Soil water, *Soil-water-plant relationships, Soil moisture retention, Vegetable crops, Fruit crops, *Irrigation requirements, Forages, Grain crops, Soil moisture meters, Grasses, Crop production, *Arizona.

Consumptive use of water by plants is defined as the unit amount of water used on a given area in transpiration, building of plant tissues, and evaporation from adjacent soil. Knowledge of consump-

tive use is necessary in planning farm irrigation and drainage systems, for improving irrigation practices, conserving energy, and assisting in irrigation scheduling. Consumptive use is affected by many management factors and such natural factors as climate, soils, and topography. Management factor may include water supply, quality, and crop variety, fertility, planting date, spacing, irrigation scheduling, cultivation and chemical spraying. The most common methods of measuring the amount of water consumed by crops have been lysimeters, water balance, and soil moisture depletion. A study of consumptive use of water by various cash, oil, hay, bermuda lawn, small grain, forage, fruit, vegetable, and green manure crops as grown in central Arizona was made by gravimetric soil water content measurements on soil samples taken at various depths and locations. Consumptive use curves were developed from the averages for several years. Tentative irrigation schedules can be calculated directly from the consumptive use curves for areas having growing seasons comparable to those in the Salt River Valley of Arizona. Direct transfer of the measured consumptive-use data in this report to an area of similar latitude, temperature, humidity, cloud cover, and wind as Phoenix is also possible.
W85-05346

EFFECT OF GIBBERELLIC ACID ON THE BUOYANCY OF SPIRODELA INTERMEDIA W. KOCH,
Universidad Nacional del Sur, Bahia Blanca (Argentina). Dept. de Agronomia.
For primary bibliographic entry see Field 5G.
W85-05610

SUBMERGED MACROPHYTES AND THE HYDRAULIC ROUGHNESS OF A LOWLAND CHALKSTREAM,
Freshwater Biological Association, Wareham (England). River Lab.
F. H. Dawon, and W. H. Robinson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1944-1948, December, 1984. 5 Fig, 10 Ref.

Descriptors: *Chalkstreams, *Macrophytes, *Hydraulic roughness, Submerged plants, Seasonal variation, Water levels, Aquatic plants, Roughness coefficient, Population dynamics, Species diversity, Velocity.

Information was sought on the seasonal variation of water velocity and hydraulic roughness of a large managed chalkstream as it relates to submerged macrophyte population. A preliminary study was made of the nature of the hydraulic roughness of plant stands both directly and through the development of models in preparation for further work on metabolic changes with velocity. These data are combined to show the role of plants in river energy changes. Water depth and velocity varied in response to discharge in winter, but additionally and more significantly to the plant growth in the spring and summer. Hydraulic roughness increased (as Manning's n) from a winter level of 0.03-0.04 to either about 0.06 in early spring, or about 0.11 in late spring. The relationship of hydraulic roughness with discharge was constant within a small range, for periods between major discharge changes after each of which a new relationship was established. The latter resulted from the removal of excess or moribund plant material particularly in the autumn, the redistribution of unstable sediments and the compaction of the stems within stands. The population density of plants was 1 per 6.6 sq m for sections of depth range 0.85-1.53 m to 1 per 3.1 sq m for the shallower section of 0.52-1.31 m in depth. (Baker-IVI)
W85-05675

CANOPY CONDUCTANCE OF CONIFEROUS FORESTS RELATED TO CLIMATE,
Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard.
A. Lindroth.
Water Resources Research, Vol. 21, No. 3, p 297-304, March, 1985. 6 Fig, 1 Tab, 34 Ref.

Descriptors: *Canopy conductance, *Conductance, *Climate, *Solar radiation, Evapotranspiration, Seasonal variation, Stomatal efficiency, Leaves.

Canopy conductance, G, and specific canopy conductance, g, were estimated from Bowen ratio measurements above a sparse Scots pine forest. Both conductances increased with increasing solar radiation, R sub g, with the highest sensitivity in the low R sub g range. Above 400-500 W/sq m they were practically constant with respect to Rg. During typical daytime situations the conductances depended primarily on vapor pressure deficit, VPD. For R sub g above 500 W/sq m, g decreased from 11 mm/s at a VPD of 300 Pa down to 5.5 mm/s at 800 Pa, then more slowly down to 3 mm/s at 2000 Pa. The diurnal variation of g was characterized by a rapid increase in the morning up to about 6 mm/s, then g slowly decreased until noon and recovered somewhat in the afternoon to decrease again down to about 2.5 mm/s in the evening. From May to August the projected needle area index varied from 2.0 to 2.6, whereas total canopy conductance increased by 100% due to variations in climate (50%), needle area (30%), and stomatal efficiency (20%). Comparison between three forests indicated that it was more important to understand the mechanisms behind the seasonal variation of G than to assess differences in G between forests, these latter differences being remarkably small. (Author's abstract)
W85-05792

2J. Erosion and Sedimentation

QUANTITATIVE EVALUATION OF SEDIMENT DELIVERY RATIOS,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
R. M. Khanbilvardi, and A. S. Rogowski.
Water Resources Bulletin, Vol. 20, No. 6, p 865-874, December, 1984. 4 Fig, 4 Tab, 24 Ref.

Descriptors: *Sedimentation, *Sediment yield, *Model studies, *Hastings, *Nebraska, Erosion, Deposition.

Ability to adequately estimate sediment yield under current or alternative land use conditions is an important step in identifying and dealing effectively with soil erosion problems. Sediment yield was computed for two watersheds in Hastings, Nebraska, and compared with ten years of measured sediment yield data. The Universal Soil Loss Equation (USLE) with different forms of sediment delivery ratio (SDR) were compared with those made by Modified USLE (MUSLE) and a fundamentally derived Erosion-Deposition Model (EDM). The USLE and USLE with SDR are poor predictors of sediment yield for individual storms compared to the MUSLE and EDM. Although MUSLE gave better results than USLE it showed somewhat more scatter of data points, but less bias in predictions, than the recently developed EDM. Both MUSLE and EDM approximated quite closely the variance observed on the measured field data. (Collier-IVI)
W85-04993

IDENTIFICATION OF CRITICAL AREAS ON FOREST LANDS FOR CONTROL OF NONPOINT SOURCES OF POLLUTION,
East-West Environment and Policy Inst., Honolulu, HI.
W. F. Megahan, and P. N. King.
Environmental Management, Vol. 9, No. 1, p 7-17, January, 1985. 70 Ref.

Descriptors: *Forest management, *Erosion, *Nonpoint pollution, Sediments, Water pollution sources, Runoff, Soil conservation, Water pollution control.

Pollution resulting from the management of forest lands is of a nonpoint character and is of two general types. One type involves changes in naturally occuring water constituents caused by the disruption of the natural ecosystem by various practices. This includes changes in sediment, dissolved chemical transport, and water temperatur
A second type of pollutant consists of exotic su
stances introduced by management practices ar
includes bacteriological pollutants and chemica
such as pesticides, fertilizers, and fire retardant
Most nonpoint source pollution problems on fore
lands can be controlled by careful planning ar
management of specific critical areas. Critical are
include sites with high mass and surface erosio
hazards, overland flow areas, and the ripari
zone. Improving land-use practices to avoid e
ceeding the capability of the land to sustain permi
ted activities is a necessary long-term task requi
ing education, extension, and incentives to institu
soil conservation practices. (Collier-IVI)
W85-05068

**CHANNEL CHANGE, SEDIMENT TRAN
PORT, AND FISH HABITAT IN A COASTA
STREAM: EFFECTS OF AN EXTREME EVEN**
Center for Natural Resource Studies, Berkele
CA.
For primary bibliographic entry see Field 2E.
W85-05069

**ANGOSTURA RESERVOIR, 1979 SEDIMENT
TION SURVEY,**
Bureau of Reclamation, Denver, CO. Engineeri
and Research Center.
J. M. Lara.
Available from the National Technical Informati
Service, Springfield, VA 22161. August 1983. 1
pp, 82 Fig, 4 Tab, 4 Ref.

Descriptors: *Reservoir silting, *Sedimentatio
*Reservoir capacity, *Sediment distribution, *Se
mentation survey, Silting, Sonar, Surveys, Ango
tura Reservoir, Wyoming, *South Dakota.

This report presents a study of sediment accumul
tions in the Angostura Reservoir over 29.6 years
the reservoir's operation. Data gathered was us
to compute a revised reservoir capacity due to t
volume of accumulated sediment since the da
was closed in 1949. Sixteen sediment samples we
collected from reservoir deposits at various se
ment ranges in the upstream portion of the res
voir. Sonic depth recording equipment was used
profile the sediment ranges. Reservoir capaci
was determined using contour surface areas co
puted by the width-adjustment method. The ori
nal surface area of Angostura Reservoir in 19
was 4,841 acres and the capacity was 159,919 ac
feet at the normal water surface elevation
3,187.2 feet. The 1979 survey resulted in a surfa
area of 4,612 acres and a capacity of 130,768 ac
feet at the same normal water surface elevatio
This indicated a loss of 29,151 acre-feet in capaci
in the 29.6 years since the dam was built.
W85-05130

**CABALLO RESERVOIR, 1981 SEDIMENT
TION SURVEY,**
Bureau of Reclamation, Denver, CO. Engineeri
and Research Center.
J. M. Lara.
Available from the National Technical Informati
Service, Springfield, VA 22161. March 1984. 50
48 Fig, 3 Tab, 3 Ref.

Descriptors: *Reservoir silting, *Sedimentatio
*Reservoir surveys, *Reservoir capacity, Siltin
Sonar, Sediment distribution, *Caballo Reservo
*New Mexico, Rio Grande.

Caballo Reservoir, New Mexico was surveyed
1981 to compile field data needed to compute t
reservoir capacity. The data were used to compu
the volume of sediments that had accumulated
the reservoir since the gates of the dam we
closed in 1938. Sonic depth recording equipme
interfaced with an automated survey system w
used to run the bathymetric survey. Reservo
capacity was computed based on surface are
determined by a width adjustment method. Res
voir capacity is 331,510 acre-feet; it has a surfa
area of 11,532 acres. Since 1938, sediments acc

mulated to a volume of 15,226 acre-feet and result in a 4.4% of loss of reservoir capacity.
W85-05134

CALCULATION OF COARSE BED-LOAD MOVEMENT,
K. Stelczer.
Water Resources, Vol. 11, No. 1, p 1-6, January-February, 1984. 3 Fig, 12 Tab, 17 Ref. Translated from Vodnye Resursy, No. 1, p 3-9, January-February, 1984.

Descriptors: *Sediment transport, *Bed load, *Hungary, *Mathematical equations, Sediment, Flow velocity, Channel morphology, Sediment load, Sedimentation.

Methods used in Hungary to calculate sediment movement are reviewed. Emphasis is placed on the main factors affecting bed-load movement, the concept of bed-load movement, bottom flow velocity, size of sediment particles, depth of flow, slope of the channel bottom, the quality of the channel deposits, channel roughness, a characterization of the critical state by means of stochastic relations, and a determination of the virtual velocity of sediment movement. (Baker-IVI)
W85-05143

EXPERIMENTAL INVESTIGATION OF BED-LOAD DISCHARGE,
V. A. Vazilevich.
Water Resources, Vol. 11, No. 1, p 7-15, January-February, 1984. 7 Fig, 18 Ref. Translated from Vodnye Resursy, No. 1, p 10-19, January-February, 1984.

Descriptors: *Bed load discharge, *Sediments, *Mathematical equations, Bed load, Model studies, Scale models, Rivers, Channels, Shear stress, Velocity, Erosion, Sedimentation.

Bed-load discharge was measured during experiments on a large-scale model of a piedmont river channel. A distinctive feature of this model channel with a length of 58 m was that it included several large channel formations. As a result of analyzing various experimental dependences relating the bed-load discharge to characteristic parameters of the flow a functional relationship uniquely relating bed-load transport per unit width to the shear stress on the bottom was selected. The experimental values of the friction velocity on a given vertical of the flow were determined from the surface velocities measured by means of floats. As a result of this study and results from earlier experimentation equations are suggested for determining the bed-load discharge in the deposition and throughgoing zones and in erosion zones. Determination of the bed-load discharge by the relationships recommended shoud be performed in the following sequence: at first the discharge is calculated on the basis of the condition that erosion of the bed can occur in the given calculated stretch. If this calculated discharge is greater than the bed-load discharge arriving in the stretch from without, then erosion of the bed actually occurs here. Otherwise the sediment discharge must be recalculated on the basis of the condition that deposition sediments occur in the given calculated stretch and, having again compared it with the discharge of sediments arriving in the stretch from without, one determines precisely which of these two deformations occurs in the calculated stretch. (Baker-IVI)
W85-05144

MASS TRANSPORT IN THE TURBULENT BOTTOM LAYER OF A WAVE FLOW OVER A SLOPING BOTTOM,
I. O. Leont'ev.
Water Resources, Vol. 11, No. 1, p 15-20, January-February, 1984. 3 Fig, 1 Tab, 8 Ref. Translated from Vodnye Resursy, No. 1, p 20-25, January-February, 1984.

Descriptors: *Sediment transport, *Turbulence, Waves, Flow, Mathematical equations, Boundary layers, Water circulation, Slopes.

Physical criteria determining the direction of movement of water masses near the bottom were established. A semiempirical model of a turbulent boundary layer in progressive gravity waves over a sloping bottom was constructed. It is assumed that the time averaged circulation of water has a steady character, that breaking of waves is absent, and outside the boundary layer the flow is irrotational. The results demonstrate that for short waves the existence of positive transport at the bottom is possible in a wider range of gradients than for long waves. An increase of the gradient and wave period promotes the development of outflow in the bottom layer. (Baker-IVI)
W85-05145

EQUATION OF SEDIMENT DISCHARGE OF A SLUMP TURBIDITY CURRENT IN A DEFORMABLE CHANNEL,
A. S. Devdariani, and T. M. Akivis.
Water Resources, Vol. 11, No. 1, p 32-37, January-February, 1984. 4 Fig, 15 Ref. Translated from Vodnye Resursy, No. 1, p 40-46, January-February, 1984.

Descriptors: *Sediment transport, *Turbidity currents, *Coastal waters, Mathematical equations, Channels, Continental margin.

Turbidity currents occasionally occurring on continental margins are examined. Atlantic-type margins fringing almost the entire Atlantic and Arctic Oceans, Mediterranean and Black Seas, and partially the Indian Ocean are the major areas of concern. On margins of this type the continental slope gradually passes downward to the more gentle continental rise, which in turn gradually joins the plains of the ocean floor. Submarine canyons similar to valleys of mountain rivers cut the continental slope. Three methods of approximation are used in the examination: linear for definitely increasing or decreasing functions; exponential for functions approaching a certain limit; and an approximation by a constant for functions about the form of which nothing is known at all. (Baker-IVI)
W85-05146

DETERMINATION OF VELOCITIES OF MASS MOVEMENT OF SEDIMENTS ON THE FORESHORE,
S. S. Pirumov, V. V. Sakvarelidze, and N. I. Chechelashvili.
Water Resources, Vol. 11, No. 1, p 55-61, January-February, 1984. 3 Fig, 1 Tab. 13 Ref. Translated from Vodnye Resursy, No. 1, p 68-75, January-February, 1984.

Descriptors: *Sediment transport, *Mathematical equations, *Velocity, *Mass wasting, *Foreshores, Gravity flow, River mouth, Submarine canyons, Shear, Slope, Sediment erosion, Cohesion.

In the mouth regions of rivers and at the heads of submarine canyons, where the slopes of the foreshore are greater than on adjacent stretches, gravity induced mass movement of sediment deposits can occur with considerable velocities. The movement of sediment accumulations is examined in the case of secular shrinkage and brittle fracture accompanied by liquefaction of the soil along the slip surface. In stretches with intense accumulation of silt or clay sediments the stability of the sediment is disturbed mainly due to an increase of its thickness as a result of sediment accumulation. Stability is disturbed instantaneously, as a result of which the cohesion coefficient in the vicinity of the slip surface can decrease considerably, which promotes sliding of the body with considerable velocities. In the coastal zone the slump moves along the path of just deposited sediments having smaller cohesion coefficients. In the case of the instantaneous formation of a slump its velocities can be considerable. Slumping can also occur as a result of secular shrinkage, leading to a gradual decrease of the yield stress. In these cases sliding occurs quite slowly and continues until the physical properties of the sliding body change qualitatively, which can lead to a considerable decrease of the cohesion coefficient during a short time interval and to an increase in the velocity of the slide. (Baker-IVI)
W85-05147

STUDY OF SEDIMENT TRANSPORT ROUTES ON THE BASIS OF DYNAMIC STRUCTURES OF BOTTOM SEDIMENTS,
V. A. Grossgeim, and I. L. Gerashchenko.
Water Resources, Vol. 11, No. 1, p 66-73, January-February, 1984. 5 Fig, 21 Ref. Translated from Vodnye Resursy, No. 1, p 88-95, January-February, 1984.

Descriptors: *Sediment transport, *Routing, *Bottom sediments, *Paleohydrology, Sedimentation, Model studies, Marine sediments, Water currents, Paleomagnetism, Gravity.

The major purpose in paleoceanologic reconstruction during explorations of certain mineral resources associated with terrigenous rocks is to determine the positions, boundaries, and origin of sand bodies-reservoirs. Reconstruction of paleocurrents is of particular importance. Reference is made only to bottom currents which transport the bulk of the sediment along the bottom of basins, including those of reservoir size. Several experiments have been made to be certain of the method of orienting cross-laminated structures of cores by means of paleomagnetism. The method of studying the orientation of cross-laminated structures is briefly reviewed. During the past 30-40 years dozens of reconstructions have been made worldwide. In all cases the arrows showing the direction of currents formed orderly systems correlating well with other types of investigations and with the regularities of sedimentation established to date. Bottom currents are regarded as a mechanism by which sediments entering basins as a result of gravity are transported from the shallow region to regions of maximum depths. Bottom-current reconstruction methods are not limited to a study of the orientation of the inclinations of series of cross-laminae. They can be reconstructed on the basis of the change in fauna, distribution of certain characteristic minerals, change in the degree of roundness of fragmental material, distribution of types of sediments, orientation of sand grains and elongated objects, and orientation of ridges on the surface of beds. (Baker-IVI)
W85-05148

LIMNOLOGICAL STUDIES IN A CROSS-SECTION OF THE MIDDLE REACH OF PARANA RIVER, II: CHARACTERISTICS AND TEMPORAL VARIATIONS OF SUSPENDED SEDIMENT GRANULOMETRY (ESTUDIOS LIMNOLOGICOS EN UNA SECCION TRANSVERSAL DEL TRAMO MEDIO DEL RIO PARANA, II: CARACTERISTICAS Y VARIACIONES TEMPORALES DE LA GRANOMETRIA DE LOS SEDIMENTOS SUSPENDIDOS),
Instituto Nacional de Limnologia, Santo Tome (Argentina).
M. L. Amsler, and E. C. Drago.
Revista de la Asociacion de Ciencias Naturales del Litoral, Vol. 15, No. 1, p 7-21, 1984. 3 Fig, 4 Tab, 21 Ref.

Descriptors: *Parana River, *Argentina, *Suspended sediments, *Granulometry, Silt, Clay, Particle size, Wash load, Flow discharge.

This paper deals with the granulometric characteristics and variation of suspended sediment at a cross-section of the middle reach of the Parana River. The frequency distributions of the mean diameters ranged between fine and very fine silts suggesting that suspended sediments are composed largely of wash load (in this case, particles finer than 31 micro-m). The concentration of particles peaked when the Bermejo River contributed its load with high percentages of clay size particles. During such times, the smallest mean diameters and the best sorting were detected. The rest of the time suspended loads were characterized by poorly sorted suspended materials and higher mean diameters within the fine silts range. Maximum mean diameters and the worst sorting were observed during special events: the highest discharge and low wash loads. It was attributed to an increase of the coarse suspended fractions. (Author's abstract)
W85-05173

LIMNOLOGICAL STUDIES IN A CROSS-SECTION OF THE MIDDLE REACH OF PARANA RIVER, III: SOLID COMPONENTS TRANSPORTED IN SUSPENSION (ESTUDIOS LIMNOLOGICOS EN UNA SECCION TRANSVERSAL DEL TRAMO MEDIO DEL RIO PARANA, III: COMPONENTES SOLIDOS TRANSPORTADOS EN SUSPENSION),
Instituto Nacional de Limnologia, Santo Tome (Argentina).
H. Bertoli de Pomar.
Revista de la Asociacion de Ciencias Naturales del Litoral, Vol. 15, No. 1, p 25-46, September, 1984. 3 Fig, 10 Tab, 18 Ref.

Descriptors: *Suspended solids, *Sediment transport, *Parana River, *Argentina, Silt, Clay, Minerals, Protozoans, Sponge spicules, Phytoliths, Silica.

This work was undertaken in order to determine the variability of concentrations, mineral associations and biogenic components of suspended solids transported by the Parana River through a cross-section of its middle reach. It has been established that total suspended solids concentrations varies between 33.7 and 893.4 mg/l according to the water discharges. The concentrations are not uniformly distributed in the water column, with a trend to increase towards the bottom. The silt-size mineralogy contains mainly metamorphic species and vitroclasts, with preponderance of quartz, followed by biotite, tourmaline, and zircon. The clay-size fraction is composed of variable proportions of illite, kaolinite, montmorillonite, and chlorite. The last two minerals are absent during low waters. Within the biogenic fraction, protists, demosponges spicules and Gramineae, Cyperaceae, Palmaceae, and Podostemaceae phytoliths were found. There is evidence that silt- and clay-sized minerals are supplied by Brazilian metamorphic sources, with lesser contributions from the mountainous Andean environment. Biogenic silicic particles are mostly authigenic, with the exception of Palmaceae and Podostemaceae phytoliths, contributed by the palm groves (Chaco-Corrients) and the upper Parana River respectively. (Author's abstract)
W85-05174

LIMNOLOGICAL STUDIES IN A CROSS-SECTION OF THE MIDDLE REACH OF PARANA RIVER, IV: INFLUENCE OF THE SUSPENDED SEDIMENT GRANULOMETRIC COMPOSITION ON WATER TRANSPARENCY (ESTUDIOS LIMNOLOGICOS EN UNA SECCION TRANSVERSAL DEL TRAMO MEDIO DEL RIO PARANA, IV: INFLUENCIA DE LA COMPOSICION GRANOMETRICA DE LOS SEDIMENTOS SUSPENDIDOS SOBRE LA TRANSPARENCIA DEL AGUA),
Instituto Nacional de Limnologia, Santo Tome (Argentina).
E. C. Drago.
Revista de la Asociacion de Ciencias Naturales del Litoral, Vol. 15, No. 1, p 47-55, September, 1984. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Parana River, *Argentina, *Suspended sediments, *Transparency, Granulometry, Sand, Clay, Silt.

This paper deals with the influence of suspended sediment granulometric composition on the transparency of Parana River water. Secchi disk measurements and the surface water samples were obtained every fifteen days from the center of the main channel from October 1976 to December 1977. The amount of sand in suspension did not influence water transparency, but clay and silt concentrations produced notable changes on Secchi disk measurements. The linear correlation coefficients, r, between transparency and clay and silt amounts were -0.83 ($p < 0.001$) and -0.76 ($p < 0.001$), respectively. The highest concentrations of clay and silt were supplied by the Bermejo Paraguay rivers system while the Alto Parana River supplied the reddish suspended matter ('red wave'). Both these sources remarkably changed water transparency in the Parana. (Author's abstract)
W85-05175

LIMNOLOGICAL STUDIES IN A CROSS-SECTION OF THE MIDDLE REACH OF PARANA RIVER, V: TEXTURAL FEATURES OF BED SEDIMENTS (ESTUDIOS LIMNOLOGICOS EN UNA SECCION TRANSVERSAL DEL TRAMO MEDIO DEL RIO PARANA, V: CARACTERES TEXTURALES DE LOS SEDIMENTOS DE FONDO),
Instituto Nacional de Limnologia, Santo Tome (Argentina).
H. B. de Pomar.
Revista de la Asociacion de Ciencias Naturales del Litoral, Vol. 15, No. 1, p 57-78, September, 1984. 15 Fig, 5 Tab, 23 Ref.

Descriptors: *Parana River, *Argentina, *Bed sediments, Sediment texture, Saltation, Leptocurtosity, Clay, Silt, Sorting, Sediment transport, Velocity.

This work was undertaken to go one step farther in the knowledge of the Parana River limnological aspects. It deals with the textural features of the bed sediments 2.7 km northern Parana City, Entre Rios, Argentina, at a primary control section. The observed variations during a sampling period of 5 years indicate that particles up to phi 2 are transported. The sediment features are as follows: a) At the center of the river medium to fine sands occur, with saltation population prevailing at phi 2 (x : 95%), well to very well sorted (sigma sub 1: 0.37), with unimodal symmetric distribution and leptocurtosity. b) Near the river edges clay silt occur, with phi 5 predominant (coarse silt), without traction population, 66% of saltation population, poorly sorted, positive bimodal distribution and leptocurtosity. This last textural parameter was the only coincident in the granometric distributions of the three sampling stations. Sorting did not fit within limits given in previous studies for fluvial sediments. Bottom current velocity is the principal factor affecting variation of transport and depositional processes. (Author's abstract)
W85-05176

EFFECT OF SLOPE AND RAINFALL INTENSITY ON EROSION FROM SODIUM DISPERSED, COMPACTED EARTH MICRO-CATCHMENTS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 3B.
W85-05191

EFFECT OF FURROW IRRIGATION EROSION ON CROP PRODUCTIVITY,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 6G.
W85-05192

SEDLAB: THE HYDROLOGY/SEDIMENT TRANSPORT MODEL OF THE USDA SEDIMENTATION LABORATORY,
For primary bibliographic entry see Field 2A.
W85-05341

SCOUR CONTROL AT OUTLOOK BRIDGE - A CASE STUDY,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
C. D. Smith.
Canadian Journal of Civil Engineering, Vol. 11, No. 4, p 709-716, December, 1984. 10 Fig, 3 Ref.

Descriptors: *Scour, *Outlook Bridge, *Saskatchewan, *Erosion control, *Bridges, Footings, Flood protection, Flood damage, Abutments, Costs.

The traffic bridge across the South Saskatchewan River at Outlook, Saskatchewan was completed in 1936. A low flood plain extends into the channel from the east bank. In order to shorten the total span for the bridge, an approach fill 260 m long was run out over the flood plain and the east abutment was located at the end of the fill. In the late 1940s the highway grade between the wings of the U-shaped abutment subsided. By the 1950s it was necessary to periodically top the highway grade with fill at the east abutment to maintain the grade profile at the entrance to the bridge. In January of 1951 12,000 bags filled with sand-cement were placed around the entire east abutment and timber piles were driven upstream across the front of the sandbags. During the 1951 spring flood the barrier was destroyed, all the sandbags except those on the downstream side of the abutment were lost, the scour went 5 m below the footing, and a hole developed in the roadway. Model tests conducted in 1956 indicated that abutment scour could be controlled with an earthguide bank, a 30 m cellular sheet pile guide wall, or with abutment riprap alone. Due to cost factors, it was decided to use riprap and in 1957 riprap was placed at the abutment. Sufficient riprap was added to bring the surface up to the normal bed elevation, 5 m above the footing, in the immediate vicinity of the abutment. About 3000 cu m of riprap was placed at a cost of $21,000. The most recent sounding in June of 1981 showed no change in riprap position, and the deepest scour in the east span was at the level of the footing 14 m out from the abutment. (Baker-IVI)
W85-05454

STABILITY AND SETTLING OF SUSPENDED SOLIDS IN SETTLING PONDS. PART II. DIFFUSION ANALYSIS OF INITIAL SETTLING OF SUSPENDED SOLIDS,
McGill Univ., Montreal (Quebec). Geotechnical Research Centre.
R. N. Yong, and D. Elmonayeri.
Canadian Geotechnical Journal, Vol. 21, No. 4, p 644-656, November, 1984. 18 Fig, 1 Tab, 24 Ref. Natural Sciences and Engineering Research Council of Canada grant A-882.

Descriptors: *Suspended solids, *Settling basins, *Wastewater treatment, *Diffusion, Model studies, Diffusion analysis, Stability, Sedimentation, Fines thickening.

The initial settling behavior of the low solids concentration suspensions is examined and analyzed to provide information on sedimentation characteristics and distribution of solids concentration profiles with them. The initial settling by self-diffusion of the suspended solids is first validated with controlled laboratory experiments and then applied to evaluate test results obtained in another lab. The method of analysis is further applied to one settling pond for prediction of settling rate and distribution of solids in the pond in the initial settling stages. In evaluations of the settling characteristics and performance of suspended solids in settling columns or ponds several choices must be made ranging from specific consideration of molecular or microscopic activity to macroscopic particle or solids settling theories where gravity-drive mechanisms dominate. The intermediate position between a complete microscopic examination and the total gravity-drive system was used. The diffusion-convection model has ben adopted and examined in terms of relative fluxes established between the downward motion of the suspended solids and the upward movement of water. The diffusion convection model developed here on the basis of relative flux holds promise as a tool in analysis and prediction. The problem addressed is one where the initial solids concentration in suspension is low and were no measurable pore pressures are obtained. This is the condition that is typical of the initial settling phase of suspended solids on its way to formation of a sediment layer. (Baker-IVI)
W85-05527

QUANTITATIVE ANALYSIS OF DEBRIS TORRENT HAZARDS FOR DESIGN OF REMEDIAL MEASURES,
Thurber Consultants Ltd., Vancouver (British Columbia).
O. Hungr, G. C. Morgan, and P. Kellerhals.
Canadian Geotechnical Journal, Vol. 21, No. 4, p 663-677, November, 1984. 11 Fig, 3 Tab, 41 Ref.

Descriptors: *Erosion control, *Prediction, *Debris torrents, Storms, Slopes, Landslides, Design criteria, Water management, Mass wasting, Channels, Bridges, Debris retention barriers.

A first attempt at quantitative prediction of debris torrent behavior in Canada is detailed. Design of debris torrent remedial measures in other countries relies heavily on site-specific experience of long duration, sometimes of several centuries. Such experience is not available in Canada. Attempts were made to combine theoretical understanding of the phenomenon with detailed observations, to obtain a semiempirical design method. This 2 year study involved hazard risk assessment and has resulted in the design of a comprehensive system of remedial measures comprising debris retention barriers and basins, channel improvements, and diversions, and the reconstruction of bridges. New design procedures were needed to cover the dynamic behavior of debris torrents. An approach is offered for determining magnitude (volume of debris material involved), frequency, peak discharge, velocity, conditions for deposition, runout distance, behavior in bends and run-up against barriers, and dynamic thrust and impact loadings. The procedures are based on some of the more practical concepts available in the specialized literature. Wider and more thorough calibration is required before the procedure can enjoy a more general acceptance. (Baker-IVI)
W85-05529

CHANNEL-FILL DEPOSITS FORMED BY AGGRADATION IN DEEPLY SCOURED, SUPERIMPOSED DISTRIBUTARIES OF THE LOWER KOOTENAI FORMATION (CRETACEOUS),
Calgary Univ. (Alberta). Dept. of Geology and Geophysics.
J. C. Hopkins.
Journal of Sedimentary Petrology, Vol. 55, No. 1, p 42-52, January, 1985. 12 Fig, 36 Ref.

Descriptors: *Channel morphology, *Sedimentation, *Aggradation, Scour, Diversion, Distributaries, Channel-filling.

Three large channels of the lower Kootenai Formation are exposed in the walls of the Missouri River valley east of Great Falls, Montana. Although the channels occur in two different stratigraphic units, they have several features in common. Each channel is contained within crevasse and bay-fill sequences, but the contacts between channel-fill deposits and laterally adjacent strata are erosional. The channels have a broad U-shape, range up to 300 m wide and 35 m deep, and exhibit a distinctive style of fill. Channel-filling occurred in increments by accretion from the bottom up and sides in, to form a concave layering which is more or less symmetrical about the axis of each channel. Lithology of the fill channel is quite different, however, and ranges from mudstone, to interbedded sandstone and mudstone, to sandstone. The channels are interpreted as superimposed distributaries formed by avulsion when the locus of sedimentation shifted from one lobe to another. The lithology of the channel-fill deposits appears to a be a function of the abandonment rate. A mudstone-filled channel results where abandonment is rapid, as in the case with upstream diversion of a trunk river system. Sandstone and mixed sandstone-mudstone fills predominate where a distributary is progressively abandoned, for example, where the discharge is diverted into an alternately favored distributary. Superimposed channels are difficult to map in the subsurface by geologic means. They cut across the trend of adjacent facies, and so their presence cannot be predicted from analysis of the containing strata. (Author's abstract)
W85-05617

ORIGIN OF SHAPE CHANGES OF SAND AND SILT IN A HIGH-GRADIENT STREAM SYSTEM,
South Carolina Univ., Columbia. Dept. of Geology.
S. K. Kennedy, and R. Ehrlich.
Journal of Sedimentary Petrology, Vol. 55, No. 1, p 57-64, January, 1985. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Sand, *Silt, *Particle shape, *Stream gradient, Sedimentary petrology, Shape, Petrology, Particle size, Sediment transport.

Changes in shape of sand and silt in streams may be a reflection of changes in source rock rather than the progressive effects of transport. If so, shape characteristics should change as the stream crosses geologic contacts. To clarify the problem, stream sediment samples were collected in two drainage basins on the west flank of the Bighorn Mountains, Wyoming. Three size fractions - fine sand, very fine sand, and coarse silt - were studied using Fourier analysis and the scanning electron microscope. Provenance discrimination improves with increasing grain size. In all three size ranges sediment derived from a glaciated crystalline rock source can be differentiated from the derived from sedimentary rock sources. Sand from sedimentary rock sources can be subdivided into shape families according to the extent of diagenesis. In very fine sand and fine sand, sediment from the Flathead Sandstone is distinguishable from that derived from other sedimentary rocks. In fine sand the Tensleep and Darwin sandstones are also distinguishable as separate sources. Along Tensleep Creek, changes in the shape composition of sediment occur rather continuously due to transport of sediment by past glacial processes. Along Paintrock Creek, however, shape proportions do not change in a continuous manner but instead change by abrupt, discrete jumps which occur where additional sources provide sediment. The shape changes are due to the dilution of upstream sediment by sediment from adjacent sources. This suggests that downstream sources provide sediment at a greater rate than the upstream sources even though the gradient decreases with distance. This can be explained by the fact that the younger, downstream sedimentary rocks are more friable than the upstream rocks. (Author's abstract)
W85-05618

ANNUAL SEDIMENT ACCMULATION AND LAND USE HISTORY; INVESTIGATIONS OF VARVED LAKE SEDIMENTS,
Umea Univ. (Sweden). Dept. of Ecological Botany.
U. Segerstrom, I. Renberg, and J.-E. Wallin.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1396-1403, December, 1984. 7 Fig, 9 Ref.

Descriptors: *Sedimentation, *Lake sediments, *Varves, *Sweden, Lakes, Annual distribution, Land use, History, Organic matter, Agriculture, Eutrophication.

Four lakes in northern Sweden, all of them having varved sediments, were investigated. The annual deposition rate of organic and mineral matter was calculated. Changes in vegetation and the history of land use have been studied mainly by pollen analysis. An increase in the annual deposition of both organic and mineral matter has occurred due to land use. The changes in deposition become especially striking during the period of agricultural expansion that has taken place in the 19th and 20th century. The organic deposition has increased by about 100% and the deposition of inorganic matter has increased by about 150-200% during the last 200 years. Eutrophication causing higher production in the lakes and/or erosion and subsequent supply of allochthonous material into the lakes seem to be the most possible reasons for these changes. (Baker-IVI)
W85-05627

PHOSPHORUS COMPOUNDS IN THE SEDIMENT OF THE SAU RESERVOIR (BARCELONA, NE SPAIN) THROUGHOUT ITS TWENTY-YEAR EXISTENCE,
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W85-05638

ECOLOGICAL INVESTIGATIONS ON THE ALLUVIAL SEDIMENTS OF THE DANUBE IN THE VIENNA AREA - A PHREATOBIOLOGICAL PROJECT,
Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Limnologie.
D. L. Danielopol.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1755-1761, December, 1984. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Alluvial sediments, *Interstitial fauna, *Danube River, *Austria, Sediments, Seasonal variation, Groundwater, Water quality, Interstitial water.

Because of the construction over the past few years of several hydroelectric power stations on the Danube there is an urgent need to preserve the groundwater reserves at the high standard required for a potable supply. A seasonal sampling program was performed in 1980. Interstitial fauna was collected and groundwater extracted from fixed standpipes placed at different depths in the alluvial sediments. The fauna of the bed sediments of a backwater of the Danube, Lobau Eberschuttwasser are delineated along with the fauna in the gravel bar sediments of the Danube near the river March. The alluvial sediments of the March bar and of the backwater Eberschuttwasser represent zones of the input/output areas of the Danube groundwater ecosystem. The superficial alluvial sediments remained unclogged in both cases. In the case of the gravel bar March, the superficial sediments are maintained far from equilibrium due mainly to physical disturbances. It appears that the interstitial fauna plays a minor role in the preservation of an open interstitial system. The opposite occurs in the alluvial sediments of the backwater Ebershuttwasser, where the interstitial environment is subject to less physical stress. In the upper layers of these sediments some of the animals which develop abundantly and persistently, contribute to the pelletization of the silty sediment which accumulates in the sand and gravel matrix. Their activity is considered to represent a type of biological disturbance which helps to preserve the free circulation of water and organic matter inside and outside the groundwater system. The groundwater fauna plays, in some cases, an important role in the functioning of a groundwater ecosystem. (Baker-IVI)
W85-05656

ANALYSIS OF THE PROCESS OF RETENTION OF ORGANIC MATTER IN STREAM ECOSYSTEMS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
R. Speaker, K. Moore, and S. Gregory.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1835-1841, December, 1984. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Sediment transport, *Ecosystems, *Streams, *Organic matter, Riparian vegetation, Riparian waters, Channels, Decomposing organic matter, Particulates, Sediments, Lotic environments, Debris dams.

Lotic ecosystems are substantially different from most other ecosystems as the continuous unidirectional flow through the system tends to transport matter to downstream reaches. The process of retention removes matter from transport and makes it available for utilization by stream biota, thus providing a critical link between input and storage. A method is described for the quantitative assessment of retention of particulate organic matter in streams and several major stream retention features are identified that can be influenced by the structure and composition of riparian zones. This study focuses on short-term retention processes on streams and does not address long-term patterns of storage. The retention of leaves was measured in the Cascade Mountain Range of Oregon using reaches of 50 m to represent the geomorphic structural diversity. Leaf retention curves conformed well to a negative exponential model. Though leaves were retained at fairly uniform rates at many sites, the presence of wood debris dams had a major influence on reach retention patterns. Retention structures differed greatly in their relative efficiency of trapping leaves. Rates of retention were closely related to general hydrological and structural characteristics of the study reaches. Leaf retention rates were greater in

reaches with higher ratios of wetted perimeter to channel cross-sectional area. (Baker-IVI)
W85-05664

ROLE OF WOOD DEBRIS IN MODIFYING CHANNEL GEOMORPHOLOGY AND RIPARIAN AREAS OF A LARGE LOWLAND RIVER UNDER PRISTINE CONDITIONS: A HISTORICAL CASE STUDY,
Geological Survey, Menlo Park, CA.
F. J. Triska.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1876-1892, December, 1984. 7 Fig, 4 Tab, 54 Ref.

Descriptors: *Channel morphology, *Geomorphology, *Riparian areas, *History, *Debris, *Red River, *Louisiana, Wood wastes, Lakes, Alluvial deposits, Debris dams, Floods, Snags.

Historical records were reviewed to estimate the impact of wood debris on a 400-500 km reach of the Red River, Louisiana. In the primal condition the banks consisted of unstable alluvial deposits easily eroded during floods. Sediment and riparian trees from eroded banks formed organic debris dams which blocked the channel and promoted channel aggradation. Over a period > 375 years wood debris dams formed in series. The longest instantaneous length of impacted channel was 225 km. The average rate of channel blockage was 1.3 to 1.6 km/year between 1793-1876. Maximum debris accumulation recorded in a single flood was 8.1 km. Exposed wood covered 80-120 km of channel. Debris dams remained in place 80-150 years. Wood debris impacted adjacent riparian areas by flooding forests and forming a series of large lakes. Under natural conditions lakes could become nearly permanent features of the riparian landscape if tributary channels filled with alluvium and organic debris. After removal of organic debris the most recently formed lakes drained over a period of approximately 30 years. Flow reversal in tributaries resulted in channel enlargement and diversion of one half to three quarters of the river's discharge adjacent to riparian lowlands. Wood debris reduced the river's width from about 185 m to approximately 40 m, and aggraded the river bed a maximum of 7 m. Tributary channels were dammed or filled with organic debris, and the river was permanently opened to navigation in 1873. Restoration of full channel flow exposed previously buried logs and eroded forested banks. By 1904, seventy years of debris dams and snag removal, levee projects, dredging and cutting bankside trees resulted in a cleared, wide, meandering channel, which might today be mistaken as typical of a pristine lowland river. (Baker-IVI)
W85-05668

SESTON TRANSPORT IN STREAMS AT COWEETA HYDROLOGIC LABORATORY, NORTH CAROLINA, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. R. Webster, and S. W. Golladay.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1911-1919. December, 1984. 5 Fig, 2 Tab, 22 Ref. DOE contract W-7405-eng-26, NSF grant DEB 8012093.

Descriptors: *Seston transport *Streamflow, *North Carolina, Seston, Streams, Organic carbon, Catchments, Environmental effects, Seasonal variation.

Seston was collected from a variety of small streams at Coweeta Hydrologic Laboratory, North Carolina in order to better understand mechanisms determining seston transport and examine the effect of catchment disturbance on seston concentrations during non-storm periods. Based on samples taken over a six year period from catchment 14 (C14), non-storm organic seston concentrations peaked in summer and were lowest in winter. Seasonal patterns in seston concentration are due in part to dilution because maximum non-storm discharge usually occurs in late winter-early spring and minimum discharge usually occurs in autumn. Highest transport occurred in spring, and transport was lowest during autumn. However, there was no relationship between organic seston concentration and discharge for samples taken from C14 during non-storm periods. Inorganic (ash) seston concentration exhibited the same seasonal pattern and could not be related to discharge during non-storm periods. The per cent ash in seston was very consistent over different dates and discharges. Statistically significant downstream increases in both organic and inorganic seston concentrations in C14 were found. The downstream increase was greatest near the source. There was no statistically significant change in per cent ash downstream from the source. Catchment disturbance resulted in significant differences among organic and inorganic seston concentrations and per cent ash in the seston of the twelve streams. Organic and inorganic seston concentrations and per cent ash were highest for streams draining the two most recently disturbed catchments, and were lowest for the two catchments which have had the longest time to recover and which were disturbed the least. (Baker-IVI)
W85-05671

SEDIMENTATION RATES AND HEAVY METAL POLLUTION OF SEDIMENTS IN THE SETO INLAND SEA, PART 3. HIUCHI-NADA,
Government Industrial Research Inst., Kyushu, Tosu (Japan).
For primary bibliographic entry see Field 5B.
W85-05687

FRACTIONATION OF ORGANIC AND INORGANIC PHOSPHORUS COMPOUNDS IN LAKE SEDIMENTS, AN ATTEMPT TO CHARACTERIZE ECOLOGICALLY IMPORTANT FRACTIONS (DIE FRAKTIONIERUNG ORGANISCHER UND ANORGANISCHER PHOSPHORVERBINDUNGEN VON SEDIMENTEN, VERSUCH EINER DEFINITION OKOLOGISCH WICHTIGER FRAKTIONEN),
Innsbruck Univ. (Austria)
For primary bibliographic entry see Field 2H.
W85-05728

SAPPING PROCESSES AND THE DEVELOPMENT OF THEATER-HEADED VALLEY NETWORKS ON THE COLORADO PLATEAU,
California Inst. of Tech., Pasadena. Guggenheim Jet Propulsion Center.
J. E. Laity, and M. C. Malin.
Geological Society of America Bulletin, Vol. 96, No. 2, p 203-217, February 1985. 13 Fig, 42 Ref. NASA grants NAS7-100 and NAGW-1.

Descriptors: *Sapping, *Theater-headed valleys, *Groundwater erosion, *Glen Canyon, *Utah, Erosion, Drainage systems, Overland flow, Groundwater movement, Seepage, Mars, Geomorphology.

Ground-water sapping is an erosional process that produces landforms with unique characteristics. Sapped drainage systems differ in morphology, pattern, network spatial evolution, rate of erosion, and degree of structural control from their fluvial counter-parts. Investigation of deeply entrenched theater-headed valleys in the Glen Canyon region of the Colorado Plateau indicates that groundwater sapping is the predominant mechanism of growth. The canyons occur in the Navajo Sandstone, a highly transmissive aquifer underlain by essentially impermeable rocks. Within this formation, two populations of valleys with markedly different features are identified. The first group exhibits theater heads: longitudinal profiles with high, steplike discontinuities and commonly asymmetric, structurally controlled patterns. The second group is characterized by tapered terminations; a relatively smooth, concave-up profile; and a more arborescent network. Because the valleys have developed under the same lithologic, stratigraphic, and climatic conditions, the differences in form are attributed primarily to structural constraints that determine the relative effectiveness of overland-flow and ground-water (sapping) processes. Of particular importance is the dip direction of the beds relative to that of valley growth, inasmuch as this relationship controls the occurrence and distribution of ground-water seepage at valley walls. Laterally flowing ground water also exploits fractures at depth, so that the drainage pattern of theater-headed valleys reflects that of the regional jointing pattern. Martian valleys exhibit numerous morphologic similarities to canyons formed in the Navajo Sandstone. These include theater-shaped heads, nearly constant width from source to outlet, high and steep sidewalls, hanging outlets, and a large degree of structural control. Although the constituent materials, scale, climate, structure, and groundwater conditions of Mars cannot be replicated in any Earth analog, the striking similarities in form suggest that the gross geomorphic processes may be similar and that sapping processes have operated to create the Martian valleys. (Author's abstract)
W85-05729

BED MICROTOPOGRAPHY AND ENTRAINMENT THRESHOLDS IN GRAVEL-BED RIVERS,
BP Exploration Co. Ltd., London (England). Sedimentology Branch.
A. C. Brayshaw.
Geological Society of America Bulletin, Vol. 96, No. 2, p 218-223, February, 1985. 4 Fig, 1 Tab, 32 Ref.

Descriptors: *River beds, *Microtopography, *Entrainment, *Gravel-bed rivers, *Bed load, Clasts, Velocity, Sediment transport, Flood flow.

Although increasingly acknowledged as an important factor in bedload transport, few data on the effects of bed conditions on entrainment in gravel-bed rivers exist. This reflects to some degree the substantial difficulties involved in obtaining accurate threshold measurements in such channels. Using a sensor which allows initial movement of labeled particles to be detected during flood flow, the entrainment thresholds of clasts incorporated into the bed microtopography have been compared with those in exposed, open plane-bed positions. The threshold velocity of clasts from cluster bedforms, the most prevalent type of bed microtopography, is found to be above that of more exposed particles of like size and shape. Measurements indicate that the initial movement of approximately 70% of particles in gravel-bed rivers will be directly influenced by the presence of neighboring grains. Bed microtopography plays an important role in delaying incipient motion. The influence of microtopography may be invoked to account for phenomena such as discontinuous particle movement and variations in the composition of bedload during discharge events. (Author's abstract)
W85-05730

CHANNEL SCOURING POTENTIAL USING LOGISTIC ANALYSIS,
Wyoming Water Research Center, Laramie.
For primary bibliographic entry see Field 2E.
W85-05779

FREE JET SCOUR BELOW DAMS AND FLIP BUCKETS,
Gibb (Alexander) and Partners, London (England).
For primary bibliographic entry see Field 8B.
W85-05781

SALT RIVER CHANNELIZATION PROJECT: MODEL STUDY.
Simons, Li and Associates, Inc., Fort Collins, CO.
Y. H. Chen, A. A. Fiuzat, and B. R. Roberts
Journal of Hydraulic Engineering, Vol. 111, No. 2, p 267-283, February, 1985. 8 Fig, 4 Tab, 7 Ref

Descriptors: *Salt River, *Phoenix, *Arizona, *Channelization, *Model studies, Fixed bed models, Movable bed models, Bank erosion, Erosion, Deposition.

A channelization project proposed for the Salt River in Phoenix, Arizona, would contain flood flows and eliminate future damage to the adjacent Sky Harbor International Airport - a severe flood in 1979 heavily damaged the facility. Two models

were tested in order to determine the adequacy of the channelization scheme. The model's flume is 36.5 m long, 12.2 m wide and 1.1 m deep; discharges of up to 100 cfs may be routed through the flume. One fixed-bed model was used to study velocity patterns, flow stages, bank freeboards and bank protection requirements. One distorted movable-bed model was utilized to study erosion and deposition patterns and bank stability in the proposed scheme. Incipient motion of bed particles and tractive force theory for stability of banks were utilized for modeling the various complicated parts of the movable-bed model. Good agreement was observed when results were compared with mathematical model results. (Collier-IVI)
W85-05783

2K. Chemical Processes

CHEMICAL COMPOSITION OF RAIN WATER WITH SPECIAL REFERENCE TO HEAVY METALS OVER LUCKNOW, UTTAR PRADESH IN 1981,
Central Ground Water Board, Lucknow (India). Central Chemical Lab.
B. K. Handa, A. Kumar, and D. K. Goel.
Mausam, Vol. 35, No. 2, p 235-237, April, 1984. 5 Tab, 7 Ref.

Descriptors: *Rain, *Chemical composition, *Lucknow, *India, Acidity, Sodium, Potassium, Calcium, Chlorides, Carbonates, Trace elements, Heavy metals.

Rain water samples were collected in 1981 and analyzed for various constituents, including trace elements by standard methods. There was no acid rain found over Lucknow. However the EC of rain water showed considerable variation, ranging between 3 and 118 microsiemens/cm. The phosphate and ammonia concentrations in rain water ranged around 0.298 mg/l and 0.66 mg/l, respectively. Concentrations of trace elements varied considerably with no direct relation being observed between quantity of rainfall and trace element concentration. Iron was the most abundant trace element, mean 30.9 mg/l. Origins for the various constituents in the rainwater include sea salt nuclei, volatile constituents from stagnant water bodies, mining activities, waste incineration, agricultural activities which include aerial spraying of insecticides, forest fires, fossil fuel burning, automobile emissions, soil dust particles, and exudation of heavy metals by vegetation. (Baker-IVI)
W85-05101

SOLUBILITIES AND SUPERSATURATIONS OF CALCIUM SULFATE AND ITS HYDRATES IN SEAWATER,
Technische Hogeschool, Delft (Netherlands). Dept. of Chemical Engineering and Chemistry.
For primary bibliographic entry see Field 3A.
W85-05114

HYDROGEOLOGIC AND GEOCHEMICAL STUDIES OF SELECTED NATURAL RADIOISOTOPES AND BARIUM IN GROUNDWATER IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
R. H. Gilkeson, K. Cartwright, J. B. Cowart, and R. B. Holtzman.
Illinois Geological Survey Report No. 1983-6. May 1983. 93 p, 13 Fig, 3 Tab, 60 ref. Project No. OWRT B-108-ILL.

Descriptors: *Radioisotopes, *Groundwater, *Barium, *Radium radioisotopes, *Uranium radioisotopes, *Bedrock, Aquifers, Geohydrology, Drinking water, Chemical properties, Sulfates, Minerals, Northern, Northern Illinois, Water quality.

Dissolved concentrations of the natural radioisotopes Rn222, Ra226, Ra228, Th230, Th232, U234, and U238 and the element Ba(2+) were investigated in a study of high concentrations of Ra226, Ra228, and Ba(2+) in groundwater from the Cambrian and Ordovician bedrock of northern Illinois. The high radium and barium concentrations are naturally present in the major aquifers--the sandstone bedrock; therefore, remedial well construction measures will not lower the concentrations. The combined concentrations of Ra226 and Ra228 range from 2.3 to 50.2 picocurie/liter; the majority of analyses exceed the limit in the drinking water regulations of 5.0 picocurie/liter. The Ra226/Ra228 activity ratio ranges from 0.2 to 41.0; a Ra226 analysis has no validity for predicting the Ra228 concentration. Important controls on dissolved Ra226 concentrations are secondary U on the sandstone matrix and the ionic strength of groundwater. The distribution of accessory minerals that contain Th232 is believed to be an important control on dissolved Ra228 concentrations. Locally the dissolved Ra226 and Ra228 concentrations are affected by dissolution-precipitation of secondary barite. Dissolved concentrations of Rn222 and U are less than proposed drinking water regulations. The extreme enrichment in U234 that occurs widespread in groundwater from the Cambrian and Ordovician bedrock is unique and problematic. The enrichment may reflect recharge of uranium to the bedrock by glacial processes. Dissolved Ba(2+) concentrations range from < 0.0 to 22.4 milligrams/liter. The high Ba(2+) concentrations occur in groundwater that is depleted in dissolved SO4(2-) by anaerobic microbial reactions.
W85-05122

USE OF URANIUM-SERIES ISOTOPES FOR STUDYING THERMAL WATERS OF THE FRUNZE REGION,
For primary bibliographic entry see Field 2F.
W85-05150

ISOTOPE INVESTIGATIONS OF THE CONDITIONS OF FORMATION OF MINERAL AND THERMAL WATERS IN SOME CAUCASIAN REGIONS,
For primary bibliographic entry see Field 2F.
W85-05152

MODELING OF CO2 DYNAMICS IN A BODY OF FRESHWATER,
For primary bibliographic entry see Field 2H.
W85-05159

EFFECT OF CATION EXCHANGE ON CALCULATED HYDRODYNAMIC DISPERSION COEFFICIENTS,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 2G.
W85-05183

CHARACTERIZATION OF WATER FROM LAVERKIN SPRINGS, UTAH,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
R. J. Eisenhauer.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-83-3. April 1983. 40 p, 4 Fig, 30 Tab, 3 Ref, 1 Append.

Descriptors: *Water analysis, *Chemical properties, *Water quality, *Springs, *Saline water intrusion, *Saline water, Salinity, Trace elements, Colorado River, Salts, Boreholes, Calcium, Magnesium, Potassium, Sodium, Dissolved solids, Utah, Groundwater movement, Groundwater, Washington County.

Water from the LaVerkin Springs (LVS) which discharge into the Virgin River, a tributary of the Colorado River, has been studied since 1971 by the Bureau of Reclamation as part of the Colorado River Water Quality Improvement Program. The 1972 and 1979 to 1980 LVS water analyses data were reevaluated and compared to evaluate uniformity of water analysis from each of the 14 springs, monthly variations in spring water analyses, differences between spring water and borehole water analyses, characteristics of spring water, and differences between the 1972 and 1979 to 1980 spring water analyses. The analyses of water taken from 10 of the 14 springs in 1972 suggest that the water issuing from each spring comes from the same source. Throughout the 1972 tests, dissolved Ca, Mg, K and Na salt concentration varied < +/- 5% from the average values. The average value of total dissolved solids (TDS) was was 9770 milligrams/liter and remained constant at 9800 milligrams/liter during January through May. The TDS dropped to a low of 9670 milligrams/liter in June but gradually returned to 9800 milligrams/liter by December. The water from all of the springs and the borehole seemed to come from the same source. The spring water tested in 1972 and again in 1979-1980 had comparable average values of Ca, Mg, K, sodium bicarbonate, chloride, and sulfate dissolved salts. The average values of dissolved salts for the two test periods compared within the variations expected from sampling and analytical errors.
W85-05309

REGIONAL SURVEY OF CHEMISTRY OF HEADWATER LAKES AND STREAMS IN NEW ENGLAND: VULNERABILITY TO ACIDIFICATION,
Columbia National Fisheries Research Lab., Orono, ME. Field Research Station.
For primary bibliographic entry see Field 2H.
W85-05312

ATMOSPHERIC TRAJECTORY MODELS FOR DIAGNOSING THE SOURCES OF ACID PRECIPITATION,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 5B.
W85-05314

NORWEGIAN MODELS FOR SURFACE CHEMISTRY: AN OVERVIEW,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2A.
W85-05317

MODELING THE REACIDIFICATION RATES OF NEUTRALIZED LAKES NEAR SUDBURY, ONTARIO,
Ontario Ministry of the Environment, Rexdale. Water Resources Branch.
For primary bibliographic entry see Field 2A.
W85-05319

MODELING IMPACTS OF ACID PRECIPITATION FOR NORTHEASTERN MINNESOTA,
Iowa Univ., Iowa City. Div. of Energy Engineering.
J. L. Schnoor, W. D. Palmer, and G. E. Glass.
In: Modeling of Total Acid Precipitation Impacts. 1984. p 155-173, 14 Fig, 4 Tab, 22 Ref.

Descriptors: *Model studies, *Acidification, Acidic water, *Hydrologic models, *Lakes, *Mathematical models, Hydrogen ion concentration, Simulation analysis, Acids, Surface water, Snowmelt, Chemical properties, Weathering, Hydrologic budget, Filson Creek, Minnesota.

The trickle-down mathematical model was successfully calibrated with field data from Filson Creek watershed, Minnesota to predict whether present acid loadings are acidifying the lakes. Even though acidic loadings were moderate at Filson Creek (pH 4.8 of bulk precipitation and a sulfate load of 11 kg/ha/yr), a substantial pH depression was observed during snowmelt. Simulations showed that the average spring pH of Filson Creek would decrease from 6.2 to 5.0 if acidic deposition increased twofold. The greatest uncertainty in forecasting lake responses to increased acidic loadings was the kinetics of chemical weathering. Hydrologic flowrates and chemical weathering rates were the most sensitive parameters in their effect on surface water pH in the trickle-down model. The model can be used with annual acid depositional loadings for long term simulations.
W85-05320

DEVELOPMENT AND CALIBRATION OF THE INTEGRATED LAKE-WATERSHED ACIDIFICATION STUDY MODEL,
Tetra Tech, Inc., Lafayette, CA.
C. W. Chen, S. A. Gherini, J. D. Dean, R. J. M. Hudson, and R. A. Goldstein.
In: Modeling of Total Acid Precipitation Impacts. 1984. p 175-203, 15 Fig, 17 Ref.

Descriptors: *Model studies, *Watersheds, *Acidification, *Hydrologic models, *Lakes, *Chemical properties, *Hydrogen ion concentration, Forest watersheds, Calibrations, Limnology, Catchment areas, Sulfur, Nitrates, Soil chemistry, Simulation analysis, Air pollution.

As part of the Integrated Lake-Watershed Acidification Study (ILWAS), a deterministic model was developed to calculate surface and groundwater chemical characteristics, given watershed and time-varying inputs such as precipitation quantity and quality, and ambient air quality. Time-varying concentrations of 16 chemical constituents are simulated by a series of homogeneous compartments consisting of the forest canopy, snow, soil layers, streams and lakes. ILWAS model results compare well with hydrologic and chemical data collected from the Panther and Woods Lake-watershed systems in the Adirondack region of New York. The flowpaths and residence time of water in the soil (organic and inorganic strata) are important determinants of lake water chemistry. The decreased pH of Panther Lake surface water during the snowmelt period appears to be caused mainly by nitric acid. The basin alkalinity supply rate which is a function of input acidity and determines how a lake may respond to changes in acid load, is determined by basin characteristics and can be calculated by the ILWAS model.
W85-05321

METAL IONS IN BIOLOGICAL SYSTEMS, VOL. 18, CIRCULATION OF METALS IN THE ENVIRONMENT.
Marcel Dekker, Inc., New York, 1984. 350 p. Edited by H. Sigel and A. Sigel.

Descriptors: *Water chemistry, *Biological systems, Ecology, *Metals, Aquatic ecosystems, Environment, Aquatic environment.

This volume contains 10 chapters devoted to various aspects of the circulation of metals in the environment. Two chapters are of particular relevance to water resources applications. One discusses the regulation of trace metal concentrations in freshwater systems, and the second natural organic matter and metal-organic interaction in aquatic systems.
W85-05325

NATURAL ORGANIC MATTER AND METAL-ORGANIC INTERACTIONS IN AQUATIC SYSTEMS,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
J. Buffle.
In: Metal Ions in Biological Systems, Vol. 18, Circulation of Metals in the Environment. Marcel Dekker, Inc., New York, 1984. Edited by H. Sigel and A. Sigel. p 165-221, 8 Fig, 1 Tab, 181 Ref.

Descriptors: *Water chemistry, *Ecology, *Organic matter, *Metals, Aquatic life, Natural organic matter, Model studies, Metal complexes.

The development of aquatic and terrestrial life is linked to the transport processes which enable metals fixed on solid substrates to be brought to the surface of living organisms. The nature of metals which are the most likely to interact with organic matter may be estimated from considerations based on thermodynamics and stoichometry. Natural organic matter (NOM) in aquatic systems consists of a very complex mixture of compounds, including, in particular, many substances which can be classified within the major biochemical groups: carbohydrates, proteins and peptides, and lipids. Aquatic organic substances are always composed of a mixture, in various proportions, of pedogenic (soil derived) and aquogenic organic substances. Most experimental titration curves of NOM by metal ions suggest a continuous decrease in complexation strength rather than a few descrete transitions from strong to weak sites. A better understanding of the complexation properties of NOM demands the development of better techniques for separation and characterization, which would give more information on the nature of the minor complexing sites as well as the physical properties of NOM, particularly aggregation. The polydispersity of NOM's properties might be a fundamental characteristic of its ecological action and that any fractionation procedure, by reducing this polydispersity, may be considered as denaturing the properties of NOM leading to the observation of artificial properties.
W85-05326

REGULATION OF TRACE METAL CONCENTRATIONS IN FRESHWATER SYSTEMS,
Neuchatel Univ. (Switzerland).
P. Baccini.
In: Metal Ions in Biological Systems, Vol. 18, Circulation of Metals in the Environment. Marcel Dekker, Inc., New York. 1984. Edited by H. Sigel and A. Sigel. p 239-286, 28 Fig, 1 Tab, 56 Ref.

Descriptors: *Water chemistry, *Ecology, *Trace metals, *Rivers, Physicochemical treatment, Lakes, Biochemistry, Sinks, Ecosystems, Cooper, Zinc, Bioaccumulation.

The phenomenology of trace metal transport in freshwater systems and the field and laboratory studies on transfer mechanisms lead to several conclusions. In rivers, trace metal transport is primarily regulated by physicochemical processes. Surface chemical theory and the hydrodynamics of particle transport provide the necessary tools to predict the characteristics of trace metal transfers. Lakes serve as sinks for incoming trace metals in particulate form. Due to grain size fractioning the finer particles with higher trace metal concentrations are transported further into the basin. The ecosystem lake disposes of negative feedback mechanisms to control the concentration of essential trace metals such as copper and zinc to a certain extent. It is postulated that primary producers and the microbial decomposers aim to control the concentration of their dissolved and biologically available forms. The following biochemical mechanisms are applied to reduce the transfer of copper and zinc into the biota: decrease of biological uptake by reduction of proton activity in the substrate (trophogenic trace metal control) and decrease of trace metal concentration by formation of new adsorbing surfaces (tropholytic trace metal control).
W85-05327

CHARACTERIZATION OF GLENWOOD SPRINGS AND DOTSERO SPRINGS WATERS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. J. Eisenhauer.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-83-10, October 1983. 52 p, 10 Fig, 14 Tab, 9 Ref, 2 Append.

Descriptors: *Spring water, *Salinity, Bicarbonates, Calcium, Trace metals, Anions, Sludges, Toxicity, Drinking water, Potable water, Groundwater quality.

Studies were initiated by the Colorado River Water Quality Office to quantify, characterize, identify beneficial uses, and find ways of preventing the waters from the Glenwood Springs and Dotsero Springs from entering the Colorado River. The Dotsero Springs are located in the Leadville limestone strata. Because of the high bicarbonate content of the Dotsero Springs Water, calcium could be reduced from 260 to 125 mg/l by partial lime treatment. Trace metals and trace anions were at a concentration of 0.1 mg/l or less and raw water met the toxicity limits for drinking water. Dehydrated salts or lime treatment sludges would not exceed toxicity limits for Resource Conservation and Recovery Act hazardous waste. The Glenwood Springs (GS) are located in the Leadville limestone strata. Because of the high bicarbonate content of GS water, calcium could be reduced from 470 to 238 mg/l by neutralization with lime (calcium hydroxide) to precipitate calcium carbonate. The trace metals and trace anions were less then 0.1 mg/l. The raw water exceeded or approached the limits of toxicity for drinking water for cadmium, chromium, fluoride, and selenium. However, chemical pretreatment and desalting necessary to bring water to below TDS limits would reduce cadmium, chromium, fluoride, and selenium below limits. The combined flow rate for the 25 identified surface springs (14 GS, plus 11 DS) of the GS-DS unit is 0.516 cu m/s (18.23 cu ft/s). The flow rate weighted average TDS for the unit is 15,016 mg/l. The salt load for the 11 DS was 69,050 metric tons annually and for the 14 GS was 174,700 metric tons annually.
W85-05329

SEASONAL AND ANNUAL VARIATION IN THE PRECIPITATION CHEMISTRY OF THE RHODE RIVER ECOSYSTEM,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
J. Miklas, T. L. Wu, and D. L. Correll.
In: Environmental Data Summary for the Rhode River Ecosystem (1970-1978), Section A: Long Term Physical/Chemical Data, Part 1: Airshed and Watershed, 1982. p 160-178, 4 Tab.

Descriptors: Data collections, *Maryland, *Chemistry of precipitation, Metals, *Hydrogen ion concentration, Organic matter, Nitrogen, Phosphorus, *Seasonal variation, Precipitation, Heavy metals, Cations, Nutrients, Calcium, Cadmium, Potassium, Baseline studies, Magnesium, Copper, Zinc, Iron, Rainfall, Nitrates.

The loading rates for total P, N, organic matter and metallic cations (K, Ca, Mg, Cu, Zn, Cd and Fe) were determined along with pH values in precipitation collected in rain gauges located at the Rhode River Estuary weather station. In general the pH of rainwater declined from 1974 through 1976, but then stabilized from 1976 through 1978. Mean yearly loadings of P were 0.81 kg/ha (bulk) and 0.60 kg/ha (dryfall). Total N bulk loading averaged 10.5 kg/ha. Average yearly organic matter loading rates were 422,000 kcal/ha. On the average, 93% of this organic matter was dryfall. The majority of metals loading rates were highly variable, with no clear seasonal or yearly trends. Average yearly loading rates for the metallic nutrients Ca, K, and Mg were 10.89, 3.22 and 2.60 kg/ha, respectively. For heavy metals, average annual loading rates of Zn, Fe, Cu and Cd were 2090, 850, 62, and 26 g/ha, respectively.
W85-05355

RADIUM FLUXES FROM A SALT MARSH,
South Carolina Univ., Columbia. Dept. of Geology.
For primary bibliographic entry see Field 2L.
W85-05468

RECHARGE IN KARST AND DUNE ELEMENTS OF A SEMI-ARID LANDSCAPE AS INDICATED BY NATURAL ISOTOPES AND CHLORIDE,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
For primary bibliographic entry see Field 2F.
W85-05530

HYDROGEOCHEMISTRY OF THE MEADE THRUST ALLOCHTHON, SOUTHEASTERN IDAHO, U.S.A., AND ITS RELEVANCE TO STRATIGRAPHIC AND STRUCTURAL GROUNDWATER FLOW CONTROL.
Colorado Univ. at Colorado Springs. Dept. of Geology and Applied Earth Sciences
For primary bibliographic entry see Field 2F.
W85-05531

EFFECT OF WATER CHLORINATION ON THE TOXICITY OF COPPER TO PHYTOPLANKTON,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 5C.
W85-05581

PHOSPHORUS RELEASE FROM THE SEDIMENTS OF FLAMING GORGE RESERVOIR, WYOMING, U.S.A.,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 2H.
W85-05630

VARIABILITY OF THE PHYSICO-CHEMICAL CHARACTERISTICS OF THE PONDS OF DOMBES (AIN) (LA VARIABILITE DES CARACTERISTIQUES PHYSICO-CHIMIQUES DES ETANGS DE LA DOMBES (AIN)),
Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Station d'Hydrobiologie Lacustre.
G. Balvay.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1655-1660, December, 1984. 7 Fig, 9 Ref.

Descriptors: *Physico-chemical properties, *Ponds, *Dombes, *France, Minerals, Nutrients, Nitrates, Ammonia, Electrical conductivity, Hydrogen on concentration, Alkalinity, Fish farming, Aquaculture, Water quality, Upstream.

Dombes is the main fish farming region in France, producing about 1200 tons of fish per year. Water from 75 ponds in the Dombes was analyzed: conductivity varied from 51 to 344 micro-S/cm, the pH varied from 6.4 to 9.95, the alkalinity ranged from 0.19 to 2.72 meq/l, nitrates ranged from 0 to 0.61 mg N/l while ammonia nitrogen ranged from 0 to 2.6 mg N/l. The water chemistry varied continuously throughout the year. The variability which exists in the ponds studied may be the result of differences in the water sources. In many cases, the water passes along a chain of ponds, so that there is a progressive enrichment of minerals and nutrients. Each pond presents an individual case, but the relations with the ponds upstream must be considered in the improvement of the quality of water for aquaculture. (Moore-IVI)
W85-05650

GEOGRAPHICAL VARIABILITY IN THE NATURAL CHEMICAL COMPOSITION OF RUNNING WATERS (VARIABILITE GEOGRAPHIQUE DE LA COMPOSITION CHIMIQUE NATURELLE DES EAUX COURANTES),
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
M. Meybeck.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1766-1774, December, 1984. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Chemical composition, *Chemical properties, *Geographical variability, Atmospheric deposition, Small watersheds, Silica, Potassium, Calcium, Magnesium, Carbonates, Sodium, Chloride, Sulfates, Lithology, Vegetation.

The water chemical composition (major elements) of unpolluted watersheds (10 sq km) is highly variable. Once the essential atmospheric inputs correction is realized, the spatial variability of elements reflects their other origins and pathways. It is minimum for SiO2 and K(+), limited for Ca(++), Mg(++), and HCO3(-) and maximum for Na(+), Cl(-) and SO4(--). This scattering is related to the influence of watershed lithology which produces various water-types in which any major ion may be dominant with the exception of potassium. On a continent scale, there is a general convergence to the calcium-carbonate type of waters. Other water quality factors, as climate, vegetation, altitude, relief and active volcanism are of secondary importance except on nutrients, which are much less variable and regulated by vegetation. Concentration statistics in the temperate region and in the world, and examples of major water-types, are given for major elements, nutrients, pH, conductivity and suspended matter. Referring to these natural variations, the 'world average reference water' concept is actually meaningless. (Author's abstract)
W85-05657

PHYSICAL AND CHEMICAL EVOLUTION OF SNOWPACKS ON THE CANADIAN SHIELD (WINTER 1979-1980),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 2C.
W85-05659

ANALYSIS OF THE PROCESS OF RETENTION OF ORGANIC MATTER IN STREAM ECOSYSTEMS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2J.
W85-05664

UPTAKE OF DISSOLVED ORGANIC CARBON IN MOUNTAIN STREAMS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W85-05665

SIZE DISTRIBUTION AND LIGNIN CONTENT OF FINE PARTICULATE ORGANIC MATTER (FPOM) FROM MICROBIALLY PROCESSED LEAVES IN AN ARTIFICIAL STREAM,
Alabama Univ. in Birmingham. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W85-05669

PHOSPHORUS UPTAKE BY DECOMPOSING LEAF DETRITUS: EFFECT OF MICROBIAL BIOMASS AND ACTIVITY,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2H.
W85-05670

INFLUENCE OF NITRATE ON THE PHOSPHORUS FLUX TO AND FROM OXYGEN DEPLETED LAKE SEDIMENTS,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
T. Tiren, and K. Pettersson.
Hydrobiologia, Vol. 120, No. 3, p 207-223, January, 1985. 6 Fig, 3 Tab, 38 Ref.

Descriptors: *Nitrates, *Phosphorus, *Lake sediments, *Anaerobic conditions, Redox potential, Mineralization, Ammonium, Dissimilation, Sediments.

Addition of nitrate to an oxygen depleted sediment leads to a stimulation of the mineralization process if a major part of the nitrate is dissimilatorily reduced. This may cause an increased release of phosphate from some sediments. Nitrate, however, maintains a high redox potential at the sediment surface and thus prevents a release of iron-bound phosporus. These two counteracting effects of nitrate addition to sediment-water systems were demonstrated in laboratory experiments. A high supply of nitrate to a phosphorus-saturated sediment caused an increased release of phosphate and ammonium once the nitrate had been used up. However, from other sediments there was no or very little release of phosphate but an increased release of ammonium caused by high nitrate dissimilation, probably due to the very high capacity of these sediments to bind liberated phosphate or due to storage of phosphorus in an increased bacterial biomass. Phosphorus fractionation, before and after the experiments with the sediments, provided information on transfers to, from and within the sediments. (Author's abstract)
W85-05716

IN SITU METHANE PRODUCTION FROM ACID PEAT IN PLANT COMMUNITIES WITH DIFFERENT MOISTURE REGIMENS IN A SUBARCTIC MIRE,
Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Mikrobiologi.
B. H. Svennsson, and T. Rosswall.
Oikos, Vol. 43, No. 3, p 341-350, December, 1984. 4 Fig, 1 Tab, 34 Ref. Swedish Natural Science Research Council gontracts B 3358-002 and B 0313-037.

Descriptors: *Methane, *Peat, *Sweden, Plant communities, Nutrients, Wetlands, Subarctic zone, Carbon dioxide, Redox conditions.

The rate of release of methane to the atmosphere from an acid peat of a subarctic mire in northern Sweden was between 0.01 and 30 mg C/sq m/h in different plant communities, constituting a moisture and nutritional gradient from dry to wet and poor ombrotrophic to minerotrophic habitats. Methane production was positively correlated with moisture, and the higher nutrient content in the minerotrophic areas may also be of importance. The corresponding release of carbon dioxide (5.7-48.8 mg C/sq m/h) seemed unrelated to moisture and availability of nutrients. The methane could account for about 50% of the carbon flux to the atmosphere. The fluxes showed great variability in seemingly homogeneous areas, which might be explained by different redox conditions in the peat below. The highest methane production in the peat horizon was located between 10 and 15 cm below the surface, where Eh was at its lowest value. (Author's abstract)
W85-05720

NITROGEN FIXATION IN SUBARCTIC STREAMS INFLUENCED BY BEAVER (CASTOR CANADENSIS),
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 2H.
W85-05737

INFLUENCE OF THE SURFACE MICROLAYER ON NUTRIENTS, CHLOROPHYLL AND ALGAL DIVERSITY OF A SMALL EUTROPHIC BOG POND,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 2H.
W85-05738

CARBON FLOW IN A SMALL TURBID MAN-MADE IMPOUNDMENT,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W85-05740

SEASONAL CHANGES IN THE CHEMISTRY AND BIOLOGY OF A MEROMICTIC LAKE (BIG SODA LAKE, NEVADA, U.S.A.),
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2H.
W85-05756

SEDIMENTOLOGY AND GEOCHEMISTRY OF SALINE LAKES OF THE GREAT PLAINS,
Manitoba Univ., Winnipeg. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2H.
W85-05760

GEOCHEMISTRY OF GREAT SALT LAKE, UTAH I: HYDROCHEMISTRY SINCE 1850,
Calgary Univ. (Alberta). Dept. of Geology and Geophysics.
R. J. Spencer, H. P. Eugster, B. F. Jones, and S. L. Rettig.
Geochimica et Cosmochimica Acta, Vol. 49, No. 3, p 727-737, March, 1985. 10 Fig, 3 Tab, 41 Ref. NSF grant EAR-7903875.

Descriptors: *Chemical properties, *Saline lakes, *Great Salt Lake, *Utah, Hydrologic budget, Precipitation, Lake evaporation, History, Stratifica-

tion, Hot springs, Interstitial water, Lake sediments, Chemical precipitation.

The hydrochemistry of Great Salt Lake, Utah, has been defined for the historic period, 1850 through 1982, from published data combined with new observations. The water balance depends largely on river inflow, atmospheric precipitation onto the lake surface and evaporation. Input of the major solutes can best be accounted for by mixing dilute calcium-bicarbonate type river waters with NaCl-dominated hydrothermal springs. Prior to 1930, lake concentrations fluctuated inversely with lake volume in response to small climatic variations. Since then, salt precipitation and dissolution have significantly modified lake brine compositions and have led to density stratification and the formation of brine pockets of differing composition. Brine mixing has become an important component of brine evolution. Calculated evaporation curves are used with mineral precipitation and dissolution to clarify these processes. Pore fluids represent important storage for solutes. Solute profiles can be modeled by simple one-dimensional diffusion calculations. Short-term historic variations in lake composition affect shallow pore fluids in the upper 2 meters of sediment. (Author's abstract)
W85-05761

CONTINUUM MODEL FOR SIMULTANEOUS CHEMICAL REACTIONS AND MASS TRANSPORT IN HYDROTHERMAL SYSTEMS,
California Univ., Berkeley. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2F.
W85-05762

VARIATION IN PH DURING SUMMER STORMS NEAR THE CONTINENTAL DIVIDE IN CENTRAL COLORADO, U.S.A.,
Geological Survey, Lakewood, CO. Water Resources Div.
M. M. Reddy, T. D. Liebermann, J. C. Jelinski, and N. Caine.
Arctic and Alpine Research, Vol. 17, No. 1, p 79-88, February, 1985. 5 Fig, 7 Tab, 11 Ref. NSF grant BSR-8012095.

Descriptors: *Hydrogen ion concentration, *Rain, *Storms, *Continental Divide, *Colorado, Chemistry of precipitation, Acid rain, Specific conductance, Automation, Samplers, Rainfall intensity.

Precipitation acidity was monitored continuously from July to September 1983 at a well-instrumented research site located near the Continental Divide in Central Colorado. Rainfall amount, temperature, pH, and specific conductance were determined using a prototype device consisting of a modified wet-only precipitation collector with appropriate sensors. Data were recorded automatically with microprocessor control by preset time intervals. Weekly wet-only composite precipitation samples were also collected. Precipitation totaled 190 mm during the period, all as rain. Sixty-five percent of the continuous pH measurements were between 3.40 and 4.10, with an average of pH 3.80. Values of pH greater than 5.00 were rare. Composite samples were significantly less acidic, and averaged pH 4.36. Precipitation pH typically decreased rapidly as a storm began, was lowest near or slightly after the time of maximum rainfall intensity, then increased slightly. Paradoxical low pH and low specific conductance were recorded, and it is possible that some initial continuous pH measurements were too low. Acid loading varied widely among storms, and may have resulted largely from short bursts of high-intensity, low-pH rainfall. (Author's abstract)
W85-05766

2L. Estuaries

WATER QUALITY CHARACTERISTICS OF THE HARIMA NADA COASTAL AREA, COD LOAD CAUSED BY PRIMARY PRODUCTION,
Hyogo Prefecture Environmental Science Inst., Kobe (Japan).
H. Tanaka, T. Nakano, and H. Watanabe.
Water Research, Vol. 19, No. 2, p 133-141, 1985. 10 Fig, 17 Ref.

Descriptors: *Chemical characteristics, *Harima Nada, *Japan, *Coastal waters, *Chemical oxygen demand, *Primary productivity, Phytoplankton, Organic matter, Seasonal variation, Decomposing organic matter.

Accumulations of nutrients resulting from large quantities of fluvial discharge were observed in the coastal area of Harima Nada (Japan) during the rainy season period. The layer of water affected by the discharge reached depths of about 3-5 m from the surface. After the passing of the rainy season, increased sunlight and rising water temperature induced the abrupt development of phytoplankton in this layer of water. The organic pollution load caused by these increased populations was estimated to be 70-90% of the overall load of coastal surface water in summer time. After this period of abnormal growth ended, the polluted seawater gradually purified itself through biochemical degradation and precipitation. The time needed to transform organic matter into inorganic matter, however, was from 3 to 4 months. (Author's abstract)
W85-04969

NUMERICAL ESTUARINE FLOW MODEL,
Tulsa Univ., OK. Coll. of Engineering and Physical Sciences.
F. S. Henry, R. C. Ahlert, R. L. Peskin, and R. Vichnevetsky.
Water Resources Bulletin, Vol. 20, No. 6, p 823-831, December, 1984. 12 Fig, 21 Ref. Office of Water Research and Technology project A-044-NJ.

Descriptors: *Estuaries, *Numerical models, *Flow, *Streamflow, *Delaware Estuary, *Delaware River, *New Jersey, *Pennsylvania, *Delaware, Channel flow, Model studies, Path of pollutants.

Tidal elevations and volume flow rates predicted by a novel flow model compare well with available field data for the Upper Delaware Estuary (New Jersey, Pennsylvania, Delaware). The model provides some two-dimensional features while using an essentially one-dimensional approach which results in a numerically stable and reasonably mass conservative model. Because data were not available, the velocities predicted to occur in the UDE could not be verified, but the model was shown to be able to match velocities given by an analytical solution to a simple channel flow. The model describes some two-dimensional features of estuarine flow that cannot be generated with conventional one-dimensional models. The model predicts that there is significant advective lateral motion in the UDE. It is assumed that these lateral motions are caused largely by the fact that the estuary's cross-stream bottom profile changes with downstream distance; the dispersion resulting from the lateral motions could significantly enhance the speed at which cross-sectional mixing occurs. Using the model velocity output, maps of particle paths were constructed to describe the advective motions predicted to occur in the UDE; the particles were assumed to be neutrally bouyant and non-diffusive. The maps indicate the influence of the Schuylkill River on the net lateral advective motion in the Camden-Philadelphia area; in this region the net lateral movement is always from the Pennsylvania bank towards the New Jersey bank. (Collier-IVI)
W85-04987

VERTICAL DISTRIBUTION OF AL, CU, FE AND ZN IN THE SOIL SALT MARSHES OF THE SADO ESTUARY, PORTUGAL,
Universidade Nova de Lisboa (Portugal). Dept. of Chemistry and Biotechnics.
For primary bibliographic entry see Field 5B.
W85-05032

CRITIQUE OF PRESENT WETLANDS MITIGATION POLICIES IN THE UNITED STATES BASED ON AN ANALYSIS OF PAST RESTORATION PROJECTS IN SAN FRANCISCO BAY,
Stanford Univ., CA. Program in Human Biology.
M. S. Race.
Environmental Management, Vol. 9, No. 1, p 71-81, January, 1985. 4 Tab, 27 Ref.

Descriptors: *Wetlands, *San Francisco Bay, *California, *Restoration, *Man-made marshes, Estuarine environment, Habitats, Ecosystems.

A detailed evaluation of past wetland restoration projects in San Francisco Bay was undertaken to determine their present status and degree of success. Many of the projects never reached the level of success purported and others have been plagued by serious problems. On the basis of these findings, it is debatable whether any sites in San Francisco Bay can be described as completed, active, or successful restoration projects at present. In spite of these limited accomplishments, wetland creation and restoration have been adopted in the coastal permit process as mitigation to offset environmental damage or loss of habitat. However, because the technology is still largely experimental, there is no guarantee that man-made wetlands will persist as permanent substitutes for sacrificed natural habitats. Existing permit policies should be reanalyzed to insure that they actually succeed in safeguarding diminishing wetlands resources rather than bartering them away for questionable habitat substitutes. Coastal managers must be more specific about project requirements and goals before approval is granted. Continued research on a regional basis is needed to advance marsh establishment techniques into a proven technology. In the meantime, policies encouraging or allowing quid pro quo exchanges of natural wetlands with man-made replacements should proceed with caution. The technology and management policies used at present are many steps ahead of the needed supporting documentation. (Author's abstract)
W85-05070

'HET GOORKEN' AND 'DE LOKKERSE DAMMEN' (ARENDONK, BELGIUM): I. INTRODUCTION AND PHYTOSOCIOLOGICAL SURVEY (HET GOORKEN EN DE LOKKERSE DAMMEN (ARENDONK, BELGIE); 1. INLEIDING EN FYTOSOCIOLOGISCHE SCHETS),
Antwerp Univ., Wilrijk (Belgium). Dept. of Biology.
D. De Baere, and R. Mahieu.
Bulletin de la Societe Royale de Botanique de Belgique, Vol. 117, No. 2, p 328-340, 1984. 1 Fig, 6 Tab, 14 Ref.

Descriptors: *Peat bogs, *Vegetation, *Het Goorken, *Lokkerse Dammen, *Belgium, *Arendonk, Species composition, Bogs, Wetlands, Aquatic plants, Heaths.

The state nature reserve 'het Goorken' and the private nature reserve 'de Lokkerse Dammen' formed until the middle of the last century the source region of the river Wamp. Some important hydrological interventions decreased the oligotrophic character and the surface of open water in the studied peat-bog. The phytosociological description of the vegetation was carried out, using the Braun-Blanquet method. A great diversity of vegetation types has been distinguished, varying from water plant vegetation, over oligotrophilous and etrophilous peat-bog communities up to carr. At some places a heath-vegetation was observed. (Author's abstract)
W85-05072

VERIFICATION OF A MODEL OF THE EASTERN SCHELDT,
RAND Corp., Santa Monica, CA.
J. J. Leendertse.
Report R-3108-NETH. April 1984. Rand Corp., Santa Monica, CA. 127 p, 96 Fig, 6 Tab, 7 Append. Contract/Grant No. DED-2091.

Descriptors: *Simulation Analysis, *Mathematical Model, *Flow Rates, *Estuaries, Salinity, Hydraulic Models, Tidal Effects, Transport Rates, Eastern Scheldt, Netherlands.

A verification simulation of a model of the Eastern Scheldt is described. Boundary conditions for a simulation of flows and water levels on 11 January 1982 were obtained from gauging stations in the offshore area of the estuary using weighting functions obtained from simulations with other models of conditions of September 1975 in the offshore area. The simulation was made first without taking into account the effects of the varying density in the estuary. By operating the model in this mode a direct comparison with a hydraulic model could be made. Good agreement was obtained between observed and computed transport rates through the Hammen, Schaar, and Roompot. The agreement is better than that obtained with a comparable simulation with the hydraulic model. To investigate the effect of the representation of a narrow channel, called the Eendracht, with the two-dimensional representation of the model, two experiments were made with a part of the model extending eastward from the Zeeland bridge. These experiments indicated that: 1) the accuracy of the model in the vicinity of the channel ends can be improved by coupling the two-dimensional model with a one-dimensional representation of this channel; and 2) tide gauge data at existing stations can be used directly as boundary conditions for this part of the model. Simulation results indicated a very good agreement between observed and computed transport rates through the Hammen, Schaar, and Roompot. The simulation in which the pressures resulting from salinity were included in a better agreement with the observed data than the simulation without the salinity. The quarter-diurnal tidal component was the most difficult to reproduce in the model.
W85-05121

FINAL REPORT ON EFFECT OF FENTHION ON SELECTED ESTUARINE SPECIES RELATED TO FIELD STUDY,
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W85-05124

EFFECT OF THREE MARSH MANAGEMENT TECHNIQUES ON THE ECOLOGY OF IRREGULARLY FLOODED CHESAPEAKE BAY WETLANDS: VEGETATION AND WATER QUALITY STUDIES, PARTS I AND II,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
For primary bibliographic entry see Field 4A.
W85-05347

ENVIRONMENTAL DATA SUMMARY FOR THE RHODE RIVER ECOSYSTEM (1970-1978), SECTION A: LONG TERM PHYSICAL/CHEMICAL DATA, PART 1: AIRSHED AND WATERSHED.
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
1982, 600 p. Edited by David L. Correll.

Descriptors: *Baseline studies, *Rhode River Estuary, *Maryland, *Estuaries, *Ecosystems, *Watersheds, *Hydrologic data collections, *Meteorological data collections, Soil profiles, Rhode River Program, Chesapeake Bay, Water quality, Chemistry of precipitation, Land use, Data collections, Geological surveys, Estuarine environment, Suspended solids, Cations, Nutrients.

This report summarizes most of the long-term, intensive physical and chemical data which were collected from 1970 to 1978 on the Rhode River, Maryland. The Rhode River program seeks to establish an understanding of the operation of this ecosystem with special emphasis upon the interaction of the watershed and the estuary and to monitor long-term changes in the ecosystem and relate them to the activities of man as well as to other variations in environmental conditions. The main purposes of this report are to make summary data for monthly, seasonal, and yearly means and variances readily available for interdisciplinary use by investigators at this site, to make the data more available to other sites for comparison purposes, and to serve as a necessary step in the synthesis and analysis of rather complex data sets. The report includes detailed studies on meteorological parameters, precipitation chemistry, geology and solids, soil profiles for three single-land-use Rhode River Watersheds, hydrology, discharge of solids, cations and nutrients, and certain stream water quality parameters.
W85-05353

DISCHARGE OF SOLIDS FROM RHODE RIVER SUBWATERSHEDS,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
For primary bibliographic entry see Field 5B.
W85-05360

SEASONAL AND ANNUAL VARIATION IN NUTRIENT DISCHARGE FROM RHODE RIVER WATERSHEDS AND CERTAIN STREAM WATER QUALITY PARAMETERS,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
For primary bibliographic entry see Field 5B.
W85-05361

SEASONAL AND ANNUAL VARIATION IN THE DISCHARGE OF METALLIC CATIONS FROM RHODE RIVER WATERSHEDS,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
For primary bibliographic entry see Field 5B.
W85-05362

RADIUM FLUXES FROM A SALT MARSH,
South Carolina Univ., Columbia. Dept. of Geology.
M. S. Bollinger, and W. S. Moore.
Nature, Vol. 309, No. 5967, p 444-446, May, 1984. 2 Fig, 13 Ref.

Descriptors: *Salt marshes, *Radium, *Isotope studies, Water analysis, Coastal waters, Cycling nutrients, Metals, Marshes, Interstitial water, Tidal effects, Tidal creeks, Bly Creek, South Carolina.

Bly Creek, a small marsh-tidal creek system near Georgetown, South Carolina, was chosen to determine the flux of Ra-228 and its great granddaughter, Ra-224 form the sediments to the ridal creek water. The highest activities of Ra-224 and Ra 228 in the tidal creek waters occur during low tide, but Ra-226 activity remains relatively constant throughout the tidal cycle. There is a large input of radium from the march sediments to the overlying waters. To produce the necessary fluxes, irrigation and bioturbation must replace interstitial water in the top 5 cm of the marsh sediments every 2-3 days. The short residence time of water in the top centimeters of the salt marsh sediments and the high flux of radium out of the sediments demonstrate that marshes are extremely active chemical systems able to respond to changing conditions on a time scale of days. These observations have important implications for the understanding of the cycling of nutrients, metals, carbon and pollutants in coastal systems. (Baker-IVI)
W85-05468

MATHEMATICAL MODELLING OF TIDAL CURRENTS IN THE HUMBER ESTUARY,
Birmingham Univ. (England). Dept. of Civil Engineering.
R. A. Falconer, and P. H. Owens.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 6, p 528-542, December, 1984. 10 Fig, 13 Ref.

Descriptors: *Model studies, *Mathematical models, *Tidal currents, *Estuaries, *Humber Estuary, *England, Tidal waters, Waves, Flooding, Hydrodynamics, Bathymetry, Velocity.

A mathematical model is described which has been used to predict water elevations and the two dimensional tide induced velocity fields in the Humber Estuary. The model makes use of the finite difference method to solve the depth integrated hydrodynamic equations governing tidal motion in the estuary. The drying out and flooding of shallow tidal waters in the estuary is included in the model using a new technique, which is particularly suited to models having a relatively large grid size. A non-conventional method of including the bathymetry has also been used, which gives rise to a more accurate evaluation of the depth mean velocity. The model has been calibrated and compared with field measured results taken by the British Transport Docks Board and an encouraging agreement between both sets of results has been obtained. The choice of the bed resistance coefficient was quite critical, particularly towards the head of the estuary. From the example results shown of the depth mean horizontal velocity field predictions, the new drying and flooding technique appeared to simulate the physical process satisfactorily, with the flow past Spurn Head giving rise to separation and strong tidal eddies in the lee of the peninsular. This hydrodynamic phenomenon forms an important aspect of the tidal circulation in the Humber Estuary. (Baker-IVI)
W85-05516

ECOSYSTEM DEFINITION AND COMMUNITY STRUCTURE OF THE MACROBENTHOS OF THE NEMP MONITORING STATION AT PIGEON HILL IN THE GULF OF MAINE,
New Hampshire Univ., Durham. Dept. of Zoology.
A. W. Hulbert, K. J. Pecci, J. D. Witman, L. G. Harris, and J. R. Sears.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-112474, NOAA Technical Memorandum NMFS-F/NEC-12. May 1982. 143 p. 16 Fig, 10 Tab, 9 Append, 63 Ref.

Descriptors: *Aquatic ecosystems, *Baseline studies, *Benthic fauna, *Benthic flora, Algae, Computers, Photography, Sampling, Bioaccumulation, Heavy metals, Polychlorinated biphenyls, Hydrocarbons, Bioindicators.

The Pigeon Hill station forms part of the baseline ecosystem definition of the National Oceanic and Atmospheric Administration's Northeast Monitoring Program (NEMP). The purpose of this report is to provide a quantitative baseline description of the dominant faunal and floral components of the Pigeon Hill benthic communities. The station was marked and permanent transects were established utilizing a stratified sampling procedure with horizontal and vertical substrata and 33 and 42 m depths. Disruptive sampling techniques were used to establish descriptive community baselines; quantitative photography was subsequently used for following the stability of the communities. A total of 149 species were identified from the disruptive samples. Horizontal communities are dominated by an algal-polychaete matrix offering a large amount of secondary substrate. Vertical surfaces are dominated by sponges, tunicates and brachiopods. Body burdens of heavy metals, PCB's and anthropogenic hydrocarbons have been established for algae, asteroids, and tunicates. Pigeon Hill, at present, is a healthy, relatively pristine location in the midst of a commercial fishery and heavy shipping traffic. The benthic communities at Pigeon Hill primarily are composed of boreal species of the exposed coast. Community dominants have been identified as indicator species and are being tracked using predominantly quantitative photographic techniques in very site-specific subhabitats.
W85-05580

STUDIES ON THE BOTTOM SEDIMENTS OF AL-HAMMARA MARSH AREA IN SOUTHERN IRAQ,
University Coll., Cardiff (Wales). Dept. of Plant Science.
S. E. Antoine.
Limnologica (Berlin), Vol. 16, No. 1, p 25-28, September, 1984. 1 Tab. 15 Ref.

Descriptors: *Marshes, *Al-Hammara Marsh, *Iraq, *Bottom sediments, Sediments, Organic matter, Calcium, Magnesium, Sodium, Potassium, Plankton, Decomposition, Macrophytes, Wastewater pollution.

The sediments of Al-Hammara marsh were collected and analyzed for the first time. The organic matter content was high, mainly due to the death and disintegration of sedimented plankton and the decay of dead benthic animals and plants. Allochthonous organic input with sewage from a small village at site III also increased the load, resulting in the largest quantity of organic material at that site. The calcareous substances were remarkably abundant due to the presence of large amounts of calcareous shells and shell fragements in the sediments. Macrophytic growth may also contribute calcareous substances as they are usually covered with calcified felts of blue-green algae. The allochthonous material and diatom silica content were lower than that of calcareous substances. Diatom silica constitutes the major part of the HCl-insoluble fraction of the sediment (allochthonous material plus diatom silica). The nutrient content of the sediments was found in adequate quantities. Slow currents or almost stagnant water in the area give the sediments a better chance to absorb more nutrients. The nutrient content varied directly with that of the organic matter. The highest nutrient content at site III, was partly due to sewage disposal. Lower nitrate values were found than for phosphate because nitrate ions are readily lost to the deeper sediment layers, and the phosphate ones are firmly absorbed on the sediment particles. Phosphates were positively correlated with the calcium. The silica contents are mainly affected by the amounts of diatom frustules found in the sediments. High calcium contents were correlated with the high calcareous substances of the sediments. Calcium and magnesium contents were also correlated with the high organic matter contents. Disintegration of dead benthic green plants and settled dead phytoplankton may replenish some of the magnesium of the sediments. Sodium and potassium were found adequately, particularly the latter, mainly due to the fact that significant amounts of these ions are still available from the deeper sediment layers to the superficial ones since the past transgressions of the sea have left a residue of the marine salt in the sediments of the lower plain of Iraq. Surface runoff and seepage may also add some of these ions to the sediment load. (Baker-IVI)
W85-05613

HYDROBIOLOGY OF STRELASUND (ZUR HYDROBIOLOGIE DES STRELASUND),
Ernst-Moritz-Arndt Univ., Greifswald (German D.R.).
H.-J. Subklew.
Limnologica (Berlin), Vol. 16, No. 1, p 191-205, September, 1984. 9 Fig, 2 Tab, 35 Ref.

Descriptors: *Aquatic life, *Strelasund, *Germany (Democratic Republic), Coastal waters, Sounds, Vegetation, Beaches, Wind, Physicochemical properties, Zooplankton, Aquatic animals, Fish, Water pollution, Wastewater pollution.

Strelasund is a sound between the mainland at Stralsund and the Isle of Rugen, German Democratic Republic. The aim of the present study is to summarize all hydrobiological and hydrographical values concerning this body of water. Information is given on the following: the soil, shores and vegetation; wind, water level, and the floodplain; physico-chemical properties of the water; biomass of zooplankton; shore plants; fauna (metazoans); fish; and wastewater and pollution. In the last 30 years this landscape has changed to an important industrial region and recreation center. (Moore-IVI)
W85-05616

NOTE ON TURBULENT PERTURBATIONS OF SALINITY IN A PARTIALLY MIXED ESTUARY,
Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, and K. Shiono.
Estuarine, Coastal and Shelf Science, Vol. 20, No. 1, p 55-78, January, 1985. 16 Fig, 5 Tab, 28 Ref.

Descriptors: *Salinity, *Estuaries, *Mixing, Turbulence, Salinometers, Internal waves, Error analysis.

Salinity perturbations measured in a partially mixed estuary were used to evaluate the usefulness of an inductive salinometer and to determine some of the characteristics of the salinity peturbations. The salinometer performed satisfactorily under most conditions. Although internal wave like effects were present, the turbulence fluctuations were dominant. The salinity and salt flux records based on the inductive salinometer measurements had adequate stationarity, systematic and random error characteristics. The high frequency cut-off of two of the salinity records and the random errors of the vertical salt flux were the least satisfactory results of the error analysis. The salinity and salt flux time series had skewness and flatness values which are similar to those for homogeneous flow turbulence parameters in laboratory flumes. A quadrant analysis showed that the normalized flux in each quadrant was sensitive to the gradient Richardson number. (Moore-IVI)
W85-05689

MACRO-INVERTEBRATE POPULATIONS AND PRODUCTION ON A SALT-MARSH IN EAST ENGLAND DOMINATED BY SPARTINA ANGLICA,
Essex Univ., Colchester (England). Dept. of Biology.
D. Jackson, C. F. Mason, and S. P. Long.
Oecologia, Vol. 65, No. 3, p 406-411, February, 1985. 2 Fig, 6 Tab, 33 Ref.

Descriptors: *Salt marshes, *Invertebrates, *Productivity, *Spartina, *England, Biomass, Canopy, Wetlands, Marshes, Standing crop.

The populations and production of the macroinvertebrates of a Spartina anglica salt-marsh in eastern England were studied over two years. A total of fifteen species were recorded in the sediments, of which twelve species were of regular occurrence, and the total population density recorded ranged from 3,481 sq m to 11,444 sq m over the twenty-four sampling occasions. The four most abundant species were Nereis diversicolor, Tubifex costatus, Corophium volutator and Hydrobia ulvae. Thirteen further taxa were associated with the canopy of Spartina, with a total population density ranging from 0 to 1,149 sq m. Total monthly standing crop ranged from 1.8 to 8.5 g C/sq m with peaks in July/August in both years. Nereis diversicolor contributed 55% to 86% of total biomass in each month. Production and respiration for each species was determined and annual assimilation calculated. The total annual production was about 16 g C/sq m/a in both 1979 and 1980, with a corresponding assimilation of about 60 g C/sq m/a. Nereis diversicolor accounted for $>$ 80% of production and assimilation in both years, and the species is clearly of considerable potential importance in the dissipation of Spartina material. The canopy dwelling species accounted for about 1% of the total annual production and assimilation. (Author's abstract)
W85-05703

RELATIONSHIP OF PHYSICAL FACTORS AND BIOLOGICAL RESPONSE IN COASTAL SEAGRASS MEADOWS,
Florida State Univ., Tallahassee. Dept. of Biological Science.
R. J. Livingston.
Estuaries, Vol. 7, No. 4A, p 377-390, December, 1984. 7 Fig, 4 Tab, 47 Ref.

Descriptors: *Seagrasses, *Gulf of Mexico, *Coastal areas, Floods, Temperature, Salinity, Water quality, Algae, Habitats, Productivity, Predation, Competition, Food chain, Estuarine environment.

Continuous, long-term studies of coastal grassbed assemblages in the N.E. Gulf of Mexico indicate complex relationships between physical controlling factors and biological response. Such seagrass systems are physically unstable over short periods. Seasonal ranges of temperature, salinity, and natural water quality conditions are considerable with periodic, recurrent 'catastrophic' events such as floods and cold winters. These factors control the distribution and productivity of the seagrasses and algae which constitute the habitat and organic substrate for diverse assemblages of organisms. In addition, the benthic plants mediate predator-prey relationships and competitive interactions. Despite the physical instability, timed sequences of distinct ontogenetic feeding populations are generally stable from year to year as are other population and community characteristics. Thus, physical processes determine overall habitat conditions and productivity cycles whereas biological processes such as predation and competition define specific community relationships. Seemingly minor changes in the physical environment due to anthropogenous activities can lead to major reorganization of the biological system; the observed biological stability of the seagrass beds can be ephemeral if important habitat features are altered in a way that exceeds the adaptive response of the system. Concepts are discussed which relate observed sequences of ontogenetic feeding units to food web patterns and geographic differences of population-niche relationships from one estuary to another. (Author's abstract)
W85-05705

DEPENDENCE OF FISHERY SPECIES ON SALT MARSHES: THE ROLE OF FOOD AND REFUGE,
Louisiana Universities Marine Consortium, Chauvin.
D. F. Boesch, and R. E. Turner.
Estuaries, Vol. 7, No. 4, p 460-468, December, 1984. 1 Fig, 48 Ref.

Descriptors: *Salt marshes, *Fisheries, *Food, *Refuge, Fish, Crustaceans, Detritus, Marshes, Algae, Macrophytes, Tidal creeks, Habitats.

Salt marshes are widely believed to serve as nurseries for many fishes and crustaceans of fishery value as a result of the high production of vascular plant detritus and the protection from predation offered by shallow, spatially complex habitats. Comparisons of the yields of species which reside in salt marsh habitats during critical life history stages (such as penaeid shrimp) with the area of such habitats and their greater densities in flooded marshes and associated tidal creeks support the premise that marshes enhance the yield of such species. A range of evidence, including the amount of detrital export from marshes, the poor nutritive value of vascular plant detritus, and natural diets, casts doubt on the notion that production of fishery species is based on the direct consumption of marsh grass detritus or predominantly on food chains based on this detritus. Vascular plants and associated algae may, however, contribute to the production of prey species. The limited observations available support the hypothesis that salt marshes offer significant escape from mortality due to predation, but there have been yet few experimental tests of this hypothesis. Knowledge of relative importance of the food and refuge functions in support of living resources is of practical value in marsh and fisheries management. Better understanding of these roles is important to the effective evaluation of the effects of coastal habitat modifications on fisheries resources and design of alterations to minimize the losses of these values. (Author's abstract)
W85-05706

EFFECT OF SEDIMENTATION ON THE PRIMARY PRODUCTION OF BENTHIC MICROFLORA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
G. P. Shaffer.
Estuaries, Vol. 7, No. 4B, p 497-500, December, 1984. 2 Fig, 1 Tab, 15 Ref. NOAA grants 04-7-158-44121 and NA80AA-D-00120.

Descriptors: *Benthic flora, *Primary productivity, *Sedimentation, *Mugu Lagoon, *California, Environmental effects, Runoff, Storm runoff, Benthic fauna, Sediments.

In February, 1978, during a study of the primary production of the benthic microflora inhabiting the intertidal and subtidal flats in the eastern arm of Mugu Lagoon, California, a major rainstorm oc-

curred. As a result of the runoff associated with the heavy precipitation, up to 50 cm of fresh silts and clays were deposited in the deepest parts of the lagoon. For February-July 1978, this deposition decreased the net primary production of the benthic community by an estimated 6.5 fold (from 135 +/- 11.7 g C/ sq m to 21 +/- 2.0 g C/sq m). Persistence of fine-grained sediment over much of the lagoon may continue to render these areas lower in exportable organic carbon. Unless another source of primary production provides the balance of the organic carbon, reductions in the epibenthic macrofauna should occur as well. (Moore-IVI)
W85-05707

DISTRIBUTION AND ABUNDANCE OF SUBMERGED AQUATIC VEGETATION IN CHESAPEAKE BAY: AN HISTORICAL PERSPECTIVE,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5C.
W85-05709

HYDROGRAPHY, NUTRIENTS, SUSPENDED ORGANIC MATTER, AND PRIMARY PRODUCTION IN A SHALLOW FJORD SYSTEM ON THE WEST COAST OF NORWAY,
Oslo Univ. (Norway). Biologisk Inst.
P. Wassmann, and A. Aadnesen.
Sarsia, Vol. 69, No. 3-4, p 139-153, 1984. 13 Fig, 1 Tab, 68 Ref.

Descriptors: *Fjords, *Hydrography, *Nutrients, *Organic matter, *Primary productivity, *Norway, Suspended solids, Nitrates, Silicon dioxide, Phosphates, Biomass, Wind, Phytoplankton, Coastal areas.

The investigation was carried out at three stations in a coastal area, characteristic for the west Norwegian coast; 21 cruises cover the period February to October 1982. The hydrography (T C, S%, O2/H2S), the nutrient concentration (NO3(-), SiO2, PO4(3-)), suspended organic biomass (chlorophyll a, phaeophytin, particulate organic carbon, and nitrogen), and in situ C-14-assimilation were measured at fixed depths. The predominant northerly and southerly winds and the resulting on-shore and off-shore transport of water had a significant influence on the hydrography at the outer station in Raunefjorden, somewhat less at the intermediate station in Kviturdvikpollen, but were of minor influence at the permanently stratified inner station in Vagsbopollen. Hydrogen sulfide occurred in the bottom water of both Vagsbopollen and Kviturdvikpollen from June to October. Maximum concentrations were up to 6 times higher than reported in a study 18 years ago in the same localities. The concentrations of nutrients and suspended organic matter were highest in Vagsbopollen and Kviturdvikpollen. Highest suspended concentrations were found at the oxic/anoxic interface. In Raunefjorden the nutrient and suspended organic matter concentrations were strongly influenced by upwelling of nutrient-rich water. The annual primary production at the three stations ranged from 180 to 230 g C/sq m per year. The topography of the fjords, the fresh-water run-off, and changes in the predominantly longshore wind stress are essential for an understanding of the phytoplankton dynamics in the area. (Author's abstract)
W85-05713

ESTUARINE MEAN FLOW ESTIMATION REVISITED: APPLICATION TO THE ST. LAWRENCE ESTUARY,
Institut National de la Recherche Scientifique, Rimouski (Quebec). Centre d'Oceanologia.
V. G. Koutitonsky, and M. I. El-Sabh.
Journal of Marine Research, Vol. 43, No. 1, p 1-12, February, 1985. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Estuaries, *Flow, *St. Lawrence Estuary, Water circulation, Water currents, Statistical analysis, Estimation.

Mean value estimate errors for estuarine (and oceanic) parameters which exhibit serial correlation and nonstationarity over a finite record length are discussed. It is shown that when trends are nonlinear over the record length, the mean value estimate error does not decrease with time. Instead, it goes through a minimum and then increases again. An optimal averaging time over which the mean estimate error is minimum is presented. The mean circulation in the lower St. Lawrence estuary is described over a record length of 78.5 days in 1979. Standard, bias, and rms errors in mean value estimates are discussed, and an averaging time yielding a minimum error is suggested for the lower St. Lawrence estuary. New measured features of the mean circulation are: a coastal current flowing downstream near the shore which deflects to the right at the mouth, and a 2 cm/s inflow in the bottom layer at mid-channel location. (Author's abstract)
W85-05736

PHYSICO-CHEMICAL CHARACTERISTICS AND PHYTOPLANKTON OF THE ENCANIZADA, TANCADA AND BUDA COASTAL LAGOONS (EBRO RIVER DELTA) (CARACTERISTICAS FISICAS Y QUIMICAS Y FITOPLANCTON DE LAS LAGUNAS COSTERAS, ENCANIZADA, TANCADA Y BUDA (DELTA DEL EBRO)),
Barcelona Univ. (Spain). Dept. de Ecologia.
F. A. Comin.
Oecologia Aquatica, Vol. 7, p 79-162, July, 1984. 46 Fig, 9 Tab, 83 Ref.

Descriptors: *Lagoons, *Encanizada, *Tancada, *Phytoplankton, *Buda, *Ebro River Delta, *Spain, Coastal waters, Physicochemical properties, Deltas, Conductivity, Nutrients, Diatoms, Biomass, Salinity, Eutrophication, Nutrients.

Three coastal lagoons - Encanizada, Tancada and Buda - of the Ebro River Delta were studied to determine physicochemical characteristics to relate the phytoplankton population to environmental factors. The three lagoons are very shallow with a mean water level of about 50 cm. The relative abundance of the main cations in the three lagoons followed the same pattern as in the sea: Na> Mg> Ca> K. In Encanizada nutrient levels were higher in late spring, decreasing gradually towards late summer, with a shift in the N/P ratio. A typical seasonal succession of diatoms, chlorophyceans and blue-green algae as in eutrophicated freshwater lakes characterizes the phytoplankton in the Encanizada lagoon from May to December. The ratio of primary production/biomass was higher in Tancada than in Encanizada. In general this ratio was higher in both lagoons during winter and spring, the period of rapid increase of salt concentration, than during the rest of the year. Salinity changes control phytoplankton development and chemical characteristics of the three coastal lagoons studied. Encanizada was also strongly affected by the higher nutrient concentrations of freshwater inflows from May to December. It maintains its hypertrophic status during the rest of the year while major changes take place in the phytoplankton community while it adapts to the increasing salinity. A smaller watershed and less concentration in flows maintain the Tancada lagoon at a lower trophic status. Slight differences can be observed between the two basins of this lagoon. In Buda, the inflows from the river mouth produce continuous changes in the salt concentration which varies within a narrower range during the year. It does not develop a rich phytoplankton community as in Encanizada and Tancada. (Baker-IVI)
W85-05749

AQUATIC MACROPHYTE FLORA OF SALINE WETLANDS IN WESTERN AUSTRALIA IN RELATION TO SALINITY AND PERMANENCE,
Murdoch Univ. (Western Australia). School of Environmental and Life Science.
M. A. Brock, and J. A. K. Lane.
Hydrobiologia, Vol. 105, p 63-76, November, 1983. 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Macrophytes, *Wetlands, *Saline lakes, *Western Australia, Salinity, Ephemeral lakes, Intermittent lakes, Aquatic plants, Seasonal variation, Submerged plants.

Fluctuations of salinity, depth and permanence (presence of water) are common in saline lakes in Western Australia and may occur on a seasonal or longer time scale. Monitoring of salinity and depth of over 80 wetlands reserved for the conservation of flora and fauna begin in 1978 in Western Australia. Over 100 reserves have gauges which are monitored at two monthly intervals. Cataloging of the macrophytes in these reserves began in 1980 and has continued through 1982. Submerged macrophytes were recorded in 66% of the lakes examined. Species of the two monocotyledon genera Ruppia and Lepilaena and the charophyte Lamprothamnium show wide tolerance of both salinity fluctuation and habitat drying. These plants occur in both permanent and ephemeral wetlands with salinities which show extremely large seasonal salinity fluctuations from slightly saline to hypersaline. Macrophytes were not recorded in 30 of the 84 wetland sampled; most of these were fresh ephemeral or hypersaline ephemeral lakes. Of the wetlands sampled, 235 were permanent and contained 31% of the macrophyte records. The other 69% of the plant records were in ephemeral lakes (77% of lakes): 52% were in seasonal ephemeral lakes and 17% in intermittent ephemeral lakes. A large proportion of plant occurrences are from the salinity categories with the highest ranges of fluctuation (40% of wetlands). The plasticity of morphology and life cycle (e.g. variable dormancy) in members of all three genera probably account for their survival in these environmental extremes. (Moore-IVI)
W85-05752

LOWER MISSISSIPPI SALINITY ANALYSIS,
Tippetts-Abbett-McCarthy-Stratton, New York.
A. Balloffet, and D. K. Borah.
Journal of Hydraulic Engineering, Vol. 111, No. 2, p 300-315, February, 1985. 11 Fig, 1 Tab, 15 Ref, 1 Append.

Descriptors: *Mississippi River, *Saline water intrusion, *Saline wedge, *Simulation analysis, Model studies, River flow. Saline-freshwater interfaces.

Two procedures were developed to simulate salinity intrusion in the Mississippi River. The first one is based on the arrested salinity wedge theory and is applicable to quasi-steady-state flow conditions. It simulated very well the experimental results of Keulegan (1966, 'The Mechanism of an Arrested Saline Wedge,' Chapter 11, 'Estuarine and Coastline Hydrodynamics,' Ippen, ed., McGraw-Hill Co., New York, NY, p 546). It also simulated the positions of salt wedge tips and their interfaces in the Mississippi River with proper adjustment of the interfacial friction factor. The second one is a steady-dynamic routing model, which routes salt water in a cascade of reservoirs in the river bottom. Densimetric critical flow is assumed over a reservoir ridge. Error in storage definition is included in a calibration coefficient for the salt-water flow computations over the reservoir ridges. The model satisfactorily simulated durations of salt wedge presence along the lower Mississippi for the existing conditions and after deepening the channel to 55 ft. (Author's abstract)
W85-05785

MATHEMATICAL MODELS OF DISPERSION IN RIVERS AND ESTUARIES,
Liverpool Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 2E.
W85-05832

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

TRANSPORT STUDIES OF MULTIELECTROLYTE SOLUTIONS ACROSS A SINTERED

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

DISC IMPREGNATED WITH CELLULOSE ACETATE,
Himachal Pradesh Univ., Shimla (India). Dept. of Chemistry.
R. L. Blokhra, M. L. Parmar, and S. S. Thakur.
Journal of Membrane Science, Vol. 21, No. 2, p 123-135, November, 1984. 6 Fig, 2 Tab, 28 Ref.

Descriptors: *Desalination, *Membrane processes, *Electro-osmosis, *Cellulose acetate, Ammonium chloride, Ammonium nitrate, Chlorides, Nitrates, Streaming potential, Electrokinetic energy, Thermodynamics.

This study attempted to evaluate phenomenological coefficients from electroosmosis and streaming potential data in the case of multielectrolyte systems; to test the validity of the linear phenomenological relationships; to verify Onsager's symmetry relationships; and to evaluate the efficiencies of electrokinetic energy conversion. The data for different aqueous solution of ammonium chloride-ammonium nitrate through a sintered disc impregnated with cellulose acetate at 30 C were analyzed in the light of non-equilibrium thermodynamics. The Onsager reciprocity relation was found to hold good for all the systems. The efficiencies of electrokinetic energy conversion have also been determined. The maximum values of conversion efficiencies for both the modes of conversion, electroosmotic flow and streaming potential, were found to be equal to each other and independent of the applied input forces. This study may prove relevant to the use of cellulose acetate in the water desalination process and the possibility of using electroosmotic methods for desalination. (Baker-IVI)
W85-05035

SIGNIFICANCE OF EFFECTS IN A REVERSE OSMOSIS DESALINATION UNIT,
Cairo Univ. (Egypt). Faculty of Engineering.
S. G. Serag-El-Din.
Desalination, Vol. 51, No. 3, p 231-254, September, 1984. 7 Fig, 8 Tab, 4 Ref.

Descriptors: *Desalination, *Reverse osmosis, *Membrane processes, Brackish water, Water treatment, Temperature effects, Flow rate, Membranes.

A reverse osmosis laboratory module using a cellulose acetate membrane and synthetic brackish water was studied using a factorial-2 design of experiments. The effects of varying the feed pressure, the feed temperature, and the feed flowrate on both the water flux and salt rejection percentage were investigated. All the effects studied (feed pressure, feed temperature, and feed flowrate) were significant at a 5% probability level. The most significant effect, as regards either the water flux or the salt rejection percentage, is the feed pressure. This is followed in significance by the feed temperature. Of all the linear effects, the feed flowrate is the least significant. Whereas no interactions are evidently significant in the case of salt rejection percentage, two significant interactions appear in the case of water flux. The effect of all the factors on the water flux is positive. Whereas the effects of feed pressure and feed flowrate are positive on the salt rejection percentage, that of feed temperature is negative. None of the operating conditions used yield a water which complies with the freshwater specifications for a once-through operation. A once-through operation followed by a single recycle, both held at the best operating conditions (feed pressure - 61.2 atm, feed temperature = 45 C, and feed flowrate = 8 l/min), using the RO unit and the cellulose acetate membrane of this work, yields freshwater of 438 ppm TDS. The water flux in this case will be half of the magnitude of the flux obtained by a once-through operation. An alternative practical technique would be to use 2 RO units in series, with the first unit producing a 111.95 l/sq m/hr flux of 1600 ppm, this being fed to the consecutive unit which produces a 115.65 l/sq m/h flux of 438 ppm. (Baker-IVI)
W85-05113

SOLUBILITIES AND SUPERSATURATIONS OF CALCIUM SULFATE AND ITS HYDRATES IN SEAWATER,
Technische Hogeschool, Delft (Netherlands). Dept. of Chemical Engineering and Chemistry.
J. A. M. Meijer, and G. M. Van Rosmalen.
Desalination, Vol. 51, No.2 , p 255-305, September, 1984. 6 Fig, 4 Tab, 66 Ref.

Descriptors: *Solubility, *Supersaturation, *Seawater, *Calcium sulfate, Hydrates, Gypsum, Calcium sulfate, Mathematical equations, Desalination.

In seawater desalination technology the prevention of calcium sulfate deposition is one of the more critical conditions for continuous operation of a desalination plant. To determine the driving force for calcium sulfate depositions from a supersaturated saline water solution of known composition, three quantities must be calculated; the solubility product, the ratio of the mean activity coefficients of calcium sulfate and the ratio of the activities of water. The transition temperature for gypsum into hemihydrate is 98 C in pure water. At this temperature the gypsum solubility line ends, since the dissociation pressure of gypsum exceeds the vapor pressure of the solution above this temperature. The transition temperature for gypsum into anhydrite is 40 C in pure water. This transition temperature can only be determined by solubility measurements. The application of vapor pressure experiments to establish this transition temperature is not permitted since the direct dissociation of gypsum into anhydrite does not exist. When other salts are present, both transition temperatures shift to lower temperature values, depending on the concentration of the added salts. A simple equation is given for calculating the growth affinity for seawater solutions at concentration factors betwen 1.0 and 7.0. (Baker-IVI)
W85-05114

CELLULOSE TRIACETATE MEMBRANES FOR SEAWATER DESALINATION,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
S. V. Joshi, and A. V. Rao.
Desalination, Vol. 51, No. 3, p 307-312, September, 1984. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Membrane processes, *Desalination, *Seawater, *Cellulose triacetate, Water treatment, Membranes, Reverse osmosis.

Experimental data on reverse osmosis using a sodium chloride solution by cellulose triacetate (CTA) membranes are presented. The investigation involved studies on the composition of membrane casting solution and their effects on the performance. Several casting formulations were studied in detail and the necessary proportions of each component are worked out from the observations. Different additive materials such as magnesium perchlorate, phthalic anhydride, maleic anhydride, dimethylphthalate, acetic acid, maleic acid and maleic anhydride plus methanol were stubstituted for the maleic anhydride in the original casting solutions. Membranes were tested on 35,000 ppm sodium chloride solution at 1000 psi operating pressure. Though all substances tried are additive for CTA, it is not yet completely clear which substance controls the membrane uniformity and clarity of the casting solution. Proper control over these two parameters is primarily important for evaluating high salt rejection membranes. (Baker-IVI)
W85-05115

CROSSFLOW MEMBRANE TECHNOLOGY AND ITS APPLICATIONS,
Osmonics, Inc., Hopkins, MN.
For primary bibliographic entry see Field 5D.
W85-05506

DEVELOPMENT OF AN AUTOMATED PLUGGING FACTOR MONITOR,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. J. Eisenhauer, and C. G. Goodner.
REC-ERC-81-12, December 1981. 13 p, 8 Fig, 2 Append, 2 Ref.

Descriptors: *Membrane processes, *Reverse osmosis, *Automation, *Electronic equipment, *Cellulose acetate membranes, *Membrane filters, *Desalination apparatus, *Hydraulic equipment, Desalination, Membranes, Filtration, Monitoring, Plugging factor, Filter rate, Process control.

Efficient and economical control of a reverse osmosis membrane water desalting process is dependent on the rapid, repetitive, and correct monitoring of the feedwater parameter known as the plugging factor. The plugging factor test is a measurement of the percent decrease in flow rate through a 0.45 micron cellulose-acetate Millipore filter membrane with a constant pressure differential of 207 KPa (gage) after 15 minutes. Several test devices are available to plant operators for monitoring the feedwater plugging factor, but their operation requires close manual attention and their results often vary in accuracy. A totally automic plugging factor monitor (PFM) was developed and tested at the Yuma Desalting Test Facility in Yuma, Arizona. The PFM tester allows selection and monitoring of water samples every 20 minutes. Resulting plugging factor calculation accuracies are within 0.4%.
W85-05597

3B. Water Yield Improvement

SYSTEMS FOR RAINFALL AND RUNOFF USE, TUCSON, ARIZONA,
Arizona Univ., Tucson. Office of Arid Lands Studies.
K. J. DeCook, and K. E. Foster.
Water Resources Bulletin, Vol. 20, No. 6, p 883-888, December, 1984. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Rainfall, *Runoff, *Tucson, *Arizona, *Water resources development, *Water supply development, Domestic water, Groundwater recharge, Urban watersheds.

There are many opportunities for using rainfall and runoff in the Tucson urban and suburban area. With diminishing supplies of groundwater which is Tucson's primary municipal water source, the use of harvested rainfall and runoff are attractive and technically feasible alternatives. Residential rainfall-harvesting systems include a catchment surface (the primary impact and catchment area is the rooftop), collection and concentration components, separation and treatment units, storage capacity and distribution capability. While the amount of precipitation in the Tucson urban area is sufficient to supply only a portion of residential household needs, it can provide a significant quantity of water to augment or partially substitute for the piped-in supply. For example, a 1700 square foot rooftop will yield about 10,625 gallons annually assuming an average annual rainfall of 11 inches and a collection efficiency of 90%; this will supply only about 11% of the current municipal input for residential water consumption. A system to control runoff can divert water form urban washes for use in parks or other landscaped areas or can be used to enhance recharge to groundwater reservoirs. A reduction in flood hazards or peaks is a concurrent benefit of controlling and diverting runoff. (Collier-IVI)
W85-04995

EFFECT OF SLOPE AND RAINFALL INTENSITY ON EROSION FROM SODIUM DISPERSED, COMPACTED EARTH MICROCATCHMENTS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
S. R. Evett, and G. R. Dutt.
Soil Science Society of American Journal, Vol. 49, No. 1, p 202-206, January-February, 1985. 2 Fig, 3 Tab, 28 Ref. USDA grant 82-CRSR-2-2005

Descriptors: *Rainfall intensity, *Soil erosion, *Slopes, *Water harvesting, Microcatchments, Compacted earth, Sodium soil dispersion, Slope stability, Interrill erosion, Erosion control.

Erosion studies were conducted on microcatchments for the purpose of designing water harvest-

g systems. Two replicates of a two factor experi-ental plot design, including 1, 5, 10, and 15% opes and 3 and 6 m lengths, were built on a avelly sandy clay loam using 11.2 Mg/ha of aCl mixed into the surface 2 to 5 cm of soil llowed by compaction with a 6-Mg roller after a avy rain. Most of the erosion was from interrill osion. The effects of slope and maximum 30 min infall intensity were significant at the 0.1% level r the 11 storms studied. The sodium treated rface layer is estimated to last up to 20 yr under ese conditions if slopes are kept to 5% or lower these microcatchments of less than 6 m length. ne same soil loss could occur within 12 yr on eas with a 15% slope with most of the sodium spersed surface layer being gone in that length of ne. (Baker-IVI)
W85-05191

ONTINUING DESIGN, REVIEW, AND ANAL-SIS WORK FOR THE SIERRA COOPERA-VE PILOT PROJECT,
orth American Weather Consultants, Salt Lake ty, UT.
D. Elliott, D. A. Griffith, J. A. Flueck, and J. Hannaford.
vailable from the National Technical Information ervice, Springfield, VA, 22161. Interim Report o. 6, Report SLWN-83-2, September 1983. 135 p, Fig, 18 Tab, 21 Ref. Contract/Grant No. 7-07--V0008.

escriptors: *Cloud seeding, *Sierra Cooperative lot Project, *Computer models, Statistical analy-, *Weather modification, *Artificial nucleation, louds, Convective precipitation, Sierra Hydro-ch, Simulation analysis, Statistical models, Project Skywater.

his work describes the research activities of ueck Associates and Sierra Hydrotech, between eptember 1982 and August 1983, concerning the ntinuing design, review, and analysis work on e Sierra Cooperative Pilot Project (SCPP) being onsored by the Bureau of Reclamation in the orthern Sierra Nevada of California. Work was nducted in the review and revision of an earlier CPP-1 design developed as an exploratory re-arch program on post-frontal convection. Statis-cal simulations and assessments were conducted examine the detectability of seeding signatures. he computer model GUIDE, was used to simu-te the effects of seeding transposed on natural CPP-1 clouds. Using similar methods, work was so conducted on the preliminary design of an ploratory research program on the SCPP con-rning the stratiform cloud forms.
W85-05349

XPERIENCES IN THE USE OF EAST ANG-IAN SANDS AND GRAVELS ('CRAGS') AS A OURCE OF WATER SUPPLY,
ast Anglian Water Co., Cambridge (England).
or primary bibliographic entry see Field 5F.
W85-05517

C. Use Of Water Of Impaired Quality

IUNICIPAL WASTEWATER INCREASES ROP YIELDS,
rizona Water Resources Research Center, ucson.
. D. Day, and C. B. Cluff.
ioCycle, Vol. 26, No. 1, p 48-49, January/Febru-y, 1985. 2 Tab, 12 Ref.

escriptors: *Crop yield, *Municipal wastewater, Arizona, *Wastewater irrigation, Wastewater dis-osal, Sorghum, Plant growth, Minerals, Nitrogen, hosphorus, Salts.

he use of municipal wastewater as a source of rigation water and plant nutrients in the commer-al production of sorghum and grain and forage as investigated. The influence of municipal astewater on sorghum grain volume-weight was so studied. The pump water contained approxi-ately 3,654, 16.2, 16.2, and 0.0 ppm of total soluble salts, nitrate nitrogen, total nitrogen, and phosphorus, respectively. The wastewater-pump water mixture contained about 1,910, 8.1, 30.1, and 3.7 ppm of total soluble salts, nitrate nitrogen, total nitrogen, and elemental phosphorus, respectively. About 91 cm of irrigation water were used to produce the sorghum crops. Average water penetrations were similar for the two types of irrigation water. Total soluble salts and nitrate nitrogen were higher in the pump water than in the wastewater-pump water mixture. The latter contained higher levels of total nitrogen and phosphorus than did pump water alone. The lower concentrations of salts in the wastewater pump water mixture indicate that this irrigation water was of a higher quality than pump water and, therefore, more desirable for growing plants. In 1975 and 1976, plants irrigated with the wastewater-pump water mixture grew taller, produced more heads per unit area, and produced higher grain yields than plants grown with pump water alone. Sorghum grain volume-weight was the same for both irrigation treatments in both years. Sorghum irrigated with the wastewater pump water mixture produced higher forage yields than did sorghum grown with pump water alone in both years. Taller plants and higher yields of both grain and forage were obtained when the wastewater pump water mixture was used for irrigating sorghum, indicating that municipal wastewater can be used effectively as a partial source of irrigation water and plant nutrients in the commercial production of sorghum in Arizona and also in similar environments throughout the world. (Baker-IVI)
W85-05059

WATER USE, GROWTH AND RUBBER YIELDS OF FOUR GUAYULE SELECTIONS AS RELATED TO IRRIGATION REGIMES,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
For primary bibliographic entry see Field 3F.
W85-05166

PRELIMINARY STUDY OF SOLAR PONDS FOR SALINITY CONTROL IN THE COLORADO RIVER BASIN,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
W. J. Boegli, M. M. Dahl, and H. E. Remmers.
Available from the National Technical Information Service, Springfield, VA 22161. Bureau of Reclamation Report REC-ERC-82-19. December 1982. 60 p, 25 Fig, 17 Tab, 46 Ref, 5 Append.

Descriptors: *Salinity, *Saline water, *Solar energy, *Solar distillation, *Desalination, *Electric power production, *Thermal energy, linings, Mine wastes, Coal mines, Nonconsumptive use, Colorado River Basin, Cost analysis, Danby Dry Lake, Sevier Dry Lake, California, Utah.

The technical and economic benefits were investigated of using solar salt-gradient ponds in the Colorado River Basin to provide salinity control and to produce project power and freshwater. It was assumed that the saline water needed for pond construction would be transported to one of two dry lakebeds in the Basin (Danby Dry Lake in southern California or Sevier Dry Lake in western Utah) as part of a salinity control/coal transport project. The ponds would be used to generate electric power that could be integrated with the Bureau's power grid or used in combination with thermal energy from the ponds to power commercially available desalination systems to produce freshwater. Economic benefits were compiled for two methods of concentrating the necessary brine for the ponds - one representing stage construction using collected brine only and the other using salt at the site to produce the concentrated brine. Results of the economic analysis show solar ponds offer benefit-cost ratios of 2.1 and 2.9 and annual cost savings of 41 and 61%, respectively, for base-load and intermediate load operations when compared to similar facilities powered by fossil fuels.
W85-05306

ADVANCED WATER RECYCLING SYSTEM REQUIRED FOR NEW SOUTH AFRICAN MILL,
Main (Charles T.), Inc., Boston, MA.
B. M. Jonsson.
Pulp and Paper, Vol. 58, No. 12, p 62-66, December, 1984. 6 Fig.

Descriptors: *Water reuse, *Recycling, *Pulp and paper industry, Water resources development, Water supply development.

Environmental and economic conditions have made process water reuse a necessity in the operation of a pulp and paper mill. The amount of water that can be reused is dependent on, and varies with, local conditions. The complex water recycling system of a major new integrated pulp and paper mill in Ngodwana, South Africa is examined. The mill is engineered for a combined production of 1,600 tpd of bleached pulp, linerboard grades, and newsprint. Water intake is limited to 6.605 million gal/day, and the process effluent is limited to 3.831 million gal/day. Four basic recirculation loops are used in the system. Loop 1 takes filtrate from the whitewater silo for use in dilution from stock preparation consistency to headbox consistency. In loop 2 cloudy filtrate from the saveall is used for slushing the wet lap pulp to the necessary stock preparation consistency. In loop 3 filtrate reclaimed from the vacuum system separators and press section trays is reused after filtering in the groundwood mill and secondary fiber system. In loop 4 clear saveall filtrate is deaerated, clarified, and filtered prior to reuse as former and press section shower water. Freshwater is continuously used for oscillating, high pressure wire cleaning showers, trim jets, all roll internal uses, and the felt cleaning showers. (Baker-IVI)
W85-05777

3D. Conservation In Domestic and Municipal Use

HOW MUCH WATER CAN YOU SAVE WITH CONSERVATION MEASURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Y. M. Walski, W. G. Richards, D. J. McCall, A. K. Deb, and J. M. Morgan.
Public Works, Vol. 115, No. 9, p 96-97, September, 1984. 2 Tab, 4 Ref.

Descriptors: *Water conservation, *Prediction, Estimating, Planning, Conservation, Water use.

A procedure has been developed for preparing quick estimates of the effectiveness of water conservation measures. The term effectiveness is used to express the change in water use and is usually given in units of flow, while the term reduction is used to describe the fractional change in effectiveness. The procedure used to estimate water conservation effectiveness for a given community consists of four basic parts: produce a flow estimate of the separate uses; look up the appropriate reduction factor from the table for each combination of measure and sector being considered; multiply the values; and sum the products to obtain the total estimated effectiveness. Two examples are provided to illustrate the use of the method to estimate the amount of water use reduction in Westchester County, New York, and in New Jersey, Hamilton Township. (Baker-IVI)
W85-05483

3E. Conservation In Industry

HOW MUCH WATER CAN YOU SAVE WITH CONSERVATION MEASURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 3D.
W85-05483

3F. Conservation In Agriculture

IRRIGATION FOR CROPS IN A SUB-HUMID ENVIRONMENT, VII. EVALUATION OF IRRIGATION STRATEGIES FOR COTTON,
Commonwealth Scientific and Industrial Research Organization, Narrabri (Australia). Cotton Research Unit.
A. B. Hearn, and G. A. Constable.
Irrigation Science, Vol. 5, No. 2, p 75-94, April, 1984. 8 Fig, 5 Tab, 11 Ref.

Descriptors: *Irrigation practices, *Cotton, *Water stress, *New South Wales, Waterlogging, Subhumid climates, Climates, Water potential, Leaves, Crop yield, Nitrogen.

Empirical functions to predict the nitrogen uptake, increase in leaf area index and minimum leaf water potential (LWP) of cotton were incorporated into a water balance model for the Namoi Valley, New South Wales. A function was then developed to describe the lint yield of irrigated cotton as a function of water stress days at 4 stages of development, total nitrogen uptake and days of waterlogging. Nitrogen uptake was reduced by 0.98 kg per ha and yield reduced by 33.2 kg lint/ha for each day of waterlogging. The optimum practice was found not to irrigate until 60 days from sowing and until the deficit in the root zone reached 50%. When the supply of water was less than 7 MI/ha there was no advantage in either delaying the start of irrigation or irrigating at a greater deficit; it was economically more rational to reduce the area sown or, if already sown, to irrigate part with 6 MI/ha and leave the rest as a raingrown crop. The simulation showed that there is no single set of practices that is always best in every season; in a number of seasons, practices other than those which on average are best, give better results. (Baker-IVI)
W85-05165

WATER USE, GROWTH AND RUBBER YIELDS OF FOUR GUAYULE SELECTIONS AS RELATED TO IRRIGATION REGIMES,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
S. Miyamoto, J. Davis, and K. Piela.
Irrigation Science, Vol. 5, No. 2, p 95-103, April, 1984. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Water demand, *Crop yield, *Irrigation, *Guayule, Plant growth, Irrigation practices, Saline water, Water stress.

The effects of irrigation regimes on water use, shrub growth, and rubber and resin yields of four guayule selections were investigated. An optional objective was to evaluate the effect of saline water irrigation on water use, growth and rubber yields. It appeared that large quantities of water are required to produce sufficient amounts of guayule biomass. The amount of irrigation water used to produce 1 t of dry shrub per ha, ignoring the contribution of rainfall, ranged from 13 to 16 cm, varying little with irrigation regimes. Rubber content was highest under the wet regime, mainly because of its large biomass but also because rubber contents remained relatively high. Environmental factors as well as the genetic potential of guayule would likely dictate rubber yields under low water stess and the value of heavy irrigation on guayule. (Baker-IVI)
W85-05166

STUDIES ON THE NITROGEN AND WATER RELATIONS OF WHEAT, II. EFFECTS OF VARYING NITROGEN AND WATER SUPPLY ON GROWTH AND GRAIN YIELD,
Waite Agricultural Research Inst., Glen Osmond (Australia).
For primary bibliographic entry see Field 2I.
W85-05167

WATER RELATIONS OF DROUGHT-RESISTANT AND DROUGHT-SENSITIVE WHEAT CULTIVARS SPRINKLED WITH SALINE WATER,
Kansas Agricultural Experiment Station, Manhattan. Evapotranspiration Lab.
M. B. Kirkham.
Irrigation Science, Vol. 5, No. 2, p 137-146, April, 1984. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Saline water, *Wheat, *Crop yield, *Plant growth, *Drought resistance, Water stress, Water demand, Leaves, Turgor, Stomatal resistance, Osmotic potential, Water potential.

Water potential, osmotic potential, turgor potential, and stomatal resistance were measured on leaves of a drought-sensitive and a drought-resistant cultivar of winter wheat treated with foliar applications of NaCl to determine the effect of salt on the water status of two cultivars varying in drought resistance. With water and salt both cultivars survived; with drought and salt, both cultivars died. With salt and drought, however, the drought-sensitive cultivar had a lower turgor potential, a higher apparent resistance, and died sooner, than did the drought-resistant cultivar. These results indicate that the drought-resistant cultivar might be better able to survive under dry and saline conditions than the drought-sensitive cultivar, because, with the low stresses, the resistant cultivar could maintain a higher turgor potential and a greater flow of water through the plant than the sensitive cultivar. The stomatal resistance increased when salt was sprayed on leaves. Stomatal closure may be a general response for leaves of all plants treated with salt. To determine the importance of stomata in controlling entry of salts into the leaves it will be necessary to identify a cultivar that keeps its stomata open when sprayed with salty water. (Baker-IVI)
W85-05168

EFFECT OF SOIL MOISTURE REGIMES ON THE YIELD AND WATER USE OF LENTIL (LENS CULINARIS MEDIC),
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
For primary bibliographic entry see Field 2I.
W85-05171

CONSUMPTIVE USE OF WATER BY MAJOR CROPS IN THE SOUTHWESTERN UNITED STATES,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W85-05346

CONDITIONAL DISTRIBUTIONS OF NEYMAN-SCOTT MODELS FOR STORM ARRIVALS AND THEIR USE IN IRRIGATION SCHEDULING,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W85-05795

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

PRELIMINARY RESULTS OF CALCULATING THE DELIVERY OF WATER FROM THE ONEGA BAY RESERVOIR TO THE BASIN OF THE CASPIAN SEA IN A COMPENSATING REGIME,
A. S. Berezner.
Water Resources, Vol. 11, No. 2, p 125-129, March-April, 1984. 1 Fig, 2 Tab, 7 Ref. Translated from Vodnye Resursy, No. 2, p 69-73, March-April, 1984.

Descriptors: *Onega Bay, *USSR, *Reservoirs, *Caspian Sea, *Water transfer, Water supply development, Water management, Planning.

Transfer of water from the Onega Bay of the White Sea is being examined as a final measure in the overall program of water transfer into the Caspian basin. The increase in irrigated area is expected to cease in the first quarter of the next century, stabilizing nonreturnable water consumption in the Caspian basin; this makes a further increase in transfers unnecessary. To evaluate the effect of compensating feeding it is necessary to perform water management calculations with the use of a sufficiently long series. Such observations were performed on the basis of a 60 year series, from 1914/15 to 1973/74, for which there are data of observations both on northern rivers and on the Volga and Caspian Sea. The surface area of the Onega Bay is about 10,000 sq km, the useful storage at a height of the drawdown level of 4-5 m is equal respectively to 40-50 cu km. The optimal capacity of the water-lifting cascade was then determined. The volume of transfer with probability p = 75% is determined to be 34.1 cu km/yr, and the average value of transfer during years when the Caspian level drops below -28.50 m is 37.8 cu km/yr. The results as presented must be regarded as a first approximation. (Baker-IVI)
W85-05155

CHARACTERIZATION OF GLENWOOD SPRINGS AND DOTSERO SPRINGS WATERS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2K.
W85-05329

EFFECT OF THREE MARSH MANAGEMENT TECHNIQUES ON THE ECOLOGY OF IRREGULARLY FLOODED CHESAPEAKE BAY WETLANDS: VEGETATION AND WATER QUALITY STUDIES, PARTS I AND II,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
D. Whigham, J. O'Neill, and M. McWethy.
Coastal Zone Unit, Maryland Dept. of Natural Resources, Annapolis, MD. 1982. Part I: 248 p, 16 Fig, 25 Tab, 5 Append, 63 Ref; Part II: 47 p, 11 Fig, 12 Tab, 10 Ref.

Descriptors: *Nutrients, *Ecological effects, *Water quality, *Marsh management, *Marsh plants, *Tidal marshes, *Primary productivity, *Drainage ditches, Environmental effects, Tidal effects, Marshes, Vegetation effects, Coastal marshes, Salt marshes, Biomass, Mosquitoes, Wetlands.

A two year study was conducted to determine the effects of ditching on the ecology of irregularly flooded Chesapeake Bay wetlands. Three sites on the Deal Island Wildlife Management Area were ditched in 1979. One area (Open Site) received standard Open Water Marsh Management treatment and was coupled to the adjacent estuary to permit complete tidal exchange. Water control structures were used at a second site (Water Control Site) to permit partial tidal coupling. The third ditched area (Closed Site) was not coupled to the estuary. Two unditched areas served as control sites. Changes in vegetation composition were still ongoing at all sites after two years. Distichlis spicata (Salt grass) and Spartina patens (Saltmeadow cordgrass) were co-dominant species of the wetlands prior to ditching. After one year D. spicata was the dominant species at the Open and Water Control Sites. By the second year Iva frutescens (Marsh elder) and Baccharis halimifolia (Seamyrtle) were abundant at the Open Site and by 198 were also abundant at the Water Control Site. S patens became the dominant species at the Closed Site where there has been no invasion by I. frutescens or B. halimifolia. Nitrogen and phosphorus concentrations have been higher in plant tissue and decomposition rates of litter have decreased at the three treated sites. Changes in vegetation composition, nutrient concentrations and decomposition rates are attributed to lowering of the water table at the three treated sites. No major changes in water quality parameters occurred at any of the sites, and intra-site differences in water quality parameters were greater than inter-site differences. Results of tidal cycle studies conducted at the

ɔen Site, compared to the Control Site, that there ɔuld be a continuous export of nutrients when-er ditched areas are completely coupled to the uary. (Author's abstract)
85-05347

OLORADO SNOW: A RESOURCE AND A RE-ONSIBILITY,
rt Collins, CO.
G. Krempel.
blic Works, Vol. 115, No. 8, p 58-60, August, 84. 4 Fig.

escriptors: *Snow, *Colorado, *Snow removal, izzards, Water resources development, Snow-elt, Avalanches, Irrigation water.

a resource, snow is critical for irrigation, skiing d water for recreational fishing. As a responsibil-, the heavy snows must be cleared for highways, ads, and mountain passes. The area is heavily pendent on the water from snowmelt in the ɔuntains for irrigation on the western plains. To ke beneficial use of snowmelt in Colorado, there s a great effort at the turn of the century to velop trans-mountain diversion ditches to bring e water from the western slope of the Rockies, nich gets more snow, to the eastern slope. The te has an annual $20 million snow removal dget. There are eight highway districts each vided into three to five patrols. Whiteouts on v roads, avalanches on high roads, and hazard-s conditions in both areas sometimes require ɔloyees to take their lives in their hands. In an empt to control avalanches, some are intention-y triggered by shells from a howitzer, or a new n designed just for this purpose. A brief summa-of the past four blizzards to hit this area is ɔvided. (Baker-IVI)
85-05480

ORM DRAINAGE DESIGN AND TECHNI-L CRITERIA,
RC Engineering, Inc., Denver, CO.
P. Ruzzo, and M. Serlet.
blic Works, Vol. 115, No. 9, p 116-119, Septem-r, 1984. 2 Fig, 2 Tab, 1 Ref.

escriptors: *Storm drainage, *Drainage control, rban runoff, Runoff, Storm runoff, Urban areas, esign criteria.

order to provide a more specific, up to date, and sier to use manual than currently available, a mplete drainage manual was prepared for Boul-r County and Longmont, Colorado. The goals the manual were to unify standards and improve e quality of drainage evaluation and design by ɔviding specific and detailed criteria for the cal communities; to reduce the effort required to epare and review drainage designs by simplify-g the methodologies and procedures and by pro-ding numerous worked examples; to provide the cessary information to prepare and review a ainage design within a single document that is mplete, organized, and easily referenced; and to ɔvide a drainage evaluation and design criteria at will prevent future drainage problems and hance the urban environment within the goals d objectives of the community. Even though the nual was prepared specifically for Boulder unty and Longmont, the general content and ganization can be used for any urbanized area. aker-IVI)
85-05484

EMPERATURE AND LIGHT EFFECTS ON HE GROWTH OF POTAMOGETON CRISPUS COLLINS LAKE, NEW YORK STATE,
nion Coll., Schenectady, NY. Dept. of Biology.
Tobiessen, and P. D. Snow.
nadian Journal of Botany, Vol. 62, No. 12, p 22-2826, December, 1984. 2 Fig, 1 Tab, 16 Ref.

escriptors: *Temperature effects, *Light intensi-, *Curly leaved pondweed, *Aquatic weed con-ɔl, *Collins Lake, *New York, Plant growth, redging, Biomass, Ice cover, Pondweed.

ɔllins Lake in east central New York State is a allow, 24 ha, calcarous lake which was dominat-ed by Potametgeton crispus. In the spring, about 60% of the area of the lake was covered by a virtually pure stand of this species. During the summers of 1977 and 1978, part of the lake was dredged to a depth of 3.3 m, which reduced the biomass and density of P. crispus nearly a thousand-fold in the dredged portion of the lake. P. crispus is a cold water plant adapted to habitats with low light intensities. Plants survive under ice at light intensities of 2 microE/sq m/sec and will grow in the lab at 7 microE/sq m/sec at 10 C and above, or less than 1% of the surface irradiance in the spring. After germination in the fall, its lack of response at cold temperatures prevents biomass accumulation and shoot elongation under the ice, even in the shallower portions of the lake where light intensities might otherwise permit them. Stem proliferation was reduced in low light intensities under typical lake temperatures, so that the dredged areas contained very low plant densities. Significant mortality may occur under the ice in the dredged areas. Biomass accumulation increased in the lake as the water temperature approached 10 C, and the plant had the ability to funnel its resources in a low-light habitat into relatively few rapidly elongating shoots which could gain access to the higher light intensities near the surface. In Collins Lake, the lowered light intensity produced by the dredging to 3.3 m apparently was a major factor contributing to the resulting control of P. crispus. Some plants did reach the surface of the lake, but they were scattered and much less vigorous than plants in the undredged area. Shallow dredging to control P. crispus would likely fail except under conditions of very low water transparency. (Baker-IVI)
W85-05523

ESTIMATION IN PARTIAL DURATION SERIES WITH INDEPENDENT AND DEPENDENT PEAK VALUES,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
D. Rosbjerg.
Journal of Hydrology, Vol. 76, No. 1/2, p 183-195, January, 1985. 7 Fig, 5 Ref.

Descriptors: *Hydrographs, *Estimating, *Flood frequency analysis, Flood control, Floods, Runoff, Monte Carlo Method.

Partial duration series with exponentially distributed peak exceedance values and Poissonian occurence times were studied in the case of both independent and dependent peak values. Especially the variance of the T-yr estimate was considered. In the case of independent peak values a formula for the variance of the T-yr estimate was developed. It contains a correction factor that accounts for the previously unexplained deviations between theory-based and Monte Carlo-based variance calculations. In the dependent case a formula for the variance of the T-yr estimate has been developed and shown to be in fine agreement with Monte Carlo based variance calculations. In the case of dependent peak values a general formula for the distribution function of the annual maximum values has been obtained. The use of the formula was exemplified, and values of the correlation coefficient between successive peak values were taken into account. (Baker-IVI)
W85-05540

IMPORTANCE OF STREAMSIDE FORESTS TO LARGE RIVERS: THE ISOLATION OF THE WILLAMETTE RIVER, OREGON, U.S.A., FROM ITS FLOODPLAIN BY SNAGGING AND STREAMSIDE FOREST REMOVAL,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
For primary bibliographic entry see Field 6G.
W85-05663

MANAGEMENT OF DITCHES. THE EFFECT OF CLEANING OF DITCHES ON THE WATER COENOSES,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Landscape Ecology and Nature Management.
For primary bibliographic entry see Field 6G.
W85-05682

4B. Groundwater Management

ENGINEERING ECONOMIC ANALYSIS OF A PROGRAM FOR ARTIFICIAL GROUNDWATER RECHARGE,
Geological Survey, Menlo Park, CA. Water Resources Div.
E. G. Reichard, and J. D. Bredehoeft.
Water Resources Bulletin, Vol. 20, No. 6, p 929-939, December, 1984. 8 Fig, 3 Tab, 27 Ref.

Descriptors: *Groundwater recharge, *Economic aspects, *Recharge, *Santa Clara Valley, *California, Costs, Cost-benefit analysis, Percolation, Model studies.

Two alternate methods are presented for evaluating the relative costs and benefits of artificial groundwater recharge using percolation ponds. The first analysis considers the benefits to be the reduction of pumping lifts and land subsidence; the second considers benefits as the alternative costs of a comparable surface delivery system. Example computations are carried out for an existing artificial recharge program in Santa Clara Valley in California. A computer groundwater model is used to estimate both the average long term and the drought period effects of artificial recharge in the study area. For the example problem, the benefits of reduced average annual pumping lifts and reduced incremental subsidence are greater than the total costs of continuing the existing artificial recharge program. Benefits for reduced subsidence are strongly dependent on initial aquifer conditions. The second analysis compares the cost of continuing the artificial recharge program with the costs of a surface system which would achieve the same hydraulic effects. Results indicate that the costs of artificial recharge are considerably smaller than the alternative costs of an equivalent surface system. In evaluating a particular program, consideration should also be given to uncertainties in future supplies and demands for water as well as to the probability of extreme events such as droughts. (Author's abstract)
W85-05001

ANALYTICAL SOLUTION TO THE PROBLEM OF SEEPAGE INTO COUNTERFORT DRAINS,
Kingston Polytechnic, Kingston upon Thames (England). School of Civil Engineering.
For primary bibliographic entry see Field 2G.
W85-05528

HYDRAULIC GRADIENT CONTROL FOR GROUNDWATER CONTAMINANT REMOVAL,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5F.
W85-05533

4C. Effects On Water Of Man's Non-Water Activities

COMPARATIVE ANALYSES OF FISH POPULATIONS IN NATURALLY ACIDIC AND CIRCUMNEUTRAL LAKES IN NORTHERN WISCONSIN,
Columbia National Fisheries Research Lab., La Crosse, WI. Field Research Station
For primary bibliographic entry see Field 5C.
W85-05132

EFFECT OF DISTURBED SOIL THICKNESS ON SOIL WATER USE AND MOVEMENT UNDER PERENNIAL GRASS,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 2I.
W85-05190

ICE JAM PREDICTION MODEL AS A TOOL IN FLOODPLAIN MANAGEMENT,

State Univ. of New York at Binghamton. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2C.
W85-05504

SIMULATION OF CHANGES IN GROUNDWATER LEVELS ASSOCIATED WITH STRIP MINING,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz, and A. S. Crowe.
Geological Society of America Bulletin, Vol. 96, No. 2, p 253-262, February, 1985. 5 Fig, 2 Tab, 47 Ref.

Descriptors: *Strip mines, *Groundwater level, *Simulation, Mathematical models, Water table, Seepage, Permeability coefficient, Hydrogeology, Groundwater recharge, Storativity, Strip mine wastes.

Coal strip mining can influence ground-water levels both spatially and in time in the vicinity of a mine. The magnitude, extent, and timing of such changes ae not, however, well known. Through the use of a finite element model that was developed specifically to study these problems, it is possible to solve for the hydraulic-head distribution within a two-dimensional region and for the position of the water table and seepage faces in a mined area as a function of time. Sensitivity analyses conducted with the model show that strip mining not only influences water levels during the mining and early post-mining period but also show that the most significant effects are observed during re-establishment of a steady-state flow system following mining. The magnitude and extent of changes in ground-water levels are controlled by at least four important hydrogeological parameters: (1) the presence of local discharge areas or sources of recharge, (2) the character of the post-mining landscape, (3) changes in the rate of recharge through the spoil, and (4) changes in the hydraulic conductivity of the spoil relative to the undisturbed geologic materials. The timing of water-level changes depends upon features of the flow system, such as how efficiently water is able to move to the low in hydraulic potential, caused by mining, and also upon the storativity of the mine spoil. All of the simulations indicate that long times are required for the flow system to re-establish steady-state conditions following mining. Such results imply that the maximum impact of mining at some sites may not be felt until many years following the cessation of mining. (Author's abstract)
W85-05731

4D. Watershed Protection

ROLE OF FORESTRY IN DRY AFRICA,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
P. A. Harou, W. A. Patterson III, and J. Falconi.
Journal of Forestry, Vol. 83, No. 3, p 142-147, March, 1985. 4 Fig, 16 Ref.

Descriptors: *Africa, *Forestry, *Arid regions, *Drought, Overpopulation, Forest management, Sahel, Irrigation, Deforestation, Grazing, Deserts, Erosion control, Watershed protection.

Recent deforestation in Africa is a result of two primary factors: drought, and increased human pressure on the resource base. The great variability in both seasonal and annual pecipitation is the most important climatic feature of these dry-land ecosystems. Unreliable rainfall and unfertile soil make the major land uses - agriculture, forestry and range management - marginal on any given site. The soils are prone to quick deterioration when mismanaged. Human influences have contributed to the degradation of vegetation in the Sahel. The forester must act within the existing climatic constraints to prevent an irreversible deterioration of the environment. Problems can occur due to escaping fires, overgrazing, and tree cutting for fuel and timber. Views on how woody vegetation should be managed in arid regions like the Sahel are discussed. The two alternatives for using trees to restore vegetation encompass a variety of activities directed at restoring vegetative cover and improving grazing and agricultural productivity. In areas where irrigation can be practiced, both cultivation and tree plantations are possible. (Baker-IVI)
W85-05467

QUANTITATIVE ANALYSIS OF DEBRIS TORRENT HAZARDS FOR DESIGN OF REMEDIAL MEASURES,
Thurber Consultants Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 2J.
W85-05529

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

PORTABLE MONITOR FOR MEASUREMENT OF DISSOLVED SULFIDE BASED ON THE GLASS/SULFIDE-SELECTIVE ELECTRODE COUPLE,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
For primary bibliographic entry see Field 7B.
W85-04975

MUTAGENIC ACTIVITY IN ORGANIC CONCENTRATE FROM NISHITAKASE RIVER WATER IN KYOTO CITY, AND ITS FRACTIONS SEPARATED BY USING LIQUID-LIQUID FRACTIONATION AND THIN LAYER CHROMATOGRAPHY,
Kyoto City Inst. of Public Health (Japan).
S. Maruoka, S. Yamanaka, and Y. Yamamoto.
Water Research, Vol. 19, No. 2, p 249-256, 1985. 9 Fig, 3 Tab, 22 Ref.

Descriptors: *Mutagens, *Nishitakase River, *Kyoto City, *Japan, *Thin layer chromatography, *Liquid-liquid fractionation, Water pollution effects.

XAD adsorption followed by elution with ethyl ether was used for recovering mutagenic substances from Nishitakase River water in Kyoto City. XAD extract recovered was separated by acid-base-neutral fractionation and tested for mutagenicity by using TA 1538 as a tester strain. The XAD extract showed strong mutagenic activity in the presence of S-9 mix, indicating the presence of frameshift type promutagens in the river water. Of the fractions separated, the neutral and basic fraction exhibited much more pronounced mutagenic activity and their contribution accounted for 98% of the mutagenic activity of the XAD extract. In order to separate mutagenic components, these active fractions were submitted to thin layer chromatography (TLC). In total 14 TLC subfractions, which had the ability to induce more than 100 net revertants/100 micro g of the neutral fraction or 10 micro g of the basic fraction, were isolated after 2 consecutive thin layer chromatographies. The importance of varying S-9 concentration in the S-9 mix is also discussed to determine the presence or absence of synergical/antagonistic effect of chemical constituents of complex mixtures like the XAD extract. (Author's abstract)
W85-04980

ULTRAFILTRATION PROCESSES FOR THE CHARACTERIZATION AND SEPARATION OF LANDFILL LEACHATES,
Manhattan Coll., Bronx, NY. Dept. of Chemical Engineering.
C. S. Slater, C. G. Uchrin, and R. C. Ahlert.
Journal of Environmental Science and Health, Vol. A20, No. 1, p 97-111, January, 1985. 9 Fig, 1 Tab, 17 Ref.

Descriptors: *Wastewater treatment, *Leachates, *Ultrafiltration, *Landfills, *Chemical analysis, Organic matter, Filtration, Lime.

Ultrafiltration is demonstrated to be an effective method for characterizing industrial landfill leachates by molecular weight (MW) distribution. The majority of the organic matter (as TOC and COD) for the hazardous wastes examined was found to be below 500 MW. The applicability of ultrafiltration as an effective process for removal of low MW organic matter from industrial wastes is limited. Ultrafiltration, however, is useful as a pretreatment process for removal of large MW compounds that interfere with subsequent treatment processes. Ultrafiltration of raw landfill leachates is hindered by concentration polarization and severe fouling. Physiochemical lime treatment of the highly turbid raw leachate was found to aid in the stabilization of product flux. (Author's abstract)
W85-04985

GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC INVESTIGATIONS ON LIPOPHILIC ANTHROPOGENIC SUBSTANCES IN MARINE ORGANISMS; I. A CLEAN-UP-PROCEDURE CONSISTING OF LIQUID-LIQUID AND REVERSED PHASE (OCTADECYL)-PARTITIONING,
Biologische Anstalt Helgoland (Germany, F.R.)
K. R. Sperling, D. Janssen, and T. Wulf.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, p 1-5, January, 1985. 3 Fig, 19 Ref.

Descriptors: *Gas chromatography, *Mass spectrometry, *Lipophilic substances, *Tissue analysis, *Cleanup procedures, *Liquid-liquid partitioning, *Reversed phase partitioning, Chemical analysis, Dimethylformamide, Octadecyl partitioning, Pesticides, Halogenated organics.

Methods are needed for the trace analytical identification of anthropogenic substances in marine matrices. Here we are mainly concerned with lipophilic compounds which may be enriched through food chains and, thus, represent a potential danger. Their investigation by capillary gas chromatography-mass spectrometry is difficult as it requires a very efficient previous separation from a matrix of lipids which accompany them due to their similar chemical nature. Clean-up methods which are usual for the determination of the 'classical' organohalogen compounds were insufficient. The ECD detector descriminates large excesses of lipids from the matrix. But the latter falsifies the mass spectra of the relevant substances completely. Several combinations of clean-up methods were checked. One of them proved to be extraordinarily effective. It consists of a liquid-liquid partitioning between dimethylformamide (DMF) and hexane followed by a reversed phase (octadecyl) partitioning. By its application, organohalogenides from commercial cod-liver oil could be separated in a capillary gas chromatograph and identified by mass spectrometry. Remarkable is that more alpha-HCH is present than gamma-HCH as the latter is a pesticide and the former merely its (more toxic) by-product. Similary, DDT's are only present in minute amounts, whereas p,p' DDE, the main degradation product, produced the main peak. Furthermore, various PCB's, toxaphenes and chlordanes were present in significant amounts. (Author's abstract)
W85-04986

IDENTIFICATION OF ASBESTOS AND GLASS FIBERS IN MUNICIPAL SEWAGE SLUDGES,
Minnesota Dept. of Health, Minneapolis
K. Bishop, S. J. Ring, T. Zoltai, C. G. Manos, and V. D. Ahrens.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 3, p 301-308, March, 1985. 2 Tab, 30 Ref.

Descriptors: *Asbestos, *Sludge, *Municipal wastes, Public health, Occupations, Human diseases.

Municipal sludge samples from five large American cities were examined for the presence of asbestos fibers. The possible toxicologic significance of the findings for specific occupational groups is discussed. No evidence was found for the presence of asbestos fibers in any of the sludge samples by x-

ray diffraction analysis using the Philips x-ray diffractometer, possibly due to the limits of detection of this method. Only the sludge sample from Los Angeles was subjected to electron microscopic analysis. The two amphibole fibers identified in the first replicate of the sample were both tremolite. It is difficult to assess the health significance of the presence of asbestos or glass fibers in single sludge samples. What the exposure level and health effects would be to workers employed in preparation of dry, bagged sludge products for sale or those applying such products in floricultural or horticultural work is unknown. This would depend on many factors including the concentration and types of asbestos fibers present in the air, the simultaneous presence of other toxicants and pathogens which may exacerbate asbestos toxicity, volume of air inhaled, times of exposure, the use of protective respiratory devices and the susceptibility of the individual. (Baker-IVI)
W85-05008

EFFECT OF BACTERIAL CULTURES ON MICROBIAL TOXICITY ASSESSMENT,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
D. Liu.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 3, p 331-339, March, 1985. 4 Tab, 23 Ref.

Descriptors: *Bacteria, *Cultures, *Toxicity, Microbial toxicity test, Water analysis, Pollutant identification.

The effect of various bacterial species on the microbial toxicity test using 6 different bacterial cultures, 12 selected chemicals and a standard set of conditions was examined. Perhaps the most important public health aspect of this study is the finding that a chemical's toxicity seems to vary dramatically from one species to another, even assayed by the same testing procedure. The extreme complexity and unpredictability of the biota-toxicant interaction is demonstrated. The diverse responses of bacterial cultures to different concentrations of the same chemical would also suggest that the linear dose-response models often used to explain toxicological responses are inadequate in ecotoxicological research on toxic substances in the natural environment. Apparently, it is not appropriate to assess the toxicity of a chemical by a single bacterial species. Thus, the battery approach involving the use of at least two or more bacterial species with the test chemical assayed at a wide range of concentrations to yield both acute and subtile effects is recommended. (Baker-IVI)
W85-05009

INCREASED RESPONSE OF THE RAINBOW TROUT GONAD CELL UNSCHEDULED DNA REPAIR ASSAY,
British Columbia Cancer Research Center, Vancouver. Environmental Carcinogenesis Unit.
D. G. Walton, A. B. Acton, and H. F. Stich.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 3, p 340-348, March, 1985. 5 Fig, 37 Ref.

Descriptors: *Testing procedures, *Toxicity, *Trout, *Unscheduled DNA repair, Fish, Organic compounds, Carcinogens, Mutagens, Bioassay.

In mammalian test systems, the UDS technique has proven to have in vivo and in vitro applications and responds to many classes of carcinogens. Data are presented which demonstrate how the in vitro UDS assay with rainbow trout gonad (RTG) cells may be modified to enhance grain production, thus increasing the sensitivity of the assay. Extending the 3HTdR treatment period to 6 hr resulted in higher grain counts. Presumably, a longer treatment period permits more DNA to be repaired, hence 3HTdR incorporation. No toxic effects were noted with the longer 3HTdR exposure. Grain count increases were not proportional to increases in 3HTdR exposure. Increasing the duration of exposure to the emulsion also yielded an increase in nuclear grain count. Increased grain production was found by lengthening the duration of carcinogen exposure to about 30 min. Other factors investigated, including varying the cell division arrest time in 2.5% ADM prior to mutagen exposure, increasing the culture media's fetal calf serum concentration, varying the 3HTdR concentration, and using RTG cells differing by an excess of 30 passages, had little effect on the observed level of UDS. By conducting the assay at 25 C instead of 18 C, increasing the 3HTdR treatment period from 3 to 6 hr, and extending the emulsion exposure period from 18 to 30 days, grain production in RTG cells can be increased two to threefold. Background grain counts, observed to increase slightly, were minimized by using a low cell density on each cover slip and by thorough rinsing of the coverslip during the preservation procedure to remove non-incorporated 3HTdR. (Baker-IVI)
W85-05010

GILL DAMAGE AS A DETERMINANT OF RESIDUAL OXYGEN CONCENTRATION IN THE SEALED JAR TEST,
Helsinki Univ. (Finland). Dept. of Zoology.
H. Tuurala, M. Nikinmaa, and A. Soivio.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 3, p 385-389, March, 1985. 3 Tab, 8 Ref.

Descriptors: *Fish, *Sealed jar test, *Gills, *Bioassay, *Residual oxygen, Toxicity, Oxygen, Respiration, Temperature effects.

The residual oxygen bioassay or sealed jar test is used as a rapid, simple means for measuring effects of toxicants on the ability of fish to withstand oxygen depletion. Additionally, the role of gill damage was investigated in determining the residual oxygen concentration by ligating gill arches, thus limiting effective gill surface area, and carrying out sealed jar tests in clean water. Tests were carried out at different temperatures to determine if tissue oxygen consumption may influence the residual oxygen concentration. Gill damage seemed to be the major determinant of residual oxygen concentration in the sealed jar test. No change in residual oxygen concentration was noted when fish were placed in sealed jars and allowed to use oxygen from clean water at different temperatures. In contrast, clear increases in residual oxygen concentration were obtained by decreasing effective gill surface area via ligation of gill arches. Thus the different effects of toxicants in the sealed jar tests at different temperatures may rather reflect the different time course of gill damage at different temperatures. It is suggested that residual oxygen test gives mainly an indication of the effect of toxicants on gill structure, and that the accuracy of the test is dependent on the speed of changes in the effective gill area. (Baker-IVI)
W85-05015

PHYTOPLANKTON CONSTITUENTS AS INDICATOR OF WATER QUALITY: A STUDY OF THE RIVER CAUVERY,
Bangalore Univ. (India). Dept. of Botany.
R. K. Somashekar.
International Journal of Environmental Studies, Vol. 23, No. 3/4, p 209-215, October, 1984. 4 Tab, 10 Ref.

Descriptors: *Phytoplankton, *Water quality, *River Cauvery, *India, Pollution load, Algae, Diatoms, Chlorophyta, Cyanophyta, Euglenophyta, Bioindicators.

Phytoplankton and water samples were collected from four stations on the river Cauvery, over a distance of 20 km, 16 km away from Mysore City, Karnakataka, India. The stations, representing different degrees of pollution, were investigated hydrobiologically to find dependable criteria for pollution levels. There is significant difference in the distribution pattern of different algal groups between the polluted and unpolluted stations. Comparatively larger numbers of green algae and diatoms were observed at the unpolluted station. Cyanophyceae dominated at the polluted stations. Euglenophytes were collected mostly from the polluted stations and the number at the unpolluted station was almost insignificant. Species encountered at different stations were enumerated and their relative tolerance to various physicochemical factors was assessed. The relative proportion of the constituent algal class in the phytoplankton could be used for evaluating the quality of water. (Baker-IVI)
W85-05030

BIOLOGICAL ASSESSMENT OF WATER POLLUTION: A STUDY OF THE RIVER KAPILA,
Bangalore Univ. (India). Dept. of Botany.
R. K. Somashekar, and S. N. Ramaswamy.
International Journal of Environmental Studies, Vol. 23, No. 3/4, p 261-267, October, 1984. 6 Tab, 14 Ref.

Descriptors: *Water analysis, *River Kapila, *India, *Bioindicators, Water pollution, Water quality, Algae, Monitoring.

An attempt was made to assess the feasibility of application of biological data to evaluate and monitor water pollution of the river Kapila, near Nanjangud, Karnataka. The pH of samples at all the stations remained on the alkaline side. Water samples at pollution stations contained higher amounts of oxidizable organic matter and the BOD was high. Station 3 recorded the lowest number of species and total algae, perhaps because of the toxicity of complex physico-chemical factors. The effluents released from the paper mill contain nitrogen complex, phosphates, silicates, sodium and potassium which, in fact, constitute the nutrients of the algae. Two pollution index factors, one at the generic level and another at species level of the algae were computed. Significant correlations were noted between biological and some physicochemical factors have been established. (Baker-IVI)
W85-05033

METHOD FOR THE DETERMINATION OF COD OF LOW LOADED WATERS (EINE CSB-METHODE FUR GERING BELASTETE WASSER),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergutewirtschaft und Abfalltechnik.
R. Wagner, and W. Ruck.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, p 268-272, 1984. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Chemical analysis, *Chemical oxygen demand, *Oxygen demand, Chlorides, Hydrogen chloride, Silver sulfate, Sulfuric acid, Potassium dichromate, Amino acetic acid, Nicotinic acid.

A method is presented for the determination of low values of COD (1-15 mg/l). This method includes the step of complete removal of chloride ions as hydrogen chloride by diffusion and uses a silver sulfate containing solution of potassium dichromate in concentrated sulfuric acid as oxidizing agent. Despite of the low concentration level many organic compounds are completely oxidized, for amino acetic acid and nicotinic acid - two more recalcitrant compounds - oxidation rates of 93.5 and 57%, respectively, were found. The investigations concerning the chloride problem are extended to concentrations up to 10,000 mg/l chloride ions. (Author's abstract)
W85-05044

MODIFIED MEMBRANE-FILTER PROCEDURE FOR CONCENTRATION OF ENTEROVIRUSES FROM TAP WATER,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
P. A. Shields, S. A. Berenfeld, and S. R. Farrah.
Applied and Environmental Microbiology, Vol. 49, No. 2, p 453-455, February, 1985. 1 Tab, 13 Ref. EPA grant R810126-01-0.

Descriptors: *Enteroviruses, *Viruses, *Water analysis, *Membrane filters, *Drinking water, Filters, Adsorption.

Enteroviruses added to 114 liters of dechlorinated tap water were recovered in a 16-ml sample by a two-stage concentration procedure in which differ-

ent types of membrane filters were used in each concentration stage. Viruses in tap water at pH 3.5 were first adsorbed to 10-in. (ca. 25.4-cm) epoxy-fiber glass filters (Filterite). Viruses adsorbed to these filters were eluted with a solution of 0.2 M sodium trichloroaceate buffered at pH 9 with 0.2 M lysine. Viruses in this solution were adsorbed to 47-mm asbestos filters (Seitz) without pH adjustment or other modification of the solution. Viruses were recovered from the Seitz filters with 16 ml of either Casitone or fetal calf serum at pH 9. With these procedures ca. 45% of several types of enteroviruses added to 114 liters of tap water could be recovered in the final 16-ml sample. (Author's abstract)
W85-05054

USE OF SIMPLE KINETIC MODELS TO HELP DESIGN ENVIRONMENTAL MONITORING SYSTEMS,
EG and G Idaho, Inc., Idaho Falls.
G. B. Wiersma, C. W. Frank, M. J. Case, and A. B. Crockett.
Environmental Monitoring and Assessment, Vol. 4, p 233-255, September, 1984. 3 Fig, 9 Tab, 67 Ref.

Descriptors: *Model studies, *Kinetics, *Monitoring, *Water quality control, Wilderness areas, Geothermal energy, Fate of pollutants, Path of pollutants.

Simple linear models were applied to help design environmental monitoring systems. Five steps are involved: the derivation of a schematic of the identified pollutant's transport and fate, the derivation of the equation in the schematic, estimation of input data and numerical solution, comparison with initial field data, and design of a monitoring system. Two examples of how this system is applied under field conditions are given. One study was located in a national park where there was a need to develop a pollutant monitoring system for wilderness areas that are designated as Biosphere Reserves. Sources of pollutant (lead) in this model could not be directly determined because of the remoteness of the site. Surface water was identifed as the critical receptor of the lead deposits. No lead above the detection limit of 0.01 mg/l was present in any surface water samples. Lead was not detected in ground water collected from springs. The second study was conducted at a known geothermal resource area slated for energy development, to determine baseline conditions. Advantages of this approach are that it forces a consideration of the system as a whole rather than a series of distinct environmental components; it forces a consideration of the physical-chemical and biological factors affecting pollutant transport in the system, it sets up an analytical procedure for data analysis at the time the monitoring system is designed, it helps show the functional relationship between pollutant levels in different environmental media, it identified points where sampling design could be changed to provide for a more efficient monitoring system, and it identified gaps in the knowledge base. (Baker-IVI)
W85-05102

ION-CHROMATOGRAPHIC DETERMINATION OF DIVALENT METAL IONS (CO, NI, CU, ZN, CD) USING EDTA AS COMPLEXING AGENT,
Government Industrial Research Inst., Osaka, Ikeda (Japan).
T. Tanaka.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 320, No. 2, p 125-127, February, 1985. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Chromatography, *Cobalt, *Nickel, *Copper, *Zinc, *Cadmium, Industrial wastes, EDTA, Pollutant identification, Metals, Wastewater analysis.

The determination of divalent transition metal ions, such as cobalt, nickel, copper, zinc, and cadmium, is described using an ion-chromatograph equipped with an anion separator system. The metal ions were separated as the anionic metal comlexes by addition of EDTA to the sample solution, and the separated complexes were detected by conductivity measurement. By this method, anions and metal ions in the sample were successively determined. The method was applied to the determination of metal ions in plating solution and waste water. When the sample solution was introduced into the system, a chromatogram of anions in the sample was obtained. Then the sample solution with EDTA was introduced and a chromatogram of anions and metal-EDTA complexes was obtained. The metals were determined from the difference of the former and the latter chromatograms. (Baker-IVI)
W85-05104

ALPHA-TOCOPHERYL ACETATE AS AN INDICATOR OF MUNICIPAL WASTE CONTAMINATION IN THE ENVIRONMENT,
California Univ., Los Angeles. Dept. of Earth and Space Sciences.
R. P. Eganhouse, and I. R. Kaplan.
Environmental Science and Technology, Vol. 19, No. 3, p 282-285, March, 1985. 2 Fig, 1 Tab, 9 Ref. DOE contract EY-76-3-03-0034.

Descriptors: *Path of pollutants, *Tocopheryls, *Vitamin E, *Municipal wastewater, *Indicators, Water pollution sources.

During studies of the extractable organic matter in municipal wastes of southern California, alpha-tocopheryl acetate (vitamin E acetate) was found to be present in all of the 27 samples tested. The concentration of alpha-tocopheryl acetate in effluents receiving mainly primary treatment ranges from 6 to 25 micro g/L, whereas sludge samples contain approximately 1100 micro g/L. This compound is produced industrially for a variety of commercial purposes and can readily be distinguished from natural alpha-tocopherol which occurs only as the free alcohol. Its occurrence in municipal wastes reflects the widespread domestic use and disposal of vitamin E acetate-bearing products. Thus, when observed in the environment, the acetate derivative is an indicator of sewage contamination. An examination of sediments deposited in the vicinity of a submarine waste outfall system clearly revealed the presence of alpha-tocopheryl acetate, suggesting that this molecule can survive the earliest stages of diagenesis. (Author's abstract)
W85-05119

CONTINUOUS DETECTION OF POLLUTANTS ON SURFACES OF RUNNING WATER (KONTINUIERLICHER NACHWEIS VON VERUNREINIGUNGEN AUF OBERFLACHEN VON FLIESSENDEN GEWASSERN),
Strohlein GmbH and Co. 4044 Kaarst 1.
H. Stremming.
Wasser, Luft und Betrieb, Vol. 28, No. 4, p 14-16, April, 1984. 3 Fig.

Descriptors: *Monitoring, *Water pollution, *Oil, *Organic compounds, Fluorescence, Reflectance, Water pollution control, Optical properties, Oil pollution, Oil spills.

A new device, the Strohlein-Flucomat, provides continuous, non-contact monitoring of water surfaces to detect pollutants like oil, kerosene, and organic substances. The Flucomat has been installed to monitor inflow into pumping station of an underground collection basin at the Dusseldorf airport (Federal Republic of Germany) in order to prevent pollutants reaching the receiving stream, the Kittelbach. The device, which works optically, is robust, simple, and requires little maintenance. Gauging is achieved by means of differences in reflected light between water and pollutants floating on its surface, and by fluorescence elicited in the pollutants by ultraviolet light. By changing distance of gauge head from water and use of different optical filters, it is possible to make either one of the gauging methods dominant. By using the fluorescent mode, measurement of layer depth for certain types of oil can be made to within tenths of millimeters. Protection against interference by outside light sources is offered. The gauge head, which is hung 50 cm above the water surface, contains the ultraviolet lamp with photo element for brightness regulation and the photomultiplier with its attendant electronics. An automatic regulator is available to ensure correct distance of the head from the water in the case of variable water level. The analog gauge signal can be registered continuously in written form to document accidents, leakages, or dumping of heavily polluted wastewater. (Gish-IVI)
W85-05140

ROLE OF MYCOFLORA OF THE VOLGA AND SOME NORTHERN WATER BODIES IN PROCESSES OF SELF-PURIFICATION AND BIOINDICATION OF WATERS,
A. A. Mil'ko, and L. I. Zakharova.
Water Resources, Vol. 11, No. 2, p 129-133, March-April, 1984. 5 Tab, 16 Ref. Translated from Vodnye Resursy, No. 2, p 95-98, March-April, 1984.

Descriptors: *Aquatic plants, *Fungi, *Volga River, *USSR, Reservoirs, Lakes, Canals, Diaspores, Monitoring, Bioindicators, Water pollution.

Water samples were taken for analysis of their mycoflora content from northern water bodies (Sheksna reservoir, Northern Dvina water system, Lake Beloe, and Vodorazdel'nyi Canal) and on the cascade of Volga reservoirs from Kalinin to Astrakhan. The water of the Volga reservoirs is polluted by fungal diaspores of more than 200 species, and the northern water bodies by about 100 species. In both cases diaspores of Oomycetes and especially Fungi Imperfecti dominate. Pollution of Volga water varies within 1500-12,700 diaspores per liter and increases downstream, the larger number of diaspores being noted in the bank zone, on shallows, and in beds of higher aquatic vegetation compared with the channel. In deep stretches of the water bodies the content of diaspores in the water decreases with depth. The Volga water is more polluted with diaspores in large populated regions than far from them. The structure of mycoflora contains information about the saprobity of waters and can be used in their biomonitoring. (Baker-IVI)
W85-05156

BASIS OF BIOINDICATION OF SURFACE WATER QUALITY AT THE ORGANISMIC LEVEL,
V. A. Alekseev.
Water Resources, Vol. 11, No. 2, p 140-150, March-April, 1984. 2 Tab, 39 Ref. Translated from Vodnye Resursy, No. 2, p 107-121, March-April, 1984.

Descriptors: *Bioindicators, *Toxicity, *Water pollution effects, Water quality, Water analysis, Aquatic life, Toxobity.

Developments in aquatic toxicology are evaluated whose results are directly concerned with indication of the quality of surface waters at the organismic level. With the appearance of new anthropogenic types of of pollutants, primarily toxic, it is necessary to speak not only about saprobity but also about toxobity (the resistance of organisms to toxic pollution) and saprotoxobity (resistance of organisms to the combination of natural and toxic pollution). Of primary concern are comparative toxicological investigations whose purpose is to determine the degree of resistance of organisms of various taxonomic ranks to various toxicants. Specific topics investigated include correlation between saprobity and toxicoresistance of aquatic organisms (hydrobionts), the system of toxobity as a result of comparative toxicological taxonomic investigations, and bioindicators (oligotoxobes, beta-mesotoxobes, alpha-mesotoxobes, and polytoxobes). (Baker-IVI)
W85-05157

QUICK METHOD OF FIELD OBSERVATIONS OF WASTEWATER SPREADING IN LAKES,
G. V. Druzhinin, O. E. Korotkevich, and V. S. Rumyantsev.
Water Resources, Vol. 11, No. 2, p 169-178, March-April, 1984. 5 Fig, 6 Ref. Translated from

odnye Resursy, No. 2, p 150-161, March-April, 84.

escriptors: *Path of pollutants, *Wastewater, akes, *Spatial distribution, Measuring instru-ents, Water analysis, Remote sensing, Data ac-isition, Temporal distribution.

vestigations of the spatial distribution of astewaters in lakes showed that domestic and dustrial wastewaters move in the water column surface, suspended or bottom layers, jets, or dividual lenses and spots on the surface and at rious depths. A quick method using remote elec-cal measurements was developed and used for udies on variable wastewater inclusions. Using s method observations were made at one point the surface, at hydrologic stations, in the sur-ce layer, at long term hydrologic stations, along th vertical observations and regime observa-ns. When investigating the spreading of astewaters in lakes the quick method is sufficient the investigated phenomenon, as its corre-onds to the statement of the problem and to the eoretical methods of its solution. The proposed ethod does not eliminate combined investigation th the sampling method, so that the newly ob-ned observations can be tied to the vast number field observation accumulated by the discrete ethods used earlier. Since the performance of in u investigation is related to large material ex-nditures, any in situ investigation can and should accurately planned beforehand. The method fers great possibilities for advance determination the volume and type of field observations, de-nding on the stated problem. The notion that ce pollution occurs gradually and successively vers zones ever more distant from the discharge e is not confirmed by this study. Apparently, the ed to interpolate between sampling points led to e idea of zonal spreading of wastewaters. (Baker-I)
85-05161

EACHING BEHAVIOR OF LEAD AND CAD-IUM AT VARIOUS PH CONDITIONS,
esiduals Management Technology, Inc., Madi-n, WI.
or primary bibliographic entry see Field 5E.
85-05370

HEMICAL CHARACTERISTICS OF LEACH-TE FROM MUNICIPAL SOLID WASTE ANDFILLS IN WISCONSON,
isconsin Dept. of Natural Resources, Madison. ureau of Solid Waste Management.
or primary bibliographic entry see Field 5E.
85-05371

OLLUTION BIOMONITORING PROGRAMS ND THE GENETIC STRUCTURE OF INDICA-OR SPECIES,
ockholm Univ. (Sweden). Inst. of Genetics.
. Gyllensten, and N. Ryman.
mbio, Vol. 14, No. 1, p 29-31, 1985. 3 Fig, 35 ef.

escriptors: *Biomonitoring, *Bioindicators, *Ge-etics, Fish populations, Pollutant identification, llozymes, Sculpin, Monitoring.

ow analysis of the genetic structure of a spices ay contribute information important for the plan-ng and implementation of biomonitoring pro-rams is reviewed. The genetic effects of pollut-nts on natural fish populations depends on the enetically determined susceptibility of the specific opulations affected. A proper assessment of the ffects is not possible without knowledge of both ne genetic population structure of the species and ne amount of variation in genetic tolerance to the ollutant between populations. A variety of param-ters have been employed to characterize popula-ons or population segments of fish, including emographic parameters, physiological and behav-oral traits, morphological and meristic characteris-cs, calcified structures, cytogenetic and immuno-enetic characteristics, biochemical genetic char-cteristics, and direct estimates of DNA sequence ivergence. Allozyme analysis has been conducted on many hundred species, and data are available for most taxonomic groups. The variability at loci that determine the response to pollution is of particular interest. Genetic variability in fourhorn sculpin is described in detail along with implications for biomonitoring. (Baker-IVI)
W85-05465

FISH DEFORMITIES AND POLLUTION IN SOME SWEDISH WATERS,
National Swedish Environment Protection Board, Nykoeping. Brackish Water Toxicology Lab.
For primary bibliographic entry see Field 5C.
W85-05466

CHEMICAL DERIVATIZATION ANALYSIS OF PESTICIDE RESIDUES. IX. ANALYSIS OF PHENOL AND 21 CHLORINATED PHENOLS IN NATURAL WATERS BY FORMATION OF PENTAFLUOROBENZYL ETHER DERIVATIVES,
Canada Centre for Inland Waters, Burlington (Ontario).
H.-B. Lee, L.-D. Weng, and A. S. Y. Chau.
Association of Official Analytical Chemists, Vol. 67, No. 6, p 789-794, November-December, 1984. 2 Fig, 4 Tab, 19 Ref.

Descriptors: *Pollutant identification, *Pesticide residues, *Chlorinated phenols, *Phenols, Pentafluorobenzyl ether, Chloroalkylphenols, Chromatography, Organic compounds, Surface waters, Water analysis, Natural waters.

A sensitive, isomer-specific method is described for the simultaneous and quantitative analysis of 22 phenols (phenol, 18 chlorophenols, and 3 choroalkylphenols) in natural waters. The sample was acidified to pH <2, extracted with dichloromethane, evaporated, and dissolved in acetone. The phenol extract was then reacted with pentafluorobenzyl bromide to give the PFB ether derivatives. After silica gel column cleanup, the ethers were chromatographed on a 12 m OV-1 fused silica capillary column attached to an electron capture detector. The detection limit was 0.1 ppb for 1 L samples. Recoveries of phenols from pH 2 water samples fortified at 10, 1, and 0.1 ppb were > 80% in most cases except for phenol which was only 30 to 35% recovered. The extraction and PFBBr derivatization procedure presented are well suited to analysis of chlorophenols in natural waters. This method applies to the determination of higher chlorophenols in water at low ppb levels, because the ECD is equally sensitive to PFB ethers of all 22 phenols. The PFBBr derivatization technique is the method of choice if simultaneous determination of non- or monochlorinated phenols together with polychlorinated phenols at trace levels is required in the same sample. If this method is applied to higher phenol concentrations, a smaller sample should be extracted so that quantitative recovery of all 22 phenols can be maintained. Because of reagent blanks and co-extractives, the detection limit of this method is 0.1 ppb for 1 L samples. (Baker-IVI)
W85-05471

ARSENIC, CADMIUM, LEAD, MERCURY, AND SELENIUM IN SEDIMENTS OF RIVERINE AND POTHOLE WETLANDS OF THE NORTH CENTRAL UNITED STATES,
Columbia National Fisheries Research Lab., Yankton, SD. Field Research Station.
D. B. Martin, and W. A. Hartman.
Journal of the Association of Official Analytical Chemists, Vol. 67, No. 6, p 1141-1146, November/December, 1984. 1 Fig, 3 Tab, 31 Ref.

Descriptors: *Heavy metals, *Sediments, *Wetlands, Riverine wetlands, Pothole wetlands, Arsenic, Cadmium, Lead, Mercury, Selenium, Sediment contamination.

In 1980 a two year study was begun of sediments in the US Fish and Wildlife Service (USFWS) wetlands to obtain baseline information on specific element concentrations. Objectives of the study were to determine the concentrations of arsenic, cadmium, lead, mercury, and selenium in the sediments of representative riverine and pothole wetlands in the North Central US, compare these element concentrations with values from the literature, and make an initial assessment of the present state of these wetlands for possible contamination. Mean of dry weight concentrations (mg/kg) for pothole and riverine locations, respectively, were arsenic 4.4 and 2.4, cadmium 0.52 and 0.26, lead 13 and 6.6, and selenium 0.89 and 0.52. Mercury concentrations did not differ significantly between pothole sediment and riverine type wetland sediments with a mean of 0.03. With the possible exception of one location, levels found in this study were within normal or background ranges according to literature values. (Baker-IVI)
W85-05472

APPLYING ANALYTICAL TECHNIQUES TO SOLVE GROUNDWATER CONTAMINATION PROBLEMS,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5G.
W85-05478

TWO-COLUMN METHOD FOR PRECONCENTRATION OF TRACE METALS IN NATURAL WATERS ON ACRYLATE RESIN,
McMaster Univ., Hamilton (Ontario). Dept. of Chemistry.
C.-C. Wan, S. Chiang, and A. Corsini.
Analytical Chemistry, Vol. 57, No. 3, p 719-723, March, 1985. 3 Fig, 3 Tab, 27 Ref.

Descriptors: *Pollutant identification, *Trace metals, *Preconcentration, Seawater, Lake water, Iron, Copper, Nickel, Manganese, Lead, Cobalt, Cadmium, Chromium, Natural waters.

Conditions for the direct preconcentration of XAD-7 columns were determined for several trace metal ions in aqueous solutions of low and high salinity. Low breakthrough volumes in the presence of humic materials necessitated their prior removal at low pH by means of a precolumn of XAD-7. The two column procedure was applied to the determination of trace metals in seawater and lake water. The final effluent for measurement by graphite-furnace atomic absorption spectrometry is readily matrix matched and permits use of the standard calibration curve procedure for the majority of trace metals determined. This results in a reduction of sample consumption and analysis time. The effectiveness of XAD-7 columns for the direct preconcentration of trace levels of metal ions is dependent on a number of factors, including pH and flow rate, particle size, humic substances, salts, and the elution of retained metal ions. (Baker-IVI)
W85-05518

AUTOMATED IODOMETRIC METHOD FOR DETERMINATION OF TRACE CHLORATE ION USING FLOW INJECTION ANALYSIS,
Miami Univ., Oxford, OH. Dept. of Chemistry.
K. G. Miller, G. E. Pacey, and G. Gordon.
Analytical Chemistry, Vol. 57, No. 3, p 734-737, March, 1985. 1 Fig, 4 Tab, 29 Ref.

Descriptors: *Chlorates, *Flow injection analysis, *Water analysis, Drinking water, Disinfectants, Trace levels, Water quality control, Iodometry.

The National Research Council's Safe Drinking Water Committee has recommended a 7-day no adverse response level of 0.125 mg/L for chlorate. Two approaches are described for the determination of chlorate ion at levels of .00001 M and .000001 M, respectively. Both methods use the reaction of chlorate ion with iodide ion to produce iodine. High acid concentration accelerates the reaction. At high acid concentrations the oxidation of I(-) by oxygen is extremely fast. These methods were developed by using flow injection analysis which excludes air from the flow stream. Both methods exhibit excellent relative standard deviation and accuracy in the determination of unknown ClO3(-). By incorporating the method into the closed flow injection analysis system, the prob-

lem of air oxidation of iodide ion at elevated concentration of acid is eliminated. Any potential interference from chlorine dioxide and chlorite ion can be eliminated by exploiting kinetic discrimination. (Baker-IVI)
W85-05519

ESTIMATION OF ACIDITY IN RAINFALL BY ELECTRICAL CONDUCTIVITY,
Trent Univ., Peterborough (Ontario). Dept. of Chemistry.
R. A. Stairs, and J. Semmler.
Analytical Chemistry, Vol. 57, No. 3, p 740-743, March, 1985. 1 Fig, 4 Tab, 3 Ref.

Descriptors: *Acidity, *Rainfall, *Conductivity, Estimating, *Acid rain, Natural waters, Ion exchange.

Measurement of electrical conductivity of a sample of rain or other natural freshwater, and of the same sample after passage through a bed of ion exchange resin in H(+) form, allows the calculation of acidity (or alkalinity) and salinity. Results for 64 samples of rain are provided. The principle behind the method is simple. All ions contribute to the conductivity of a solution in direct proportion to their concentration in equivalents per unit volume and their equivalent conductances. A solution containing a single ionic solute, such as hydrochloric acid, requires only a single conductance measurement for analysis. Two solutes require two measurements. The second measurement is performed after the solution has been allowed to pass through a column of a strongly acidic, cation exchange resin, which will replace the sodium ions with hydrogen ions. The method as described is suitable for automation. (Baker-IVI)
W85-05520

SELECTIVE SEPARATION AND DETERMINATION OF DISSOLVED CHROMIUM SPECIES IN NATURAL WATERS BY ATOMIC ABSORPTION SPECTROMETRY,
New South Wales Inst. of Tech., Broadway (Australia). School of Chemical and Earth Sciences.
T. L. Mullins.
Analytica Chimica Acta, Vol. 165, p 97-103, November, 1984. 6 Tab, 17 Ref.

Descriptors: *Chromium, *Atomic absorption spectrometry, Pollutant identification, Harbors, Natural waters, Water pollution sources.

A procedure for determining the concentrations of dissolved chromium species in natural waters is described. The method uses a single initial separation by co-precipitation, from which both chromium(III) and chromium(VI) concentrations are determined independently. The organic contribution is then calculated by difference from a determination of the total dissolved concentration. In the water studied, total concentrations were relatively high (1-5 micro-g/l) with Cr(VI) the predominant species in all areas with one exception, where organically bound chromium was the major species. The relatively high chromium concentrations found in these six locations in the Sydney, Australia area reflect in part the use of most of the waterways in this area as industrial carriers. Lower levels found in Port Hacking reflect the primary use of the bay as a recreational area devoted particularly to the use of power and sail boats. (Baker-IVI)
W85-05524

SUPPRESSION OF INTERFERENCES IN THE DETERMINATION OF LEAD IN NATURAL AND DRINKING WATERS BY GRAPHITE-FURNACE ATOMIC ABSORPTION SPECTROMETRY,
University of Strathclyde, Glasgow (Scotland). Dept. of Pure and Applied Chemistry.
P. R. Sthapit, J. M. Ottaway, D. J. Halls, and G. S. Fell.
Analytica Chimica Acta, Vol. 165, p 121-130, November, 1984. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Lead, *Pollutant identification, *Atomic absorption spectrometry, Water analysis, Drinking water, Natural waters, Heavy metals,

Interference effects in the determination of lead in waters are examined comprehensively, both for wall atomization and platform atomization, by looking at the individual effects of the inorganic constituents of waters. Their suppression by the use of lanthanum chloride and nitric acid is examined and the effectiveness of the treatment assessed by comparison with the results obtained for the analysis by flame and flame atomic fluorescence spectrometry. The interferences are confirmed to be mainly sulfate and chloride, of which the most important chloride is magnesium chloride. Although the use of the platform was successful in decreasing sulfate interference, it did not control the other interferences and would require the use of a matrix modifier. Nitric acid essentially controlled the chloride interferences while the lanthanum removed the sulfate interference. Comparison with two other methods, flame a.a.s. after preconcentration by evaporation and flame atomic fluorescence spectrometry prove that the lanthanum-nitric acid mixture effectively overcomes the interference effect in real samples. The method proposed is simple, staightforward and rapid and has proved a satisfactory replacement for a liquid-liquid extraction/graphite furnace atomic absorption spectrometry method. (Baker-IVI)
W85-05525

DETERMINATION OF CHROMIUM(VI) IN WASTE WATER AND INDUSTRIAL EFFLUENTS BY DIFFERENTIAL PULSE POLAROGRAPHY,
Bayer A.G., Leverkusen (Germany, F.R.). Organisch-Analytisches Lab.
C. Harzdorf, and G. Janser.
Analytical Chimica Acta, Vol. 165, p 201-207, November, 1984. 3 Fig, 2 Tab, 5 Ref.

Descriptors: *Chromium, *Wastewater analysis, *Differential pulse polarograpy, *Industrial wastes, Pollutant identification, Polarography, Heavy metals.

A method is described for the determination of chromium(VI) in water and waste water. Interfering cations are separated by co-precipitation with aluminum from the phosphate-buffered solution Differential-pulse polarographic measurement of chromium(VI) in the same background solution at pH 10 or 12 provides a lower limit of determination of 30 micro-g/l Cr(VI). No significant losses of chromium(VI) occur in the precipitation step; chromium(VI) is not susceptible to reduction by waste water constituents at the moderate pH maintained throughout the procedure. The polarographic characteristics of chromium(VI) in phosphate-buffered solution are discussed. Two polarographic peaks are obtained in the pH range 9-12, the characteristics of which depend strongly on the actual pH. Both peaks reflect the reduction of Cr(VI) to Cr(III). The peaks appear at about -0.3 and -0.9 V vs. silver/silver chloride, thus providing the option of measuring at different potentials. By this means, interference from polarographically active organic constituents can be detected and optimum conditions of measurement may be selected for different types of sample. (Baker-IVI)
W85-05526

USE OF LONG SOLIDS RETENTION TIMES TO IMPROVE THE ACTIVATED SLUDGE BIODEGRADATION OF A COMPLEX WASTE,
South Dakota School of Mines and Technology, Rapid City.
For primary bibliographic entry see Field 5D.
W85-05551

USE OF A RAPID BIOASSAY FOR ASSESSMENT OF INDUSTRIAL WASTEWATER TREATMENT EFFECTIVENESS,
Occidental Chemical Corp., Grand Island, NY.
N. A. Casseri, W.-C. Ying, and S. A. Sojka.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 867-878, 6 Fig, 6 Tab, 11 Ref

Descriptors: *Industrial wastewater, *Toxicity, *Bioassay, *Fish, Phenols, Fathead minnows, Daphnia, Organic chemistry, Biological oxy demand, Adsorption, Biological treatment, Che cal treatment, Evaluation, Toxic wastes.

For many wastewaters containing a large var of pollutants, it is difficult to devise an object means of assessing treatment effectiveness. Bi say is sometimes preferred to complete chemi characterization for some effluents because the sults are more indicative of their potential ecol cal impact on the receiving water. Aquatic toxi data obtained in 45 minutes using the Beckm Microtox system, for two types of raw, partia and completely treated industrial wastewat were well correlated with the 48-hr Daphnia the 96-hr fish toxicity data for the same samples conducting this research program, the follow important advantages in using the Microtox bi say procedure were identified: 1) it is fast, 2 requires a small volume of sample; 3) it can acc modate unstable samples; 4) it can demonstr toxic effect at any percentage level in a statistic significant manner; 5) its results are more rep ducible; and 6) the testing organisms are ready use with no maintenance efforts. The reduction the Microtox toxicity in the treated samples w consistent with such reductions in TOC, COD, some specific compounds of interest. Therefo the Microtox bioassay can be used in evalua the effectiveness of chemical, biological, and sorption processes employed in treating com industrial wastewaters.
W85-05570

USE OF SATELLITE DATA FOR MONITO ING OIL SPILLS IN CANADA,
INTERA Environmental Consultants L Ottawa (Ontario).
For primary bibliographic entry see Field 7B.
W85-05578

ECOLOGICAL MONITORING OF AQUEO EFFLUENTS FROM PETROLEUM REFIN IES,
CONCAWE, The Hague (Netherlands).
F. G. Payne, C. Girton, W. deLigny, A. deRoocker, and A. Sirvins
Available from the National Technical Informa Service, Springfield, VA 22161, as PB83-114 Report No. 8/82, September 1982. 56 p. 22 Fig Tab, 35 Ref. + glossary.

Descriptors: *Monitoring, *Ecological effects, refineries, *Water pollution, *Environmental fects, *Oil industry, Effluents, Wastewater an sis, Oil.

The report provides information which will al the management of inland and coastal refineries evaluate the need for appropriate ecological m toring programs to study the effect of aque discharges on the environment into which they discharged. The stages in the development monitoring program are reviewed and a desc tion is given of some benefits that may arise f properly conducted studies. Other sections ou procedures for sampling, collection and analysi data and describe several case histories at refi sites in a variety of natural habitats. The re illustrates the practical contribution that an eco ical monitoring program can make to overall r ery management. It is emphasized that suc program should be approached only in cons tion with appropriate experts, who are unlikel be part of normal refinery staff, and that s experts should be involved in subsequent rev and updating.
W85-05582

ANALYTICAL CHEMISTRY,
National Water Research Inst., Burlington (On io).
E. Nagy, and W. R. Penrose.
In: Oil and Dispersants in Canadian Seas: Rese Appraisal and Recommendations, EPS 3-EC 27, May 1982. Environmental Protection Serv Ottawa (Ontario). p 135-143

scriptors: *Pollutant identification, *Oil pollun, *Separation techniques, *Oil, *Path of pollut-s, *Dispersants, *Fate of pollutants, *Water pol-ion sources, Gas chromatography, Water analy- Thin layer chromatography, Chromatography, antitative analysis, Infrared spectroscopy, Bio-nsformation, Bioaccumulation, Hydrocarbons.

er the past ten years, research on analysis of roleum in environmental samples has been cen-ed on the development of methods to identify spill sources (fingerprinting). Increasing empha- has also been placed on the development of alytical methods used in the studies of specific hways, biotransformation and bioaccumulation ocesses in terrestrial, marine and freshwater eco-tem. Sampling for oil pollution is carried out by thods which are used in the sampling of other vironmental contaminants. Some samples may uire filtration before extraction. Most samples cept direct GC injection and purging of hydro-bons) are concentrated before solvent extrac-n. The most commonly used methods of analysis infrared or fluorescence spectrometry. Gas romatography is useful in monitoring the dissap-arance of paraffins by bacteria while column romatography has been used to separate alkanes, omatic and polar compounds. High pressure uid chromatography has been used in the analy- of polyaromatic hydrocarbons in seawater, sedi-nt and biological tissue. Volatile petroleum hy-ocarbons may be detected by gas chromatogra-y. Most dispersants are extractable into organic vents and may be analyzed qualitatively by IR ectroscopy or thin-layer chromatography. Quan-itive analysis of dispersants can be accomplished gas chromatograpy. Fingerprinting of disper-nts should be tested under field conditions.
85-05593

HARACTERIZATION AND TREATABILITY F DRAINAGE SAMPLES FROM COAL PILES T STEAM ELECTRIC POWER STATION.
earborn Environmental Consulting Services, ssissauga (Ontario).
eport No. EPS 3-WP-82-4, August 1982. 159 p, Fig, 56 Tab, 5 Append, 49 Ref.

escriptors: *Waste characteristics, *Wastewater eatment, *Electric powerplants, *Coal, *Piles, ectric power, Field tests, Coal piles, Drainage, ainage water, Coke piles.

his study was conducted to illustrate characteris-s and treatability of drainage from coal piles at nadian steam electric generating stations and ke piles at Canadian steel mills. A review of the chnical literature was conducted, followed by lective field sampling, analyses and bench-scale eatability studies. The factors governing coal pile ainage characteristics were determined to be the pe and properties of the stored coal, meteorolog-al conditions, and coal pile management prac-es. For the study, discharges from coal piles at ve steam electric generating stations and two ke piles at steel-making facilities were sampled, alyzed, and evaluated for treatment. It was con-uded that the coal pile drainage samples could be ccessfully treated to meet the criteria applied in is study using relatively simple physical-chemical eatment technology. The most cost-effective eatment for the eastern coal pile drainage sample as determined to be pH adjustment using lime d the addition of an anionic polyelectrolyte as a agulant aid. Successful treatment of the western al pile drainage samples involved the addition of ther calcium chloride or lime as a primary coagu-nt. In some instances, an anionic polyelectrolyte as required to improve settling. The most cost-fective treatment method would depend on the aracteristics of the specific coal pile drainage.
85-05594

APID AND SENSITIVE AUTOMATED DE-ERMINATION OF PHOSPHATE IN NATU-AL WATERS,
Malaga Univ. (Spain). Dept. de Ecologia.
A. Fernandez, F. X. Niell, and J. Lucena.
Limnology and Oceanography, Vol. 30, No. 1, p 27-230, January, 1985. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Phosphates, *Water analysis, *Pollutant identification, Chemical analysis, Malachite green oxalate, Detergents, Surface waters, Seawater.

A method is described for the determination of phosphate in natural waters using the basic dye malachite green oxalate and the detergent Flaminox which stabilizes the dye-phosphomolybdate complex and is a wetting agent in the automatic system. The method was automated by means of a Technicon AutoAnalyzer II. The method is linear even below 0.1 micro-g atom P/liter if a 5-cm absorption cell is used. It shows very good reproducibility. Known amounts of silicate and arsenate were added to low nutrient seawater and the interference studied. Interference caused by silcates can be removed by adding an acid line to the circuit. That produced by arsenate is controlled by adding a sodium thiosulfate line. The major problem in automating the method was the detergent. (Baker-IVI)
W85-05622

AUTOMATED FISH RESPIRATORY MONITORING SYSTEM FOR STREAM ACIDIFICATION EPISODE ASSESSMENT,
Tennessee Technological Univ., Cookeville. Cumberland Biological Station.
E. L. Morgan, and R. C. Young.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1432-1435, December, 1984. 1 Tab, 15 Ref.

Descriptors: *Acidification, *Fish behavior, *Measuring instruments, Water pollution effects, Acidity, Streams, Water quality, Hydrogen ion concentration, Acid rain, Monitoring, Trout, Bluegill.

Physiological and behavioral responses of fish have been measured in the laboratory as a means of detecting dose-dependent stress resulting from acidification. Providing validation of cause/effect responses from fish subjected to increasing stream acidification by evaluating surface water quality data in light of site-specific derived biological values would be an important complement to monitoring programs. In meeting this goal, an automated biosensing monitor was developed for monitoring fish ventilatory (breathing) rates in response to natural and experimental changes in water quality characteristics affected by acidification. Utilizing floating dock facilities and a stream-side mobile laboratory, fish breathing rate detectors were interfaced to a minicomputer for continuously generating physiological response data simultaneously with chemical/physical information. Following a series of simulated acid rainfall hydrographic episodes, rainbow trout and bluegill sunfish showed pronounced initial changes in breathing rates after several hours exposure to peak pH shifts from 7.2 to 4.5. (Baker-IVI)
W85-05629

PROBLEMS ASSOCIATED WITH SULPHATE DETERMINATION IN COLORED, HUMIC WATERS IN KEJIMKUJIK NATIONAL PARK, NOVA SCOTIA (CANADA),
Canadian Wildlife Service, Halifax (Nova Scotia).
J. Kerekes, G. Howell, and T. Pollock.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1811-1817, December, 1984. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Pollutant identification, *Sulfates, *Kejimkujik National Park, *Nova Scotia, Methyl thymol blue analysis, Ion chromatography, Humic acid, Organic compounds, Acidification.

Water samples from the tributaries of Kejimkujik Lake and the outflow of Beaverskin Lake in Kejimkujik National Park, Nova Scotia are discussed. The sulfate concentrations were determined with both the methyl thymol blue (MTB) method and the ion-chromatography (IC) method. The latter method gave consistently lower sulfate values in colored, humic waters which led to an overabundance of cations. This suggests the presence of organic anions, previously masked by the apparently high sulfate concentration obtained by the MTB method. When the estimated organic anion concentrations are included in the charge balance with the ion-chromatography sulfate determinations, good balances are obtained. The five streams sampled represent a wide range of water color and show varied seasonal patterns of sulfate concentrations. There was an excellent relationship determined between color and dissolved organic carbon concentrations in Kejimkujik waters. It is cautioned that water chemistry, as it relates to acidification, cannot be considered successfully without an adequate treatment of the organic anions present which contribute to the acidity of dilute colored, humic waters. (Baker-IVI)
W85-05661

INFLUENCE OF CURRENT VELOCITY ON PERIPHYTON DISTRIBUTION AND SUCCESSION IN A NORWEGIAN SOFT WATER RIVER,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2H.
W85-05677

ACIDIFICATION AND EARLY WARNING ORGANISMS IN FRESHWATER IN WESTERN NORWAY,
Bergen Univ. (Norway). Zoological Museum.
G. G. Raddum, and A. Fjellheim.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1973-1980, December, 1984. 5 Fig, 1 Tab, 21 Ref.

Descriptors: *Acidification, *Norway, *Invertebrates, *Bioindicators, Monitoring, Acid rain, Water quality, Water pollution effects, Lakes, Rivers, Aquatic insects, Calcium, Aluminum, Hydrogen ion concentration.

Benthic invertebrates were sampled during the ongoing monitoring of acidified rivers and other studies carried out in southern and western Norway. The water chemistry results indicate that the water was characterized by low concentrations of dissolved salts. The northern and eastern parts of South Norway have the lowest degree of acidification. In these parts pH usually ranged between 6 and 6.5 and the conductivity between 5-30 microS/cm. The acidity increased when moving further south and west. In the most acidified areas near the coast the conductivity was higher, due to contribution from sea salts, acid deposition and increased leaching of cations from the soil and bedrock. The content of calcium was generally low, <2 mg Ca/liter. Aluminium concentration was low (<5-40 micro-g/liter) in the non-acidified regions, increasing to 100-310 micro-g/liter in the most acidified parts. The pH sensitive amphipod Gammarus lacustris was found only in the watershed of Stordalen and in the most lime-rich parts of Roldal/Suldal. Lepidurus arcticus was found in a few of the uppermost lakes of the Laerdal watershed in 1970-72 and these were the only localities holding this species currently. Snails were more common but only a few species were recorded. Of the leeches Helobdella stagnalis had the widest distribution and has one time been observed in a lake with a pH range of 4.6-5.1. The number of recorded species of stoneflies from the investigated watersheds was 21. The number of species/groups of caddisflies larvae listed is 25. Only two species of mayflies were found in the most acid water. Some siphlonurids were recorded in water with pH about 5.0. Baetis was recorded in localities with Ca <0.4 mg/l and conductivity <5.0 microS/cm at pH > 6.0. (Baker-IVI)
W85-05678

IMPROVED RECOVERY OF FECAL COLIFORMS FROM THE OTTAWA RIVER BY MEMBRANE FILTERS IN THE PRESENCE OF FOOD DEBRIS,
Health and Welfare Canada, Ottawa (Ontario). Bureau of Microbial Hazards.
J. M. Farber, A. N. Sharpe, and M. Kalab.
Canadian Journal of Microbiology, Vol. 31, No. 1, p 16-18, January, 1985. 1 Fig, 2 Tab, 7 Ref.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

Descriptors: *Membrane filters, *Fecal coliforms, *Bacterial analysis, Filtration, Membrane processes, Coliforms.

In the absence of food debris, Sartorius and Millipore HA filters recovered substantially fewer fecal coliforms from Ottawa River water than did Millipore HC. On addition of a small quantity of sterile blended carrot to water samples, recovery by the poorer filters equalled than on Millipore HC. Scanning electron microscopy revealed bacteria sheltered in crevices formed by carrots fibers and thus protected from the normal stresses of exposure. Addition of carrot debris (e.g., 0.03 g carrot to 100 mL of sample) thus provides a convenient and inexpensive means of reducing variations in fecal coliform recovery between brands of membrane filters. (Author's abstract)
W85-05741

FLUX OF LEAD IN SUBMERGED PLANTS AND ITS RELEVANCE TO A FRESHWATER SYSTEM,
Westfield Coll., London (England). Dept. of Botany.
For primary bibliographic entry see Field 5B.
W85-05745

WET DEPOSITION MONITORING - EFFECT OF SAMPLING PERIOD,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
R. G. de Pena, K. C. Walker, L. Lebowitz, and J. G. Micka.
Atmospheric Environment, Vol. 19, No. 1, p 151-156, 1985. 6 Fig, 7 Tab, 2 Ref, 1 Append. NOAA and DOE contracts NA82RAC00032, NA84EAC00015(N), NA82RAC0157 and NA83RAC00087.

Descriptors: *Rainfall, *Sampling, *Wet deposition, *Acid rain, Monitoring, Ammonium, Sulfates, Nitrates, Calcium, Magnesium, Hydronium, Temperature.

A comparison between weekly and event sampling of rainfall for chemical quality has been undertaken to assess the differences in concentrations of ions introduced by different sampling periods. The data were analyzed over the period from 18 March 1981 - 28 June 1983. The weekly samples yielded lower concentrations and deposition values for all ions analyzed. The differences were significant at the 99.9% confidence level. These results cannot be explained by evaporation. The difference in the deposition depths is much lower than the difference in concentrations and in any case it would work in the opposite direction. It is suggested that some ammonia exchange takes place in the field, and that in the weekly collection there is more adsorption on the walls of the bucket. It is also suggested that the lower values obtained with the weekly collector are due to a larger biological uptake of the ions. If this is so, then the differences should be large in the summer months with higher temperatures causing an increase of biological activity. Such was the case for sulfate, ammonium and H3O(+) ions but not the case for nitrates, calcium ions and magnesium ions. (Baker-IVI)
W85-05773

GRAN'S TITRATIONS: INHERENT ERRORS IN MEASURING THE ACIDITY OF PRECIPITATION,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
W. C. Keene, and J. N. Galoway.
Atmospheric Environment, Vol. 19, No. 1, p 199-202, 1985. 2 Fig, 2 Tab, 29 Ref.

Descriptors: *Acid rain, *Sampling, *Chemistry of precipitation, *Gran's titrations, Organic compounds, Ammonia, Acidity.

Results calculated from the Gran's titration of a precipitation sample are presented and compared with the major organic and inorganic chemical constituents of the sample. These results show that the chemistry of the sample was inconsistent with acidities calculated by Gran's technique. Gran's original technique has limited applicability in the differentiation of strong and weak acidity in precipitation samples containing weak organic acids. High ammonia ion concentrations also interfere with the calculation of total acidity. Although derivation and segmented linearization techniques may work well in simple solutions, they have limitations in the analysis of precipitation containing complex mixtures of unidentified strong and weak acids. Therefore, in the absence of complete chemical characterization, data generated by Gran's technique, and related modifications, should be evaluated with caution and an appreciation of potential limitations. Ranges of errors in calculating strong acidity using Gran's method are evaluated for precipitation collected at several sites around the world. (Baker-IVI)
W85-05774

ASSESSMENT OF BACTEROIDES FRAGILIS GROUP ORGANISMS AS INDICATORS OF HUMAN FAECAL POLLUTION,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5B.
W85-05808

ROLE OF IMMUNOASSAY IN THE ANALYSIS OF MICROCONTAMINANTS IN WATER SAMPLES,
Surrey Univ., Guildford (England). Dept. of Biochemistry.
G. W. Aherne, J. English, and V. Marks.
Ecotoxicology and Environmental Safety, Vol. 9, No. 1, p 79-83, February, 1985. 2 Tab, 11 Ref.

Descriptors: *Bioassays, *Water pollution effects, *Immunoassays, *Fate of pollutants, Steroids, Methotrexate, Water supply, Pollutant identification, Water pollution sources.

Concentrations of natural and synthetic steroids and an anticancer drug (methotrexate) have been determined in water by adapting established immunoassay procedures. The limits of detection for the assays used were 10 ng/liter for norethisterone, 5 ng/liter for ethinyl estradiol and progesterone, and 6.25 ng/liter for methotrexate. Results below the level of detection were obtained in all the samples examined (8 river samples and 6 potable supply samples) except for 2 river samples (17 ng/liter) for norethisterone, and 1 river sample and 1 potable water sample for progesterone (6 ng/liter). A concentration of 1 micro g/liter of methotrexate was found in a sample of hospital effluent. There appears to be no evidence of adverse effects from reused water resources which may be contaminated from the normal use of such highly active therapeutic agents. (Author's abstract)
W85-05811

EFFECTS OF VARIOUS ORGANIC CHEMICALS ON THE REGREENING OF RED COLORED CHLORELLA ZOFINGIENSIS,
Hamburg Univ. (Germany, F.R.). Inst. fuer Allgemeine Botanik.
U. Irmer, K. Heuer, and A. Weber.
Ecotoxicology and Environmental Safety, Vol. 9, No. 1, p 121-133, February, 1985. 5 Fig, 1 Tab, 34 Ref.

Descriptors: *Toxicity, *Bioassays, *Chlorella, *Plant physiology, *Water pollution effects, Organic compounds, Algae, Chlorophyll, Paraquat, Pentachlorophenol, Salt.

Under nitrogen-deficient culture conditions Chlorella zofingiensis decomposes the chlorophylls, synthesizes secondary carotenoids, and thus develops red colored resting stages (akinetes). On transfer of the akinetes into nitrogen-containing fresh culture medium the algae regreen completely within a short period. The regreening process reacts with high sensitivity to the addition of environmentally hazardous chemicals. This system proved to be much more sensitive than other methods of testing for ecotoxicity. This screening test is universally applicable and offers, in addition, the possibility of testing volatile compounds since it is carried out in air-tight culture vessels. A phytotoxicity of 50% calculated as inhibition of the chlorophyll biosynthesis during exposure for 48 hr was found for paraquat at concentrations of 0.15 micro M (added as methysulfate) and 0.28 micro M (added as chloride) and for pentachlorophenol (PCP) at 0.16 micro M. The chemicals 2- and 4-nitrophenol, however, proved to be much less toxic. Here, a 50% inhibition of chlorophyll biosynthesis was observed at 49 and 75 micro M. When exposed to 4-chloroaniline even concentrations of 200 micro M were not sufficient to cause 50% inhibition of the regreening process. In additional experiments the influence of increasing salt concentrations (NaCl stress) and simultaneous exposure to the toxicants was examined. A step-by-step increase in the salinity of the experiment medium resulted in a drastic reduction of the toxicity caused by the addition of paraquat. This effect was much less pronounced when PCP was employed as toxicant. A different result was obtained with 2-nitrophenol: Here the toxic action was slightly enhanced. Differences in the time-dependent toxic response were also observed using the diverse toxicants. Probable causes are discussed. (Author's abstract)
W85-05814

5B. Sources Of Pollution

ELECTROCHEMICAL DETERMINATION AND CHARACTERIZATION OF SURFACTIVE SUBSTANCES IN FRESHWATERS,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 2H.
W85-04972

NUMERICAL ESTUARINE FLOW MODEL,
Tulsa Univ., OK. Coll. of Engineering and Physical Sciences.
For primary bibliographic entry see Field 2L.
W85-04987

NUMERICAL MODEL OF POLLUTION TRANSPORT IN ESTUARIES,
Tulsa Univ., OK. Coll. of Engineering and Physical Sciences.
F. S. Henry, R. C. Ahlert, R. L. Peskin, and R. Vichnevetsky.
Water Resources Bulletin, Vol. 20, No. 6, p 833-839, December, 1984. 7 Fig, 16 Ref. Office of Water Research and Technology project A-04-NJ.

Descriptors: *Pollution transport, *Path of pollutants, *Estuaries, *Numerical models, *Delaware Estuary, *Pennsylvania, *New Jersey, *Delaware, Model studies, Dye releases.

Theoretical study of transport in estuaries is made difficult by the unsteady, turbulent nature of estuarine flow. A novel numerical model was developed that simulates the transport of a conservative, neutrally bouyant, dispersed pollutant in a well-mixed estuary. The model provides some two-dimensional features of pollution transport while using an essentially one-dimensional approach. The estuary's cross-section is divided into three channels running side-by-side; It is assumed that the transport of pollution in each channel can be modeled as a one-dimensional problem. The model was tested against data taken from a dye study conducted in the Delaware Estuary (Pennsylvania, New Jersey, Delaware) by the United States Environmental Protection Agency. The model was able to predict both lateral and downstream concentration profiles, and matched field data with reasonable accuracy. The model also matched an analytic solution for the transport of a contaminant in an estuary of constant cross-sectional area. (Collier-IVI)
W85-04988

SIMULATION OF HERBICIDE CONCENTRATIONS IN STORMFLOW FROM FORESTED WATERSHEDS.
Georgia Univ., Athens. School of Forest Resources.

rimary bibliographic entry see Field 2A.
04991

TRIBUTION OF PRECIPITATION TO
LITY OF URBAN STORM RUNOFF,
neastern Forest Experiment Station, Broo-
PA.
Halverson, D. R. DeWalle, and W. E.
e.
r Resources Bulletin, Vol. 20, No. 6, p 859-
December, 1984. 5 Tab, 16 Ref.

riptors: *Water quality, *Urban runoff,
m runoff, Nitrogen, Sulfate, Phosphorus, Po-
m, Calcium, Hydrogen ion concentration, At-
heric deposition, Source of pollutants.

pitation and runoff samples were collected for
orms in a nonindustrial urban area in Central
sylvania between July 1980 and June 1981.
ff was collected from tree surfaces, a residen-
oof and street, a shopping mall parking lot, a
town business district alley, and a heavily
led street. Analysis of the water samples
ed 10 to 25 percent of the nitrogen, 25 per-
of the sulfate, and less than 5 percent of the
horus, potassium, and calcium in water
v a tree was deposited by the precipitation.
residential roof caused insignificant changes in
r chemistry. The results for the four paved
showed that all the nitrogen, and from 16 to
rcent of the sulfate and 13, 4, and 2 percent of
hosphorus, potassium, and calcium, respec-
, in runoff was deposited by the precipitation.
pitation can also be an important source of
e and phosphorus in runoff. All of the sur-
raised the pH of the runoff, with the largest
ases, from a pH of 4 to about 7, occurring in
f from the paved areas. Precipitation and
f chemistry was not related to antecedent
itions such as the length of the preceding dry
d. (Author's abstract)
-04992

NTIFICATION OF ASBESTOS AND GLASS
ERS IN MUNICIPAL SEWAGE SLUDGES,
esota Dept. of Health, Minneapolis.
rimary bibliographic entry see Field 5A.
-05008

IPETITION OF FATE PROCESSES IN
BIOCONCENTRATION OF LINDANE,
rta Environmental Centre, Vegreville.
amamoorthy.
tin of Environmental Contamination and
cology, Vol. 34, No. 3, p 349-358, March,
2 Fig, 4 Tab, 21 Ref.

riptors: *Fate of pollutants, *Bioconcentra-
*Lindane, Organic compounds, Pesticides, In-
cides, Toxicity.

role of sorption by natural and synthetic mate-
as well as volatilization on the residence time
concentration of lindane in water was investi-
d. The values of partition coefficients, biocon-
ration factor, volatilization rate constant and
half-life for volatilizational loss from water
predicted and compared with literature
es. All of the water quality parameters except
ls and pH increased over the experimental
od, possibly from the sediments reaching an
ibrium with the recycling river water. Fertil-
eggs accumulated lindane in significant
unts and similar levels are found in sac fry
sed to very low concentrations. Sorption of
ne to sediment as well as to the surfaces of the
s of the exposure chamber was investigated.
duplicated tests show almost 30 times greater
tion by plexi-glass container than glass surface
10 day period. Theoretical BCF values, using
ne solubility data are calculated to be higher
the experimental value by 1000 fold. The
ulated Henry's law constant of 0.202 indicated
dominance of the liquid phase resistance to
ne and thereby favors partitioning of lindane
e vapor phase. The calculated values for vola-
tional rate constant and half-life for volatiliza-
al loss from water are in reasonable agreement
the literature values, considering the widely ranging vapor pressure and aqueous solubility values for lindane reported in the literature. (Baker-IVI)
W85-05011

IDENTIFICATION AND DETERMINATION OF SOME TRACE ORGANIC COMPOUNDS IN COASTAL SEAWATER OF NORTHERN GREECE,
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
K. Fytianos, G. Vasilikiotis, and L. Weil.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 3, p 390-395, March, 1985. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Organic compounds, *Water pollution sources, *Coastal waters, *Greece, Thessaloniki, Kavala, Gulfs, Oil spills, Chlorinated hydrocarbons, Pesticides, Aromatic compounds, Polychlorinated biphenyls, Marine environment.

A combination of gas chromatography - mass spectroscopy was used to identify and determine traces of organic compounds in coastal seawater samples taken from two gulfs with increased marine pollution. These gulfs were Thermaikos and Kavala, which are located in Northern Greece. The former is situated near the large city of Thesssaloniki which has a large industrial area including a refinery unit. The latter is close to a smaller city, Kavala, which is rapidly developing due to off shore oil wells. Lindane, p,p'-DDT, dieldrin and polychlorinated biphenyls were found in trace amounts. The concentration of the organochlorine compounds was higher in the harbor areas of Thessaloniki and Kavala. Polycyclic aromatic hydrocarbons were found in both unpolluted and polluted areas of the two gulfs. Some organic compounds were identified existed at a concentration range of ng/L, which is still comparatively low. However, particularly high concentrations were observed in highly industrialized regions and near the off-shore oil platform, where there is always the possibility of marine pollution, due to oil discharge. (Baker-IVI)
W85-05016

VERTICAL DISTRIBUTION OF AL, CU, FE AND ZN IN THE SOIL SALT MARSHES OF THE SADO ESTUARY, PORTUGAL,
Universidade Nova de Lisboa (Portugal). Dept. of Chemistry and Biotechnics.
F. H. S. Reboredo, and C. A. G. Ribeiro.
International Journal of Environmental Studies, Vol. 23, No. 3/4, p 249-253, October, 1984. 4 Tab, 18 Ref.

Descriptors: *Vertical distribution, *Heavy metals, *Salt marshes, *Sado Estuary, *Portugal, Fate of pollutants, Aluminum, Copper, Iron, Zinc.

Marsh soil analysis is important as a rapid evaluation factor of the pollution statur of an area. The accumulation of Al, Cu, Fe and Zn was studied in the soil cores of the coastal areas of the Sado estuary, using an acid digestion procedure and an EDTA extraction to detect the total metal content and the metal fraction easily removed, respectively. The lowest values for each metal were always observed at Station 1 which was very close to the Atlantic Ocean. Mean values observed at the other Stations (about 8.0 and 20.0 km upstream) were similar. The dilution effect at 1 is more pronounced due to the nature of the soil marsh. The dominant component at the first sampling point is the sandy fraction with about 72.5% of the total, while at the other stations the silt-clay fraction is about 85%. For Al the third core (10-15 cm deep) always presented the highest value in spite of the percentage of the silt-clay in each core remaining about constant. For Al and Fe the recovery values were similar at all sampling points, in spite of the different nature of the matrix. For Cu and Zn, the recovery values were generally lower at Station 1 and similar at the other stations. For Cu it seems unlikely that this element will be easily released from the organic matter by EDTA, since the extraction of this fraction from the matrix with strong oxidant agents and later analysis indicate that it was responsible for 40% of the total value. (Baker-IVI)
W85-05032

METALS AND CHLORINATED HYDROCARBONS IN SURFICIAL SEDIMENTS OF THREE NILE DELTA LAKES, EGYPT,
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 6G.
W85-05037

RELATIONSHIP OF A COAL FIRED POWER PLANT TO THE LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN THE SEDIMENT OF CAYUGA LAKE,
Department of Energy, New York. Environmental Measurements Lab.
M. Heit.
Water, Air, and Soil Pollution, Vol. 24, No. 1, p 41-61, 1985. 1 Fig, 4 Tab, 45 Ref.

Descriptors: *Powerplants, *Cayuga Lake, *New York, *Lake sediments, *Polycyclic aromatic hydrocarbons, Organic compounds, Aromatic compounds, Hydrocarbons, Water pollution sources, Wind, Coal-fired powerplants.

The relationship between a coal-fired power station to the distribution of polycyclic aromatic hydrocarbons (PAH) and related organic compounds in the sediment of Cayuga Lake, situated in the rural Finger Lakes region of New York State, is presented. Cayuga lake is 61.4 km long with a maximum width of 5.6 km and depth of 133 m. The lake was formed by glacial action and is located in a north-south oriented basin that becomes progressively steeper towards the south, resulting in a shift in the prevailing winds to movement along the axis of the lake so that emissions from the plant would be expected to pass over most of Cayuga Lake. Currents appear to be slight. The Milliken Station is a coal-fired electric generation station located about 21 km northwest of Ithaca, New York, on the east bank of Cayuga Lake. Other than for a small confined area near the stacks, the Milliken coal fired station had no discernible effect on the PAH levels in the sediment of Cayuga Lake. PAH emissions from the stacks are either very low and masked by other sources, or are atmospherically transported and deposited elsewhere. Except in the confined area near the Milliken stacks, the highest PAH concentrations measured were found in sediment taken in urban Ithaca and in various marinas along Cayuga Lake. Region wide atmospheric deposition appears to be the prime source of PAH entering the Lake, except in some areas where runoff appears to be a more important mechanism. The powerful PAH carcinogens 3-methylchloranthrene and 7,12-dimethylbenzanthracene were not detected in any samples and are thought not to be environmental hazards. No nitrogen heterocyclic PAHs were found in any of the samples. Although marinas, urbanized areas, and the Milliken powerplant all had elevated PAH levels in close proximity to them, it appears that their impacts are limited and localized. In all cases, a rapid falloff in PAH concentrations with distance from source, <100 m, was found to occur. This is in marked contrast to the uniform PAH levels found over most of the course of Cayuga Lake which reflect a region-wide pattern of deposition. (Baker-IVI)
W85-05038

SULFATE IN LAKES OF EASTERN CANADA; CALCULATED YIELDS COMPARED WITH MEASURED WET AND DRY DEPOSITION,
National Water Research Inst., Burlington (Ontario). Aquatic Physics and Systems Div.
M. E. Thompson, and M. B. Hutton.
Water, Air, and Soil Pollution, Vol. 24, No. 1, p 77-83, January, 1985. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Sulfates, *Lakes, *Atmospheric deposition, *Canada, *Acid rain, Runoff, Water pollution sources, Air pollution, Fallout.

Sulfate yields in eastern Canada, calculated as lake concentration times runoff, are presented on an

approximately west to east axis, and are compared with wet deposition data from CANSAP (Canadian Network for Sampling Precipitation) and APN (Air Pollution Network) data on dry deposition. This comparison was begun with an awareness of many possible sources of error some of which include analytical problems in measuring sulfate at low concentrations; possible terrestrial sources of sulfates; possible retention or transformation of sulfate in the watershed or in lake sediments; errors in applying regional runoff data to lakes of unknown hydrology; and variations in sample dates and sampling frequencies. For wet deposition uncertainties arise from analysis of sulfate, undercatch, evaporation, the need to interpolate between stations, and local influences on precipitation chemistry. For dry deposition the same difficulties exist with the additional problem of estimating deposition velocities. In southern Ontario and southwestern Quebec there was excellent agreement between sulfate yields and wet plus dry deposition taking the dry deposition data for Chalk River as representative. In the more remote areas, where dry deposition is less important, the agreement is also good, and this overall good agreement tends to validate both data sets. A very high sulfate yield was obtained for Lac Laflamme which may be due to its elevation. The good agreement between sulfate yields and total deposition data indicates that there is little retention of sulfate within the watersheds or in the lakes, and that most, if not all, of the sulfate in the lakes can be ascribed to atmospheric deposition. The results demonstrate the magnitude of the problem of long range transport of air pollutants and the stress that acid deposition imposes on the surface waters of eastern Canada. (Baker-IVI)
W85-05039

INTERACTIONS OF COPPER AND LEAD WITH NOSTOC MUSCORUM,
Syracuse Univ., NY. Dept. of Civil Engineering.
W. D. Schecher, and C. T. Driscoll.
Water, Air, and Soil Pollution, Vol. 24, No. 1, p 85-101, January, 1985. 1 Fig, 10 Tab, 28 Ref.

Descriptors: *Copper, *Lead, *Algae, *Fate of pollutants, *Nostoc, Accumulation, Thermodynamics, Hydrogen ion concentration, Calcium, Sulfates, Citrates, Adsorption, Bioconcentration.

The effects of variations in solution chemistry on Cu and Pb uptake by suspensions of the blue-green alga Nostoc muscorum were investigated. The thermodynamic model that was used provided a qualitative description of algal-metal interactions. In addition to the limitations that are intrinsic to all equilibrium models, the general applicability of the calculations is restricted by limited characterization of surface sites, inabilities to account for intracellular uptake of metals, and a lack of understanding of the role of extracellular exudates in algal-metal interactions. Although these interactions are complicated and dynamic, they appear to be influenced by the same thermodynamic properties that affect particles in solution. Although exceedingly simplistic, thermodynamic calculations enable us to assess the effects of pH, surface characterization, and the nature and concentration of complexing ions in solution on algal-metal interactions. The effects of pH on the uptake of Cu and Pb by N. muscorum were similar to results reported by other studies and were in basic agreement with cationic adsorption models. The release of organic exudated into solution and the presence of a mucilagenous sheath material appeared to be an important factor in regulating the distribution of the metals, and were thought to be responsible for some of the deviation between model and observed results. Calcium had a mitigating effect on metal uptake, which was thought to be due to competitive reactions between Ca and the metals for active surface sites. The presence of sulfate reduced Cu uptake by N. muscorum at pH values less than 5.6 which correlated with the theoretical formation of CuSO4 complex; and citrate decreased metal uptake by N. muscorum of both Cu and Pb, and the observed decrease was in basic agreement with model predictions. (Baker-IVI)
W85-05040

INFLUENCE OF NTA ON THE REMOBILIZATION OF METALS FROM LAKE AND RIVER SEDIMENTS (DER EINFLUSS VON NTA AUF DIE METALLRUCKLOSUNG AUS GEWASSERSEDIMENTEN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergutewirtschaft und Abfalltechnik.
M. Stein, and R. Wagner.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, p 252-262, 1984. 7 Fig, 7 Tab, 38 Ref.

Descriptors: *Nitrilotriacetic acid, *Metals, *Lake sediments, *River sediments, *Neckar River, *Lake Constance, *Germany (Federal Republic), Sediments, Aluminum, Calcium, Chromium, Lithium, Magnesium, Manganese, Lead, Iron, Phosphorus, Potassium, Barium, Nickel, Copper, Cobalt, Cadmium, Hydrogen ion concentration.

The particle-size fraction < 200 micro m of seven sediments originating from Lake Constance and the Neckar River were eluted up to eleven times at pH-values of 6, 7,5 and 9 using NTA-concentrations of 0, 0.3, 1, 3 and 10 mg/l H3NTA. The concentrations of 17 elements were determined by ICP/AES-spectrometry in all solutions. The elements examined do not behave the same in all sediments. This suggests that different species are present and that remobilization is a function of these. The slopes of the isotherms of remobilization, normalized to the specific amount of element contained in each sediment, show different behaviors, which give rise to the establishment of three groups of: 1) Elements which are not affected by NTA under the experimental conditions involved. These are aluminum, calcium, chromium, lithium and magnesium. 2) Elements which are slightly affected by NTA. These are manganese, lead and iron. Phosphorus is indirectly solubilized. In one sediment potassium and barium were slightly and presumably indirectly influenced by NTA. 3) Elements which are strongly remobilized by NTA. This group consists of nickel (at all pH-values), copper and cobalt (preferentially at pH 7.5, the least at pH 9), zinc (strongly affected at pH 7.5) and cadmium (strongly remobilized at pH 7.5, to a lesser extent at pH 9, not at pH 6). (Author's abstract)
W85-05043

LEGIONELLA ANISA: A NEW SPECIES OF LEGIONELLA ISOLATED FROM POTABLE WATERS AND A COOLING TOWER,
Center for Infectious Diseases, Atlanta, GA. Div. of Bacterial Diseases.
G. W. Gorman, J. C. Feeley, A. Steigerwalt, P. H. Edelstein, and C. W. Moss.
Applied and Environmental Microbiology, Vol. 49, No. 2, p 305-309, February, 1985. 4 Tab, 24 Ref.

Descriptors: *Legionella, *Bacteria, *Drinking water, Public health, Bacterial physiology, Water pollution sources.

Between March 1980 and June 1981, five strains of Legionella-like organisms were isolated from water. Four were recovered from potable water collected from hospitals in Chicago, Ill., and Los Angeles, Calif., during outbreaks of nosocomial legionellosis. The fifth strain was isolated from water collected from an industrial cooling tower in Jamestown, N.Y. The strains exhibited biochemical reactions typical of Legionella species and were gram-negative motile rods which grew on buffered charcoal-yeast extract agar but not on blood agar, required cysteine, and were catalase positive, urease negative, nitrate negative, hippurate negative, and nonfermentative. All strains were positive for oxidase and beta-lactamase and produced a brown, diffusible pigment. Of the five strains, four exhibited blue-white autofluorescence under long-wavelength UV light. The fatty-acid composition and ubiquinone content of these strains were consistent with those of other Legionella species. Direct fluorescent-antibody examination of the five strains with conjugates to previously described Legionella species demonstrated no cross-reactions except with the conjugates to L. longbeachae serogroup 2 and L. bozemanii serogroup 2. Four strains gave a 4+ reaction to the L. longbeachae serogroup 2 conjugate and the fifth strain gave a 1+ reaction. Each of the five strains gave a 4+ reaction with conjugate to L. bozemanii serogr 2. DNAs from the five strains were highly rel (84 to 99%) and showed 5 to 57% relatedne other Legionella species. These strains constitu new species in the genus Legionella, and the n Legionella anisa sp. nov. is proposed. The strain of L. anisa is WA-316-C3 (ATCC 352 (Author's abstract)
W85-05046

INFLUENCE OF EASILY DEGRADABLE N URALLY OCCURRING CARBON S STRATES ON BIODEGRADATION OF MO SUBSTITUTED PHENOLS BY AQUATIC B TERIA,
North Carolina Univ. at Chapel Hill. Dept Environmental Sciences and Engineering.
R. J. Shimp, and F. K. Pfaender.
Applied and Environmental Microbiology, 49, No. 2, February, 1985. 4 Fig, 6 Tab, 29

Descriptors: *Biodegradation, *Phenols, *Bact *Fate of pollutants, Cresol, Aminophenol, Cl phenol, Napthalene.

The influence of readily degradable, naturally curring carbon substrates on the biodegradatio several monosubstituted phenols (m-cresol, aminophenol, p-chlorophenol) was examined. natural substrate classes used were amino a carbohydrates, and fatty acids. Samples of the crobial community from Lake Michie, a meso phic reservoir, were adapted to different leve representatives from each natural substrate cla chemostats. After an extended adaptation pe the ability of the microbial community to deg the monosubstituted phenols was determined using a radiolabeled substrate uptake and min ization method. Several microbiological chara istics of the communities were also measured. aptation to increasing concentrations of a acids, carbohydrates, or fatty acids enhanced ability of the microbial community to degrad three phenols. The stimulation was largest fo cresol and m-aminophenol. The mechanism sponsible for the enhancement of monosubstit phenol metabolism was not clearly identified, the observation that adaptation to amino acids increased the biodegradation of glucose and, lesser extent, naphthalene suggests a general st lation of microbial metabolism. This study de strates that prior exposure to labile, natural strates can significantly enhance the abilit aquatic microbial communities to respond to x biotics. (Author's abstract)
W85-05050

INFLUENCE OF NATURALLY OCCURR HUMIC ACIDS ON BIODEGRADATION MONOSUBSTITUTED PHENOLS BY AQU IC BACTERIA,
North Carolina Univ. at Chapel Hill. Dep Environmental Sciences and Engineering.
R. Shimp, and F. K. Pfaender.
Applied and Environmental Microbiology, 49, No. 2, p 402-407, February, 1985. 5 Fig, 1 21 Ref.

Descriptors: *Phenols, *Bacteria, *Humic a *Biodegradation, Degradation, Fate of pollut Cresol, Aminophenol, Chlorophenol, North C lina.

Samples of the microbial community from Michie, a mesotrophic reservoir in central N Carolina, were adapted to various levels (10 1,000 micro g/liter) of natural humic acids in mostats. The humic acids were extracted water samples from Black Lake, a highly col lake in the coastal plain of North Carolina. adaptation, the microbial community was t for its ability to degrade the monosubstituted p ols m-cresol, m-aminophenol, and p-chloroph Adaptation to increasing levels of humic significantly reduced the ability of the micr communities to degrade all three phenols. decline in biodegradation was accompanied decrease in the number of specific compound graders in the adapted communities. Short- exposure of the community to increasing leve

umic acids had no significant effect on the ability f the community to degrade m-cresol. Thus the ippressive effect of humic acids, on monosubsti-ited phenol metabolism was the result of long-rm exposure to the humic materials. Increasing ie levels of inorganic nutrients fed to the chemos-ts during the humic acid adaptation had little ffect on the suppressive influence of the humic ids, indicating that nutrient limitation was prob-ly not responsible for the metabolic suppression. he results of the study suggest that long-term xposure to humic acids can reduce the ability of icrobial communities to respond to monosubsti-ited phenols. (Author's abstract)
/85-05051

RACE METALS IN THE COLUMBIA RIVER STUARY FOLLOWING THE 18 MAY 1980 RUPTION OF MOUNT ST. HELENS,
regon State Univ., Corvallis. School of Oceanog-phy.
. F. Riedel, S. L. Wilson, and R. L. Holton.
acific Science, Vol. 38, No. 4, p 340-349, Octo-er, 1984. 4 Fig, 5 Tab, 26 Ref.

escriptors: *Columbia River Estuary, *Estuaries, Mount St. Helens, *Trace metals, Water pollution ources, Path of pollutants, Copper, Iron, Manga-ese, Nickel, Lead, Zinc, Metals.

issolved and suspended concentrations of cadmi-n, copper, iron, manganese, nickel, lead, and zinc ere measured in the Columbia River Estuary llowing the 18 May 1980 eruption of Mount St. elens. Soluble concentrations of these trace ele-ents were not substantially elevated by the influx f volcanic ash and mud into the estuary during is period, except for somewhat higher than usual oncentrations of manganese and copper. A labo-atory experiment indicates that manganese ached from volcanic debris in fresh water and in ie transition from fresh to slightly saline water robably caused the elevated Mn concentrations. opper in solution may also have been enhanced ightly by leaching from the material into fresh ater. (Author's abstract)
/85-05056

CIDITY PROBLEMS CAUSED BY FLOOD ONTROL WORKS OF THE RIVER KYRON-OKI,
. Alasaarela.
esientutkimuslaitoksen Julkaisuja, Vol. 49, p 3-16, 982. 10 Fig, 2 Tab, 21 Ref.

escriptors: *Sulfates, *Acidity, *Flood control, Environmental impact, *Kyronjoki River, *Fin-nd, Regulated flow, Path of pollutants.

ulfates leaching from the bed of the former Litor-a Sea have resulted in acidity problems in the ver Kyronjoki (Finland). Calculations based on ie change in sulfate concentration of the river ater indicated that the waters draining from the itorina basin contain 40-60 times the amount of lfate contained in the waters of the higher aches of the river. The acidity of the river water orrelated highly significantly with the degree of ilution of the sulfate runoff. The correlation of cidity with the amount of sulfates in the waters raining form the Litorina basin was considerably eaker. The sulfate concentration in these waters so high that the increased leaching caused by, g., drainage projects does not correspondingly crease the acidity problems. Considerably more nportant is the proportion in which the high-lfate concentration waters are mixed with the ainstream flow. The periodical pumping of high-lfate waters in conjunction with planned em-ankment works may cause harmful acid waves in he river Kyronjoki. Such situations could be pre-ented by suitable flow regulation. (Author's ab-tract)
/85-05060

ESTING THE APPLICABILITY OF THE REAMS MODEL TO ESTIMATION OF AGRI-CULTURAL NUTRIENT LOSSES IN FINLAND,
For primary bibliographic entry see Field 2E.
/85-05062

IDENTIFICATION OF CRITICAL AREAS ON FOREST LANDS FOR CONTROL OF NON-POINT SOURCES OF POLLUTION,
East-West Environment and Policy Inst., Honolulu, HI.
For primary bibliographic entry see Field 2J.
W85-05068

PROSPECTS OF ACID RAIN OVER INDIA,
Meteorological Office, Poona (India).
K. Nand.
Mausam, Vol, 35, No. 2, p 225-232, April, 1984. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Acid rain, *India, *Acid deposition, *Hydrogen ion concentration, *Bombay, *Agra, Air pollution, Sulfur dioxide, Spatial distribution, Source of pollutants, Chemistry of precipitation.

Rainfall pH data of monthly samples collected from 10 Background Air Pollution Monitoring Network stations in India along with the other published data regarding precipitation chemistry and air pollution from different parts of India, as well as from other parts of the world, have been studied for assessing the prospects of acid rain over India. Rainfall pH values over unpolluted areas in India may be between 6 and 7 and lowering of pH to acidic values (less than 5.6) might be restricted to areas close to highly industrialized cities only, such as Bombay (pH 4.5); the phenomenon of acid rain may not be of regional nature. The main reason for the above is acid-base neutralization reactions in the presence of basic particulate matter. Due to high levels of suspended particulate matter over Agra, of which a good fraction is expected to be of a coarse mode, pH of rainwater over Agra is not expected to be in the acidic range. It may also not change to acidic values after the commissioning of Mathura Refinery, since the expected increase in concentration of gaseous pollutants at Agra (especially SO2) is not large. (Collier-IVI)
W85-05100

CHEMICAL COMPOSITION OF RAIN WATER WITH SPECIAL REFERENCE TO HEAVY METALS OVER LUCKNOW, UTTAR PRADESH IN 1981,
Central Ground Water Board, Lucknow (India).
Central Chemical Lab.
For primary bibliographic entry see Field 2K.
W85-05101

DOSE EQUIVALENT COMMITMENTS FROM FALLOUT RADIONUCLIDES IN THE OPEN WATERS OF THE GREAT LAKES, 1973-1981,
Canada Centre for Inland Waters, Burlington (Ontario).
R. W. Durham, and S. R. Joshi.
Environmental Monitoring and Assessment, Vol. 4, No. 4, p 405-417, December, 1984. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Great Lakes, *Radionuclides, *Fallout, *Precipitation, Radioactivity, Radioactive wastes, Water quality, Lakes, Nuclear powerplants, Strontium radioisotopes, Cesium radioisotopes, Cerium radioisotopes, Antimony radioisotopes.

The water quality of the Great Lakes with respect to radioactivity is of concern since it is one source of the radiation dose received by the population of the Great Lakes Basin. The major contribution to radioactivity levels of the lake waters has come from fallout resulting from nuclear weapons testing in the atmosphere. The emergence of a nuclear power generation industry along the Great Lakes shoreline during the last two decades has created a potential problem from radioactive contamination. Aqueous wastes from this industry are discharged directly to the Great Lakes with the cooling water while some radionuclides discharged to the atmosphere are carried to the lake through precipitation scavenging. The levels of Ce-144, Cs-137, Sb-125, and Sr-90 were found to be very low over the period 1973 through 1981. Only up to 1975 was any Ce-144 detected, after which it dropped below the detection limit. Concentrations of the other three radionuclides decreased with time. Sr-90 and Cs-137 provide essentially all of the radiological dose from drinking Great Lakes water. The doses equivalent committments have been calculated from these measurements and found to be well within the Great Lakes Water Quality Agreement's water quality objective for radioactivity. (Baker-IVI)
W85-05103

PERSISTENCE AND FATE OF POLYNUCLEAR AROMATIC HYDROCARBONS DEPOSITED ON SLASH BURN SITES IN THE CASCADE MOUNTAINS AND COAST RANGE OF OREGON,
Oregon State Univ., Corvallis. Dept. of General Science.
T. J. Sullivan, and M. C. Mix.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 2, p 187-192, March, 1985. 2 Fig, 7 Tab, 22 Ref.

Descriptors: *Persistence, *Fate of pollutants, *Polynuclear aromatic hydrocarbons, *Slash burn, *Coast Range, *Cascade Mountains, *Oregon, Litter, Hydrocarbons, Aromatic compounds, Stream pollution.

Polynuclear aromatic hydrocarbons (PNAH) comprise a diverse group of nonpolar, lipophilic compounds produced during incomplete combustion processes. PNAH persistence over time on slash burn areas and the movement of these chemicals from charred litter into soil and an adjacent stream were investigated at sites in the Cascade Mountains and the Coast Range of Oregon. Phenanthrene and fluoranthene were gradually lost from the litter, reaching concentrations below detection limits less than two years after burning. Higher molecular weight polynuclear aromatic hydrocarbons were more persistent in the litter, decreasing after five years to about 19-23% of initial deposition. Movement into the top 2 cm of soil profile was more pronounced for the lower molecular weight PNAH, but all compounds appeared to equilibrate between litter and soil on the basis of organic content within one year after burning. Differential persistence and fate of PNAH in slash burn sites is explained by physical chemical characteristics of the compounds, such as solubility, vapor pressure, and octanol-water partition coefficient. The 5-7 ring compounds exhibit greater sorption by soil and litter organic matter as reflected by their higher octanol/water partition coefficients. Evaporation loss and leaching are less significant due to lower vapor pressure and water solubility. (Baker-IVI)
W85-05109

NATIONAL PESTICIDES MONITORING PROGRAM: RESIDUES OF ORGANOCHLORINE CHEMICALS IN FRESHWATER FISH, 1980-1981,
Columbia National Fisheries Research Lab., MO.
C. J. Schmitt, J. L. Zajicek, and M. A. Ribick.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 2, p 225-260, March, 1985. 6 Fig, 10 Tab, 88 Ref.

Descriptors: *Organochlorine compounds, *Persistence, *Fish, *Pesticides, Monitoring, Mirex, Pentachloroanisole, Benzene hexachloride, Endrin, Heptachor, Heachlorobenzene, Dacthal, Methoxychlor, Water analysis.

Results for organochorine chemical residues in freshwater fish collected in 1980 and 1981 are presented and compared with earlier findings. Concentrations of some of the most persistent organochlorine compounds were lower in 1980-1981 than at any time since the early 1970s. Average concentrations of DDT, polychlorinated biphenyls, and dieldrin declined significantly from 1976-1977 to 1980-1981, especially at the sampling stations where concentrations were the highest. Toxaphene levels at some sites in the South and the Great Lakes also declined somewhat since 1978-79, probably as a consequence of this insecticide's rapidly falling popularity for use on cotton. Despite declining concentrations, residues of many persist-

ent pesticides were still high enough in 1980-1981 to constitute a threat to fish and wildlife, as recently documented episodes of wildlife mortality have demonstrated. (Baker-IVI)
W85-05111

DETAILED MODEL FOR THE MOBILITY OF ARSENIC IN LACUSTRINE SEDIMENTS BASED ON MEASUREMENTS IN LAKE OHAKURI,
Auckland Univ. (New Zealand). Dept. of Chemistry.
J. Aggett, and G. A. O'Brien.
Environmental Science and Technology, Vol. 19, No. 3, p 231-238, 1985. 13 Fig, 4 Tab, 15 Ref.

Descriptors: *Arsenic, *Fate of pollutants, *Lake Ohakuri, *New Zealand, *Lake sediments, Lakes, Sediments, Industrial wastes, Hydroelectric plants, Seasonal variation, Stratification, Geothermal resources.

Lake Ohakuri is one of eight hydroelectric lakes on the Waikato River, New Zealand. The river passes through several active geothermal areas, and effluents from geothermal sources in these areas contain significant amounts of arsenic, the most important single source being the Wairakei power station. The mobility of arsenic in sediments in Lake Ohakuri has been monitored between 1980 and 1982 and the release of arsenic to the overlying water related to seasonal changes in both lake water and sediment. Despite the presence of considerable amounts of organic matter in these sediments, the arsenic cycle appears to be dominated by inorganic chemical processes. Arsenic(III), reputedly the more toxic form of inorganic arsenic, is present in the interstitial water, but provided the surficial layer of the sediment remains oxic, it is largely contained in the sediment system through adsorption on hydroxyiron(III) species near the sediment surface. The extent to which both arsenic(V) and arsenic(III) enter the lake water is largely dependent on the length of the stratification period. Although the redox potential of the lake water and river system generally favors the formation of arsenic(V), the current lack of knowledge of the rate of oxidation of arsenic(III) in natural waters prevents a meaningful assessment of the fate of the arsenic(III) released to the lake. (Baker-IVI)
W85-05117

THERMODYNAMICS OF THE HYDROGEN PEROXIDE-WATER SYSTEM,
Texas Tech Univ., Lubbock. Dept. of Chemistry.
H. Hwang, and P. K. Dasgupta.
Environmental Science and Technology, Vol. 19, No. 3, p 225-258, March, 1985. 4 Fig, 29 Ref.

Descriptors: *Hydrogen peroxide, *Sulfuric acid, *Thermodynamics, *Henry's law, Chemical reactions, Chemistry of precipitation.

The gas-phase concentration of hydrogen peroxide and its Henry's law constant are of critical importance in estimating the concentration of H2O2 in the aqueous phase such as in cloud droplets. This information may be used to assess the importance of the H2O2-mediated conversion of dissolved S(IV) to H2SO4 in hydrometeors. Henry's law constant of hydrogen peroxide was measured over a wide concentration and temperature range. Equilibrium gas-phase concentrations of hydrogen peroxide in dilute solution (0.00015 - 0.15 M) were determined for the temperature range 276-303 K. Henry's law is obeyed through the entire concentration range, and Henry's law constant (K sub H) may be expressed as exp(7920/T (K) - 15.44). A novel method for generation of low concentrations of water-soluble gases such as hydrogen peroxide was developed which involves the passing of an air stream through a porous tube immersed in a solution of H2O2. (Collier-IVI)
W85-05118

EFFECTS OF DEICING SALTS ON WATER CHEMISTRY AND VEGETATION IN PINHOOK BOG, INDIANA DUNES NATIONAL LAKESHORE,
National Park Service, Omaha, NE. Midwest Region.
For primary bibliographic entry see Field 5C.
W85-05123

SENSITIVITY ANALYSIS APPLIED TO UNSATURATED FLOW MODELING OF A RETORTED OIL SHALE PILE,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 2F.
W85-05181

SHORT TERM AND LONG TERM EFFECTS ON GROUNDWATER BY WASTEWATER INFILTRATION IN SUBSOIL SYSTEM,
National Swedish Environment Protection Board, Solna. Research Dept.
For primary bibliographic entry see Field 5D.
W85-05216

OIL SPILLS: WHAT HAVE WE LEARNED,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 5C.
W85-05223

LEACHABILITY OF BARIUM-RADIUM SULFATE SLUDGES,
Regina Univ. (Saskatchewan). Faculty of Engineering.
P. M. Huck, and B. Anderson.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 375-386. 3 Fig, 11 Tab, 9 Ref.

Descriptors: *Leaching, *Sludge, *Sulfates, Uranium, Milling, Barium, Radium.

In the milling of uranium ore, only a small amount of product called yellow cake is produced, while almost the entire mass of ore is transformed into a waste product called tailings. These tailings are typically conveyed in slurry form to an impoundment area where the solids settle. The initial phase of a research program designed to examine the leachability of 226Ra from barium-radium sulfate sludges is presented. Liquid/solid contact time was relatively unimportant over the range of 0.5-4 hr. Leaching likely occurred almost immediately following contact of sludge with the leachant. 226Ra in the sludge was stable in the presence of deionized water at liquid:solid ratios in the range 10:1 to 1000:1. There was a slight increase in leachate dissolved 226Ra activity levels per gram of sludge at higher liquid:solid ratios. Low and high values of leachant pH increased radium leaching, with solutions of low pH being the strongest leachants. The effect of pH was reduced by the observed buffering capacity of the sludge. Monovalent salt solutions proved to be strong leachants. The amount leached decreased as molarity increased over the range 0.001-0.1 M. Divalent cations all appeared to be relatively strong leachants for radium, with the BaCl2 solution providing the greatest amount of leaching observed in the study. Dissolved 226Ra activity levels in the leachate decreased as leachant molarity increased. Only monovalent salts gave radium leachate values greater than the hypothetical minimum expected from the sludge mother liquor.
W85-05261

MICROSYSTEM SEDIMENT-WATER SIMULATION STUDY FOR THE PROPOSED JORDANELLE RESERVOIR, HEBER CITY, UTAH,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
D. Craft.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-83-13. December 1983. 21 p, 6 Fig, 11 Tab, 6 Ref.

Descriptors. *Reservoir design, *Reservoir sites, *Reservoir linings, *Simulation analysis, Water quality, Anaerobic conditions, Trace metals, Mine wastes, Water analysis, Soil analysis, Trace elements, Limnology, Design criteria, Jordanelle Reservoir, Upper Colorado Region, Central U Project, Bonneville Unit, Provo River, Heber C Utah, Keetley, Utah.

The technique of microsystem sediment-water s ulation was used to predict water quality data the proposed Jordanelle Reservoir, Heber C Utah. Simulation microsystems were prepared four sites located in the north arm of the reserv basin including two sites located in an abando acid mine tailings pond. Data obtained from tailings pond microsystems indicated that low water and high trace metal concentrations exist in the north arm of the reservoir. These d suggested that some kind of membrane or co pacted earth lining will be necessary to seal contain the mine spoilage. Other sites in the re voir basin exhibited normal water quality. Near proposed dam, anaerobic conditions will deve rapidly due to high available concentrations organic carbon, and the subsequent release of z iron, and manganese may pose a water qua problem. In the north arm near Keetley, simula data indicated that anaerobic conditions will develop as quickly or be a severe as conditi expected near the dam. Overall, the availability nitrogen and phosphorus forms in the Provo Ri and Jordanelle sediments indicated that poss problems with algal blooms may exist in the re voir.
W85-05305

HERBICIDAL RESIDUES AND ENVIRO MENTAL EFFECTS FROM THE EXPERIMI TAL APPLICATION OF TWO 2,4-D FORM LATIONS TO CONTROL EURASIAN WATE MILFOIL,
Bureau of Reclamation, Denver, CO. Applied S ences Branch.
For primary bibliographic entry see Field 5C.
W85-05308

ATMOSPHERIC TRAJECTORY MODELS F DIAGNOSING THE SOURCES OF ACID PI CIPITATION,
Michigan Univ., Ann Arbor. Dept. of Atmospl ic and Oceanic Science.
P. J. Samson, and M. J. Small.
In: Modeling of Total Acid Precipitation Impa 1984. p 1-24, 15 Fig, 5 Tab, 34 Ref.

Descriptors: *Model studies, *Acid rain, *W pollution sources, *Air pollution, *Sulfur, *Fat pollutants, *Path of pollutants, Sulfates, Predicti Comparison studies, Hydrologic models, Sim tion analysis, Mathematical studies.

The University of Michigan Atmospheric Co butions to Interregional Deposition (ACID) Mo was applied to simulate concentrations of amb S and wet S deposition for January and July 1978 at several Sulfate Regional Experim (SURE) sites to evaluated the validity of mo predictions. In general, the model did a reasona job of predicting ambient sulfates during Janu and July but underestimated sulfates for locati near major Midwestern source regions, and ove timated sulfates at locations further downw The model reproduced the general magnitude precipitation-associated sulfate, but underestima wet deposition at several points downwind major source regions. The ACID model was applied to several receptor locations in the east United States and Canada in 1978 to study sou receptor relationships. The model estimated t independent of emissions, the area of greatest tential for contribution to ambient sulfate was cated in upstate New York. The estimated con bution field for S wet deposition illustrated the in precipitation-bearing winds from the southw by diminishing the role for the Sudbury site expanding the role for the Ohio River Basin.
W85-05314

EULERIAN MODELING OF THE TRANSPO AND CHEMICAL PROCESSES AFFECTI LONG-RANGE TRANSPORT OF SULFUR OXIDE AND SULFATE,

ı Univ., Iowa City.
. Carmichael, and L. K. Peters.
Modeling of Total Acid Precipitation Impacts.
. p 25-51, 18 Fig, 3 Tab, 31 Ref.

criptors: *Model studies, *Acid rain, *Water
ution sources, *Mathematical models, *Hydro-
models, *Simulation analysis, *Fate of pollut-
*Sulfur, *Sulfates, Topography, Temporal
ibution, Spatial distribution, Mathematical
tions, Air pollution.

ulerian combined transport/chemistry/remov-
odel that describes regional distribution of
and sulfate in the eastern United States is
ribed. The grid model is based on the coupled
e-dimensional advection-diffusion equation and
rporates chemical transformation, dry deposi-
spatial variation of topography, and spatial
temporal variations of mixing layer heights,
l field, eddy diffusivities, deposition velocities,
temperature and water vapor concentration
iles. Simulation results consisting of 24-hr
aged SO2 and sulfate ground level concentra-
contours, deposition contours, and diurnal
and sulfate vertical and ground level profiles
discussed along with regional SO2 and sulfate
nces. These results illustrate the models capa-
y to simulate the interactions between emis-
s, transport, chemistry and removal.
5-05315

RWEGIAN MODELS FOR SURFACE
EMISTRY: AN OVERVIEW,
sk Inst. for Vannforskning, Oslo.
primary bibliographic entry see Field 2A.
5-05317

DELING IMPACTS OF ACID PRECIPITA-
N FOR NORTHEASTERN MINNESOTA,
a Univ., Iowa City. Div. of Energy Engineer-

primary bibliographic entry see Field 2K.
5-05320

VELOPMENT AND CALIBRATION OF
E INTEGRATED LAKE-WATERSHED
DIFICATION STUDY MODEL,
ra Tech, Inc., Lafayette, CA.
primary bibliographic entry see Field 2K.
5-05321

DROLOGIC AND WATER QUALITY
DELS FOR AGRICULTURE AND FOREST-

ginia Polytechnic Inst. and State Univ., Blacks-
g.
primary bibliographic entry see Field 2A.
5-05338

SWERS MODEL,
primary bibliographic entry see Field 2A.
5-05342

NITE ELEMENT STORM HYDROGRAPH
DDEL,
r primary bibliographic entry see Field 2A.
5-05343

MPLIFIED METHOD FOR APPROXIMAT-
G SUBSURFACE TRAVEL TIMES FOR SO-
TES IN WATERSHEDS,
r primary bibliographic entry see Field 2A.
5-05344

UIDE TO THE SELECTION OF MATERIALS
R MONITORING WELL WELL CON-
RUCTION AND GROUND-WATER SAM-
ING,
nois State Water Survey Div., Champaign.
r primary bibliographic entry see Field 7B.
5-05350

SCHARGE OF SOLIDS FROM RHODE
VER SUBWATERSHEDS,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
J. W. Pierce.
In: Environmental Data Summary for the Rhode River Ecosystem (1970-1978), Section A: Long Term Physical/Chemical Data, Part 1: Airshed and Watershed, 1982. p 344-423, 17 Tab, 21 Ref.

Descriptors: *Watersheds, *Maryland, *Suspended solids, *Organic matter, *Seasonal variations, *Annual distribution, Regression analysis, *Baseline studies, Minerals, Mathematical studies, Mathematical equations, Sediment transport, Land use, Agricultural watersheds, Forest watersheds, Discharge capacity.

Discharge measurements were conducted at 7 weirs of Rhode River Subwatersheds and aliquots of flow-integrated water samples were analyzed for concentrations of total particulate material, mineral solids, and organic solids. Concentrations of solids in the integrated samples ranged from a low of 0.8 mg/liter to 1806.7 mg/liter total material and 0.2 to 1528.9 mg/liter for mineral solids. The lowest measured concentration of total solids in the samples occurred most frequently in the winter months, followed by spring. These two seasons were also characterized by the least fluctuations in flow rates. The average concentration of the samples was highest in the summer at all weirs and lowest in the summer. The lowest average concentration of organic matter occurred in the spring or winter. The concentration of solids did not appear to be affected by land use patterns. The greatest average weekly measured discharge of particulate material occurred in the summer, spring or winter, but never in the fall. Overall, there was very little difference between the 7 weirs in the ratio of mineral matter to organic solids. Regression analysis was used to predict missing values for particulate discharge. These data can be used to characterize non-point discharge by land use such that, given a mix of land uses in a watershed, seasonal or annual predictions could be made on the discharge of materials to receiving waters.
W85-05360

SEASONAL AND ANNUAL VARIATION IN NUTRIENT DISCHARGE FROM RHODE RIVER WATERSHEDS AND CERTAIN STREAM WATER QUALITY PARAMETERS,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
D. L. Correll.
In: Environmental Data Summary for the Rhode River Ecosystem (1970-1978), Section A: Long Term Physical/Chemical Data, Part 1: Airshed and Watershed, 1982. p 424-502, 1 Fig, 35 Tab, 14 Ref.

Descriptors: *Watersheds, *Maryland, *Nutrients, Discharge measurement, Nitrogen, Phosphorus, *Seasonal variation, Turbidity, *Annual distribution, Nitrogen compounds, Iron, Hydrologic data collections, Nitrate, Ammonia, Organic carbon, Phosphates, Data collections, Silica.

Twelve basins of the Rhode River watershed were analyzed for nutrient discharge (N, P, Ca, Mg, Si, Fe), pH, water temperature, turbidity, and inorganic C to study seasonal and annual variations. Mean annual discharge of P from basin-sized watersheds was 633 g/ha. No consistent seasonal pattern of P concentration or discharge was noted. N area yield discharges from basin-sized watersheds averaged 2,200 g/ha/yr. N area yields also showed no consistent seasonal pattern from one year to the next. The mean N/P ratio was highest in the winter, followed by spring and lowest in the summer. The mean annual energy content of organic matter in discharge water was 65.1 g-cal/liter. Concentrations of nitrate are highest in the winter and lowest in the fall while dissolved ammonia and organic N concentrations are highest in the summer. In all seasons orthophosphate-P constituted over half of the total P in an average year and well over half of this was bound to particulates. Dissolved orthophosphate levels were least in winter and increased steadily through the year till fall. Concentrations of reactive Si in spot tests from five basins were highest in summer. Mean dissolved Fe concentrations were higher in the fall. The mean pH of runoff for winter and spring seasons shows a general decrease from 1972 through 1978. Turbidity and temperature of streams vary among basins.
W85-05361

SEASONAL AND ANNUAL VARIATION IN THE DISCHARGE OF METALLIC CATIONS FROM RHODE RIVER WATERSHEDS,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
T. L. Wu, and H. E. Remenapp.
In: Environmental Data Summary for the Rhode River Ecosystem (1970-1978), Section A: Long Term Physical/Chemical Data, Part 1: Airshed and Watershed, 1982. p 503-600, 3 Fig, 4 Tab, 2 Ref.

Descriptors: *Heavy metals, *Maryland, *Metals, Discharge measurements, *Watersheds, *Cations, *Seasonal variation, *Hydrologic data collections, *Annual distribution, Land use, Rhode River, Baseline studies, Data collections.

Seasonal and annual variation of the discharge of metallic cations from eight mixed land use basin-sized Rhode River watersheds were determined by the measurement of the acid leachable metal content. Data are presented for discharge levels of Cu, Zn, Cr, Cd, Pb, Mn, Fe, Ca, Mg, Na, and K from each of the eight watersheds and area-yield discharge data are also given. In general, streamflow for all watersheds is highest in winter and lowest in summer. During 1975 which was a very wet year, summer area-yield discharges of Fe, Zn, and Cd were above their means, while Mn, Mg, and Ca were below. The extreme variability in concentration and discharge of metals is seen in data from watershed 101. Water discharge varied from 0 to 8 cm/month while flow weighted mean levels of Zn in discharge varied 300-fold. Mean discharges values of metals ranged three orders of magnitude and declined in the order of Na, Ca, K, Fe, Mg, Mn, Zn, Cr, Pb, Cu, and Cd.
W85-05362

RED HILL DISPOSAL SITE: A CASE STUDY,
Brown, Vence and Associates, San Francisco, CA.
For primary bibliographic entry see Field 5E.
W85-05368

INVESTIGATIONS OF LEACHATE CONTAMINATION OF GROUND AND SURFACE WATERS AT THE FRESH KILLS LANDFILL, NEW YORK CITY,
L. M. Page, S. J. Raila, and N. R. Woliner.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 175-209, 11 Fig, 1 Tab, 2 Append.

Descriptors: *Landfills, *Path of pollutants, *Fate of pollutants, *Groundwater pollution, *Leaching, *Tidal marshes, *Water pollution sources, *Geohydrology, Leachates, Chlorine, Conductivity, Salt marshes, Saline water intrusion, Salinity, Tidal currents, Wetlands, Tide lands, Monitoring, Aquifers, Tidal rivers, Surface water, Surface-groundwater relations, Garbage dumps, Waste dumps, New York.

The method and results used to determine the nature of groundwater and surface water contamination at the Fresh Kills landfill, Staten Island, New York as one part of the work necessary to satisfy Part 360 of the State Environmental Conservation Law and obtain a permit to continue operation are described. A hydrogeologic investigation showed saltwater intrusion of the glacial, Cretaceous Age and bedrock aquifers along the Arthur Kill and other tidal streams. In the south-central portion of Fresh Kills, the glacial and Cretaceous Age deposits have been contaminated by saltwater from tidal waters. The huge quantity of tidal flush overwhelms the estimated leachate flow so that little, if any effects of the landfill leachate can be seen at present. The chloride content of the groundwater was found to be abnormally high in

the garbage areas where monitor wells were installed. This was attributed to the residual high chlorine content of the tidal wetlands in which the garbage was placed which in turn was caused by saltwater intrusion. High conductivity contours were directly related to Arthur Kill and the tidal streams and the associated saltwater intrusions. Further studies are in progress to evaluate the directions, rates and volumes of contaminant flow from the landfill.
W85-05369

IMPACT OF SEWERAGE IRRIGATION ON THE CHEMISTRY OF GROUND AND SURFACE WATERS,
Kentucky Geological Survey, Lexington.
For primary bibliographic entry see Field 5E.
W85-05378

GEOHYDROLOGIC MODELLING FOR INDUSTRIAL WASTE DISPOSAL SITE EVALUATION,
Golder Associates, Atlanta, GA.
J. E. Baker, and A. Brown.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 380-392, 5 Fig, 3 Ref.

Descriptors: *Waste disposal, *Model studies, *Site selection, *Design criteria, *Mathematical models, *Hydrology models, *Path of pollutants, Groundwater movement, Land disposal, Fate of pollutants, Simulation analysis, Groundwater pollution, Models, Industrial wastes.

The Discrete Particle Random Walk (DPRW) model is presented as a suitable groundwater flow and solute transport model to aid in the selection and design of alternative waste disposal facilities. The model consists of a data entry and problem set-up component, a groundwater flow solution, a solute transport component, and output of results. The DPRW algorithm avoids problems encountered by direct solution of equations governing advection and dispersion processes. The model directly simulates the movement of the discrete particle in a porous media over discrete timesteps. To apply the DPRW model, certain geohydrologic and hydraulic data must be known, the solute transport portion of the model must be calibrated and a time history of both the quantity of seepage from the waste disposal facility and the geochemical make-up of the seepage through the operation and well into the reclamation of the facility must be known. The DPRW allows complex hydrogeologic settings to be studied. The transient nature of operation and reclamation of the waste disposal facility can be considered and the number of simplifying assumptions required is reduced. However, use of the model may require more input data, a higher degree of expertise, and more complicated verification methods.
W85-05379

FIELD INVESTIGATION OF A SUPERFUND SITE,
Residuals Management Technology, Inc., Madison, WI.
For primary bibliographic entry see Field 5E.
W85-05380

NATURAL BUFFERS FOR SLUDGE LEACHATE STABILIZATION,
Dames and Moore, Bethesda, MD.
For primary bibliographic entry see Field 5E.
W85-05383

WATER QUALITY EFFECTS AND GROWTH BENEFITS OF ENTRENCHING SEWAGE SLUDGE IN SANDY FOREST SOILS,
North Central Forest Experiment Station, East Lansing, MI.
For primary bibliographic entry see Field 5E.
W85-05384

ASSESSMENT OF THE RESIDUAL EFFECTS OF LONG-TERM SPRAY DISPOSAL OF AN INDUSTRIAL SLUDGE,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 5E.
W85-05394

GENERAL STOCHASTIC MODEL FOR PREDICTING BOD AND DO IN STREAMS,
North Carolina Univ. at Charlotte. Dept. of Mathematics.
S. D. Damaskos, and A. S. Papadopoulos.
International Journal of Environmental Studies, Vol. 21, No. 3/4, p 229-237, October, 1983. 6 Fig, 10 Ref.

Descriptors: *Model studies, *Stochastic process, *Biochemical oxygen demand, *Dissolved oxygen, Differential equations, Path of pollutants, Prediction, Statistical studies.

Recent work on stochastic models for dissolved oxygen (DO) and biochemical oxygen demand (BOD) is extended in a more stochastic and therefore more realistic point of view. It is assumed that there are five major activities on the stream: the pollution and dissolved oxygen are decreased by bacterial action; the DO is increased due to process of reaeration at a rate proportional to the DO deficit; the BOD is only decreased by sedimentation and absorption at a rate proportional to the amount of pollution present with proportionally constant k3, in units of DO per day; the pollution is increased from small sources along the stretches of stream with rate la in ppm per day which is independent of the amount of pollution present, and the DO is decreased at a rate d-beta in ppm der day. Stochastic models are presented in terms of random differential equations and the solution processes are discussed. An example with computations is provided to illustrate the use of the model to determine the statistical properties of the BOD and DO processes at any point down the stream. (Baker-IVI)
W85-05443

COMPARISON OF SEASONAL AND DIURNAL PATTERNS OF SOME PHYSICO-CHEMICAL PARAMETERS OF THE OPEN AND CLOSED PARTS OF LOKTAK LAKE, MANIPUR, INDIA,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W85-05444

FLUORIDE CONCENTRATION IN THE WATER OF THE RIVER CAUVERY, KARNATAKA, INDIA,
Mysore Univ. (India). Dept. of Botany.
R. K. Somashekar, and S. N. Ramaswamy.
International Journal of Environmental Studies, Vol. 21, No. 3/4, p 325-327, October, 1983. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Fluoride, *River Cauvery, *Karnataka, *India, Water pollution, Public health, Birds, Wildlife, Fish, Health hazard, Industrial wastes, Pulp and paper industry, Agricultural chemicals, Fertilizers.

A two year study was conducted concerning fluoride levels in the waters of river Cauvery near Mysore, Karnataka, India. Cauvery is an important river with a total length of 1500 km. Water from this river is used for domestic and industrial purposes all along its course. Fluoride concentrations were measured at five sampling points streching over 25 km. Sampling station 3 receives large amounts of effluents from fertilizer and paper factories. The effluents of a fertilizer factory have an average fluoride concentation of 300 mg/l. The fluoride levels at stations 3 and 4 exceed the value stipulated by WHO. Station 4 is near a bird sanctuary and the higher levels of fluoride in water at this point have threatened the bird life. Health hazards thus exist in the area and it is concluded that the water of the river Cauvery is not suitable for domestic use at stations 3 and 4. (Baker-IVI)
W85-05448

INFLUENCE OF REDOX POTENTIAL AND PH ON THE HEAVY METAL CONTENT OF GROUND WATER IN THE HEISINGER AUE AREA, WEST GERMANY (DER EINFLUSS VON REDOXPOTENTIAL UND PH AUF DIE SCHWERMETALLGEHALTE DES GRUNDWASSERS DER HEISINGER AUE (RUHRTAL SUDLICH ESSEN),
Essen Univ. (Gesamthochschule) (Germany F.R.).Fachbereich 9 - Geologie.
P. Neumann-Mahlkau.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 1, p 1-5, February, 1985. 11 Fig, 1 Ref

Descriptors: *Heavy metals, *Groundwater pollution, *Heisinger Aue, *Germany (Federal Republic), Redox potential, Hydrogen ion concentration, Zinc, Cadmium, Copper, Lead, Iron, Arsenic.

In the Heisinger Aue area south of Essen (West Germany) the soil is contaminated with heavy metals from industrial water pollution. Different soil horizons are exposed to the ground water because the ground water level is fluctuating depending on meteorological conditions. Analysis of the ground water from test pits yielded differing values of Zn, Cd, Cu, Pb, Fe and As. Exact observations of the soil profiles and measurements of Eh and pH show that there is a relation between Eh and the content of heavy metals in ground water. (Author's abstract)
W85-05450

EUTROPHICATION AND THE BALTIC SEA CAUSES AND CONSEQUENCES,
Stockholm Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W85-05464

DUAL FORMULATION OF FLOW FOR CONTAMINANT TRANSPORT MODELING: 1. REVIEW OF THEORY AND ACCURACY ASPECTS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. O. Frind, and G. B. Matanga.
Water Resources Research, Vol. 21, No. 2, p 159-169, February, 1985. 15 Fig, 18 Ref.

Descriptors: *Path of pollutants, *Groundwater flow, *Groundwater pollution, Solute transport, Model studies, Fate of pollutants, Mathematical models.

The dual formulation for flow can offer significant advantages in the context of contaminant transport studies, compared with the conventional approach based on potentials only. The stream function solution provides directly the flow paths that control advective transport. These flow paths facilitate the direct visual positioning of contaminant plumes within a flow domain. The advective advance of a contaminant can be determined easily on the basis of the stream function plot. Because the governing equations are of the same form, one numerical model can provide both potentials and stream functions. Flow nets can be produced directly without the need for graphical construction. The stream function solution yields accurate boundary fluxes directly. These are important in connection with seepage from/to lakes and rivers. The method provides a means to verify the accuracy of the calculated velocity field, which is vulnerable to breakdown whenever the water table gradient approaches zero. The dual flow model can thus play a role in maintaining accuracy in transport simulations. The dual formulation applies only when flow transients are negligible and where the transport process is linear. (Baker-IVI)
W85-05496

DUAL FORMULATION OF FLOW FOR CONTAMINANT TRANSPORT MODELING; 2. THE BORDEN AQUIFER,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. O. Frind, G. B. Matanga, and J. A. Cherry
Water Resources Research, Vol. 21, No. 2, p 170-182, February, 1985. 17 Fig, 11 Ref. Natural Sci

and Engineering Research Council of
da grant A8368.

riptors: *Path of pollutants, *Model studies,
den Aquifer, *Ontario, Groundwater pollu-
Groundwater flow, Simulation, Landfills,
e transport, Velocity.

validity and usefulness of the flow patterns
ated on the basis of short-term hydraulic head
are assessed. The contaminant plume consid-
occurs in an unconfined sand aquifer at an
doned landfill on the Canadian Forces Base at
en, Ontario. The landfill began operation as a
e dump in 1940 and rapidly expanded during
var years. It was closed and covered with a
layer of local sand in 1976. The Borden case
illustrates that for certain systems the long-
average flow regime that is needed for the
sment of contaminant migration cannot be
ned from field measurements of hydraulic
alone. Rather, it should be deduced by utiliz-
nformation that is representative of the long
. The information sought should include de-
l stratigraphic data, measurements of perme-
y that are independent of field water level
and the available recharge. Simulation should
ed to investigate relevant combinations of the
neters and identify those that lead to extreme
itions of aquifer contamination. The Borden
suggests the possible existence of a weak link
me state of the art flow transport modeling
edures due to the fact that such procedures
consist of an operational sequence involving
calculation of hydraulic heads, the differentia-
to obtain velocities, and the calculation of
port components based on those velocities.
rly errors or irregularities in the velocities will
assed on to the transport procedure unless
cepted by manual inspection. The result will
not unreasonable-looking, but still incorrect,
lated plume. The dual approach to flow mod-
thus provides a useful basis for contaminant
sport studies, both in the evalution of the hy-
eologic parameters relevant in the context of
transport problem and in the screening out of
rs in the simulated flow field. (Baker-IVI)
-05497

**LTISOLUTE MASS TRANSPORT WITH
EMICAL INTERACTION KINETICS,**
re Dame Univ., IN. Dept. of Civil Engineer-

. Kirkner, A. A. Jennings, and T. L. Theis.
nal of Hydrology, Vol. 76, No. 1/2, p 107-117,
ary, 1985. 4 Fig, 17 Ref. DOE grant DE-AC-
EV10253.

criptors: *Mass transport, *Convection, *Dis-
ion, *Kinetics, Chemical reactions, Ground-
er management, Finite element method, Simu-
n, Solute transport, Algorithms.

ey aspect of the problem of protecting ground-
er reserves is the ability to predict the migra-
of contaminants within the groundwater
em. An algorithm is presented for multicom-
ent contaminant transport, which includes the
cts of convection, dispersion, kinetic sorption
tions and equilibrium solution-phase reactions.
main feature of the algorithm is the modulari-
on of the chemical calculations, thus allowing
erent chemical models to be studied quite
ly. Comparisons of numerical simulations vs.
lytical and experimental results are given. Cur-
work includes the use of this algorithm to
ress the problem of the validity of the local
ilibrium assumption. (Baker-IVI)
5-05534

**TION OF THE SEAWATER INTERFACE IN
COASTAL AQUIFER BY THE METHOD OF
CCESSIVE STEADY STATES,**
chnion - Israel Inst. of Tech., Haifa. Faculty of
il Engineering.
primary bibliographic entry see Field 2F.
5-05535

**EAKTHROUGH OF BRINE THROUGH
MPACTED FINE GRAINED SOILS,**
Windsor Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W85-05571

PETROLEUM REFINERY STORMWATER RUN-OFF STUDY,
Standard Oil Co. (Ohio), Cleveland.
For primary bibliographic entry see Field 2A.
W85-05572

ECOLOGICAL MONITORING OF AQUEOUS EFFLUENTS FROM PETROLEUM REFINERIES,
CONCAWE, The Hague (Netherlands).
For primary bibliographic entry see Field 5A.
W85-05582

OIL AND DISPERSANTS IN CANADIAN SEAS: RESEARCH APPRAISAL AND RECOMMENDATIONS.
Environmental Protection Service, Ottawa (Ontario).
Available from Minister of Supply and Services Canada as En46-3/82-2E, EPS 3-EC-82-2, May 1982. Edited by J.B. Sprague, J.H. Vandermeulen, and P.G. Wells. 185 p, 574 Ref.

Descriptors: *Marine environment, *Environmental effects, *Oil spills, *Oil pollution, *Arctic, *Dispersants, *Fate of pollutants, *Water pollution effects, Ecological effects, Marine animals, Marine plants, Phytoplankton, Zooplankton, Microbial degradation, Literature review, Oil industry, Oil slicks, Cleanup operations.

This report appraises the fate and effects of petroleum spilled in Canadian marine environments, and the implication of using dispersants on spills in order to identify both knowledge and gaps in understanding the problems of oil pollution in northern waters. Twelve chapters by individual scientists give perspectives on the Canadian oil industry; fate and behavior of oil in the sea; microorganisms and degradation of oil; analytical chemistry; and effects of oil, dispersants, and chemically dispersed oil on phytoplankton, macrophytes, zooplankton, fish, benthic and intertidal organisms, birds, marine mammals, and communities, and ecosystems. General information gaps on dispersants and the fate and effects of oil in the Arctic exist. Further research is required to minimize the effects of spills. This implies that Canada should strengthen its capabilities for long-term studies of marine environments.
W85-05583

FATE AND BEHAVIOUR OF OIL SPILLS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
D. Mackay.
In: Oil and Dispersants in Canadian Seas: Research Appraisal and Recommendations, EPS 3-EC-82-2, May 1982, Environmental Protection Service, Ottawa (Ontario). p 7-27, 2 Fig.

Descriptors: *Biodegradation, *Oil spills, *Fate of pollutants, *Dispersants, *Oil slicks, *Marine environment, *Cleanup operations, *Arctic, Microbial degradation, Oil pollution, Evaporation, Oxidation, Models.

The physical, chemical, and biological processes which occur at sea when oil is spilled are described. During the first day of the spill, evaporation and dispersion of oil particles into the water column take place. Evaporation proceeds until 25% of the spill may have evaporated in 2 to 5 days. Subsequent photolytic oxidation in the atmosphere is fairly rapid. As the spill spreads, an increasing fraction of oil is dispersed into the water column and the surface slick may disappear. The oil remaining on the surface eventually becomes tar lumps which may be stranded on beaches. Biodegradation is the most important oil removal process during the first year. Small amounts of oil sink to the bottom or are ingested by animals of various trophic levels. The spreading and drifting of oil slicks have been extensively modeled and are relatively predictable. However, little is known about dispersion of oil in the water column. The principal resistive effect to dispersion is the water-oil interfacial tension. Dissolved hydrocarbons under an oil slick may be of toxicological significance. The incorporation of oil into growing first-year ice and its subsequent release in the spring has been well documented. Burning of oil on ice has been tried but more research is required on its environmental effects. Oil spill modelling will involve the integration of many complex environmental processes.
W85-05584

MICROORGANISMS AND THE DEGRADATION OF OIL UNDER NORTHERN MARINE CONDITIONS,
Alberta Univ., Edmonton. Dept. of Microbiology.
D. W. Westlake.
In: Oil and Dispersants in Canadian Seas: Research Appraisal and Recommendations, EPS 3-EC-82-27, May 1982, Environmental Protection Service, Ottawa (Ontario). p 47-53.

Descriptors: *Microbial degradation, *Marine environments, *Biodegradation, *Oil pollution, *Dispersants, *Marine bacteria, *Hydrocarbons, *Fate of pollutants, Oil spills, *Microorganisms, Microbiological studies, Degradation, Water pollution effects, Arctic, Cleanup operations, Marine sediments.

The interactions of the various physical and chemical parameters which control the microbiological degradation of oil under northern marine environmental conditions are summarized. The types of oil degrading microorganisms present in an environment will be increased if oil is present at that site. Oil biodegradation studies have been enhanced by using a synthetic crude spiked with specifically labeled hydrocarbons which allows monitoring of the disappearance of individual or groups of compounds. Under the severe environmental conditions of northern marine waters, it is doubtful that oil-degrading microbes could play an important role in the clean-up of oil spills. Oil incorporated into anaerobic sub-tidal sediments will not undergo biodegradation, as the initial attack on hydrocarbon molecules by microorganisms requires oxygen. Factors affecting the utilization of oil by marine microorganisms include the availability of nutrients, temperatures and ice formation, and the toxic effects of dispersants. More data is needed on the distribution and activity of oil-degrading microorganisms and on the status of the controlling physicochemical parameters in northern marine ecosystems. Research on the toxicity of oil (and the oil plus dispersants) and its effect on the C/N ratio of the already stressed environment is recommended.
W85-05585

EFFECTS OF PETROLEUM HYDROCARBONS ON PHYTOPLANKTON AND MACROPHYTES,
Department of Indian Affairs and Northern Development, Ottawa (Ontario).
N. Snow.
In: Oil and Dispersants in Canadian Seas: Research Appraisal and Recommendations, EPS 3-EC-82-27, May 1982, Environmental Protection Service, Ottawa (Ontario). p 55-63.

Descriptors: *Oil pollution, *Water pollution effects, *Fate of pollutants, *Phytoplankton, *Macrophytes, *Oil, *Microbial degradation, *Phytotoxicity, Oil spills, Toxicity, Arctic, Marine environment, Hydrocarbons, Dispersants, Photosynthesis, Marine algae, Marine plants.

A range of phytoplankton responses exists to both oil fractions and whole oils with species-specific toxicities, depending on how the oils are introduced into the environment, on water temperature, and on other physiologic conditions. Low concentrations of hydrocarbons stimulate phytoplankton activity but depress photosynthesis and algal growth. The effects of oil on marine macrophytes follow a pattern similar to the effects on phytoplankton. If the phytotoxicity of crude oil or its components is mediated via cell membrane disrup-

tion, or if cellular metabolic substrates are being changed, then chemical dispersants could affect such a mode of action. Dispersants would accelerate the introduction of oil into the water column and the mixture might prove more toxic than oil alone. More work is needed on the effects of dispersed oil on marine plants under all conditions which dispersants might be used. It is recommended that the effects of oil and dispersed oil on epontic phytoplankton communities, and arctic and subarctic sublittoral macroalgae be studied at different seasons of the year. Further research is also needed on the effects of petroleum hydrocarbons on inter-conversion of biochemical cell constituents, the mechanisms of phytotoxicity, and the effects of differing sizes of oil droplets.
W85-05586

ANALYTICAL CHEMISTRY,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W85-05593

INFLUENCE OF DISPOSAL ENVIRONMENT ON AVAILABILITY AND PLANT UPTAKE OF HEAVY METALS IN DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
B. L. Folsom, C. R. Lee, and D. J. Bates.
Technical Report EL-81-12, December 1981. Final Report. 159 p, 25 Fig, 52 Tab, 155 Ref, Append.

Descriptors: *Heavy metals, *Marsh plants, *Bioaccumulation, Cyperus esculentus, Spartina alterniflora, Distichtis spicata, Sediments, Contamination, Saline Water, Spoil banks, Dredging, Zinc, Cadium, Copper, Iron, Manganese, Arsenic, Mercury, Nickel, Chromium, Lead, Organic compounds, Nitrogen, Phosphorus, Sulfur, Grease, Hydrogen ion concentrations, Calcium carbonate.

Heavy metal uptake by Cyperus esculentus from 15 highly contaminated freshwater sediments under reduced (flooded) and oxidized (upland) disposal conditions was investigated in the greenhouse. Heavy metal uptake by Spartina alterniflora and Distichlis spicata from 14 highly contaminated saltwater sediment under flooded disposal conditions was also investigated. The sediments were transported to the laboratory where half was potted and maintained in a flooded state; the other half was air dried and ground before being potted (upland condition). Cyperus esculentus was grown from tubers planted in the freshwater sediments. Seeds of S. alterniflora and D. spicata were planted in the saltwater sediments. The plants were harvested and analyzed for the heavy metals Zn, Cd, Cu, Fe, Mn, As, Hg, Ni, Cr and Pb. The sediments were analyzed for total heavy metals, diethylene triamine pentaacetic acid (DTPA) extractable heavy metals, heavy metals in the sediment interstitial water, oil and grease, pH, calcium equivalent, total phosporus, total Kjeldahl nitrogen, and organic matter. Air drying the sediments resulted in increased DTPA extractable and interstitial water heavy metals. Plant uptake of heavy metals, especially Zn, and Cd, was greater in plants grown in upland sediments compared with flooded sediments. Plant yield was an important factor in determining plant uptake of heavy metals. Since the results of this investigation showed that plant uptake of heavy metals was site specific, it is recommended that a plant bioassay be performed on sediments to determine the availability of heavy metals contained in those sediments.
W85-05601

SUBMODELS FOR THE NUTRIENT LOADING ESTIMATION ON RIVER ZALA,
Magyar Tudomanyos Akademia, Budapest. Szamitastechnikai es Automatizalasi Kutato Intezete.
M. Bolla, and T. Kutas.
Ecological Modelling, Vol. 26, No. 1/2, p 115-143, December, 1984. 14 Fig, 8 Tab, 16 Ref.

Descriptors: *Nutrient loading, *River Zala, *Lake Balaton, *Hungary, Model studies, Estimating, Nutrients, Nitrogen, Phosphorus, Snowmelt, Simulation.

An important requirement of the Balaton Ecological Modelling approach to water-body modelling is to develop a nutrient loading estimation for Lake Balaton. For the Western Basin, estimates were made of the nutrient load from municipal sewage and of agricultural origin discharged by River Zala. The approaches used are described by different submodels: submodels which separate flood-waves from base-flow, regression submodels for the relationships between the discharge and different kinds of nutrient loadings, a submodel which separates the phosphorus and nitrogen of municipal sewage and those of agricultural origin and an erosion submodel. Any of the submodels can be dropped out or substituted by other submodels. The submodels are calibrated separately before they are merged. On the basis of these submodels a simulation was performed for the time interval 1976-79. The monthly and yearly averages of the simulated daily results were in good agreement with the existing measurements. Using this approach one can also take account of snowmelt. Knowing the number of snowy days, the average depth of snow-cover and other parameters characterizing a sub-watershed, the volume of melted snow can be calculated. The location of snowmelts should be done by another submodel influenced by meteorological factors such as air temperature. With this approach one can also take into consideration other phosphorus and nitrogen compounds. (Baker-IVI)
W85-05604

DISPERSION OF RADIOACTIVE POLLUTION IN SURFACE WATER,
Karlova Univ., Prague (Czecheslovakia). Dept. of Nuclear Physics.
I. Chytil.
Ecological Modelling, Vol. 26, No. 1/2, p 145-153, December, 1984. 16 Ref.

Descriptors: *Radioactive wastes, *Nuclear powerplants, *Dispersion, Path of pollutants, Surface waters, Mathematical equations.

A mathematical description of the dispersion of radioactive pollution in surface water is presented based on a discussion of the phenomena which influence it. A differential equation in the general form is obtained and simplified to give the most convenient solution for the investigation of radioactive doses during normal operation of a nuclear power plant. Specific activity of radionuclides is time-and space-dependent and is influenced by physical, chemical and biological phenomena each of which is different in significance and is variable depending on the character of the stream. The influence of each phenomenon is expressed by the transport equation or by the boundary conditions. Simplification of the transport equation and boundary conditions is considered. An example is provided in which the prediction of the distribution of the specific activity in the streams is determined which leads to the predictive calculation of radioactive doses from nuclear power plants. The results have been used to predict the radioactive doses from planned power plants. (Baker-IVI)
W85-05605

IMPACT OF HUMAN ACTIVITIES ON WATER QUALITY - A CASE STUDY OF WATER POLLUTION IN JAIPUR (INDIA),
Rajasthan Univ., Jaipur (India). Dept. of Botany.
B. Gopal, and P. K. Goel.
Limnologica (Berlin), Vol. 16, No. 1, p 39-43, September, 1984. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Water pollution sources, *Wastewater disposal, *Industrial effluent, *Jaipur, *India, Water pollution effects, Sanitation, Drinking water, Public health.

A brief report is offered on the sources of water pollution resulting from diverse human activities in India. Extreme contrasts exist between the rural and the urban areas. Industrial effluents are among the most important sources of water pollution next to the domestic wastes. Continued use of the same water for bathing, sewage disposal, drinking and all other purposes leads to frequent disease outbreaks and other problems. Water pollution around Jaipur, which lies in the semiarid region of th state of Rajasthan, is described. There are sever small industries in the area and most of the wast are dumped into the Amanishah drain passin through the township. In many cases effluents a disposed of on land. (Baker-IVI)
W85-05614

HEAVY METALS IN THE SEDIMENTS O LLANGORSE LAKE, WALES SINCE CELTI ROMAN TIMES,
Trent Univ., Peterborough (Ontario). Dept. of B ology.
R. Jones.
Verhandlung Internationale Vereinigung Limnol gie, Vol. 22, No. 3, p 1377-1382, December, 1984. Fig, 19 Ref.

Descriptors: *Llangorse Lake, *Wales, *Heav metals, *Eutrophic lakes, *Lake sediments, Sed ments, Chemical analysis, Copper, Lead, Zinc, T tanium, Catchments, History, Soil erosion, Organi matter.

Llangorse Lake is a small, shallow, eutrophic lak situated in the lowlands of the eastern half of th Brecon Beacons National Park in south centr Wales. An abrupt change in stratigraphy near th bases of the sediment cores was noted, caused by substantial increase in soil erosion following expa sion of forest clearing activity after the Wel tribes had been subjugated by the Romans in th campaign of AD 74-78. Changes in the concentr tions of titanium, copper, zinc and lead in th sediments caused by this major pertubation in th lake catchment and also concentrations of thes metals in more recent sediments were examined. I the silty/clay above the transition zone, the co centration of Cu increases and then declines in a cores. These changes appear to be associated wit an increase and then a decline in sediment organi matter. Even though the top few cm of sedime were not sampled, it is likely that Cu, Zn, and P are still accumulating as a result of atmospher supply from anthropogenic sources, from agricu tural sources and from recreational activity, a occurs in lakes in other areas. (Baker-IVI)
W85-05625

RIVER BURE, UNITED KINGDOM: PAT TERNS OF CHANGE IN CHEMISTRY AN PHYTOPLANKTON IN A SLOW-FLOWIN FERTILE RIVER,
University of East Anglia, Norwich (England) School of Environmental Sciences.
For primary bibliographic entry see Field 2E.
W85-05676

SEDIMENTATION RATES AND HEAV METAL POLLUTION OF SEDIMENTS IN TH SETO INLAND SEA, PART 3. HIUCHI-NADA
Government Industrial Research Inst., Kyushu Tosu (Japan).
A. Hoshika, and T. Shiozawa.
Journal of the Oceanographical Society of Japan Vol. 40, No. 5, p 334-342, October, 1984. 5 Fig, Tab, 8 Ref.

Descriptors: *Sedimentation rate, *Heavy metals *Water pollution sources, *Hiuchi-Nada, *Japan *Seto Inland Sea, Copper, Zinc, Lead radioiso topes, Industrial wastes.

In the Hiuchi-Nada area of the Seto Inland Sea Japan, sedimentation rates were determined with the Pb-210 technique, and heavy metals in sedi ments were also analyzed. Sediments were collect ed in twelve short sediment cores and a long sediment core, using 1-m and 6-m gravity corers The sedimentation rates vary from 0.14 to 0.31 g sq cm/yr. The highest sedimentation rate was ob served in the central part of the area, while lowe sedimentation rates were observed in the eastern part. In Hiuchi-Nada, a remarkable increase i copper and zinc contents is noticeable as early a the 1800's. Over the past 240 years a copper smelt er at a south-western side of this area has been causing serious pollution of the sediment. Now anthropogenic copper and zinc loads into the sedi

ment are 123 and 376 ton/yr compared to natural copper and zinc loads of 82 and 401 ton/yr, respectively. The highest level of copper and zinc pollution was observed in the 1960's, when the relative enrichments above background values (copper; 19 and zinc; 93 mg/kg) were 5.5 and 2.8, respectively. (Author's abstract)
W85-05687

PHOSPHORUS CYCLING IN IONICALLY POLLUTED ONONDAGA LAKE, NEW YORK,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, C. T. Driscoll, M. C. Wodka, R. Honstein, and S. P. Devan.
Water, Air, and Soil Pollution, Vol. 24, No. 2, p 121-130, February, 1985. 3 Fig, 44 Ref.

Descriptors: *Onondaga Lake, *New York, *Phosphorus, *Cycling nutrients, Lake restoration, Industrial wastes, Chlor-alkali industry, Fate of pollutants, Mixing, Chemical reactions, Lake sediments.

Onondaga Lake is a small lake located in metropolitan Syracuse, New York. It is considered one of the most polluted lakes in the northeast US, having received the domestic effluents and much of the industrial wastes from the metropolitan area for more than a century. A ten-fold reduction in P loading to the lake from 1970-1981 was achieved through implementation of reclamation measures that included a ban on P detergents and the addition of secondary and tertiary processes at the adjoining sewage treatment plant. The failure of Onondaga Lake to respond to major reductions in external P loading achieved by 1981 reflects the degree to which the system was originally overloaded. The ionic loading from a chlor-alkali manufacturer has altered the behavior of P in a least four ways: reduced vertical mixing; enhanced chemical reactivity of P; increased rate of deposition of P; and reduced availability of sedimentary P. These features reflect very nonconservative behavior of P in the lake, which should facilitate the positive response of the lake to further restoration efforts. Internal P cycling, and P concentrations, in the lake would increase if the loading of ionic material from the major source was discontinued, due to the reversal of existing pollution-based alterations of the P cycle. The available P in the productive layers of the lake would increase, reversing a trend toward nutrient-limitation that has been achieved at great cost. It could alter the phytoplankton assemblage of the lake, and increased the transport of P from the lake to Lake Ontario. (Moore-IVI)
W85-05690

LONG DISTANCE TRANSPORT OF ANTHROPOGENIC LEAD AS MEASURED BY LAKE SEDIMENTS,
Trent Univ., Peterborough (Ontario). Environmental and Resource Studies Program.
R. D. Evans, and F. H. Rigler.
Water, Air, and Soil Pollution, Vol. 24, No. 2, p 141-151, February, 1985. 4 Fig, 1 Tab, 28 Ref.

Descriptors: *Lead, *Lake sediments, *Atmospheric deposition, *Ontario, *Quebec, Heavy metals, Lead radioisotopes, Path of pollutants, Spatial distribution, Fallout.

Long-term atmospheric deposition of Pb has been measured using lake sediment cores. The average 'whole-lake' Pb burden was measured for several lakes in each of four regions located throughout Ontario and Quebec, Canada. Since the regions were remote to any point source of Pb, large scale variation in atmospheric transport could be studied. The results indicate that Pb deposition is highest in South-Central Ontario, where lake burdens ranged from 312 to 432 mg/sq m, and that it decreases in an eastward direction into Quebec. Lowest deposition was at the site farthest north, Schefferville, Quebec, where fallout was 31 to 42 mg/sq m, less than one-tenth of that previously observed in South-Central Ontario. Lead-210 dating of sediment cores from the northern site showed that input to these remote lakes has occurred over the same time period as in the southern sites. (Author's abstract)
W85-05691

SEASONAL VARIATIONS OF OIL RESIDUES IN WATER OF SHATT AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Marine Science Centre.
A. A. Z. Douabul, and H. T. Al-Saad.
Water, Air, and Soil Pollution, Vol. 24, No. 3, p 237-246, March, 1985. 3 Fig, 5 Tab, 34 Ref.

Descriptors: *Shatt al-Arab River, *Iraq, *Oil pollution, *Seasonal variation, Water pollution sources, Fate of pollutants, Hydrocarbons, Distribution, Wastewater pollution, Urban runoff.

The Shatt al-Arab River is the most important river and the only source of fresh water in the arid surroundings of southern Iraq. Shatt al-Arab waters are liable to contain petroleum origin wastes because of the numerous oil operations. Five sampling sites were selected to represent different regions of the north section of Shatt al-Arab River. A reference stations was chosen at the Euphrates River. The distribution and seasonal variations of petroleum residues in the water column were determined spectrofluorometrically. Water samples collected from the reference station throughout the study period had no measurable amounts of petroleum hydrocarbons. The petroleum residue concentrations in the Shatt al-Arab River water column were found to vary between 1.7 to 35.4 micro-g/L Kuwait crude oil equivalents. The results suggested that petroleum hydrocarbons present in this river originated from diverse sources. Sewage discharge and urban runoff may be the most significant sources of oil entering the river. It is estimated that the river transports about 48 tons of petroleum hydrocarbons to the Arabian Gulf annually. Hydrocarbon amounts tend to be highest in winter (averaged 17.4 micro-g/L) and lowest in summer (averaged 3.1 micro-g/L). Processes brought about by temperature variations are postulated to produce the pronounced seasonal variation in petroleum residues, while variations in the water volume of the river seem to have limited effect in this respect. (Moore-IVI)
W85-05696

PERSISTENCE OF PHENOLS IN AQUATIC MICROCOSMS RECEIVING CHRONIC INPUTS OF COAL-DERIVED OIL,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. R. Southworth, S. E. Herbes, P. J. Franco, and J. M. Giddings.
Water, Air, and Soil Pollution, Vol. 24, No. 3, p 283-296, March, 1985. 7 Fig, 1 Tab, 18 Ref. DOE contract DE-AC05-840R21400.

Descriptors: *Phenols, *Oil pollution, *Coal-derived oil, Fate of pollutants, Oil spills, Microcosms, Microbial degradation, Alkylphenols.

The environmental fate of constituent phenols of a coal-derived oil spill intermittently on water was evaluated in aquatic microcosms. Phenols dissolved rapidly from the oil into the water, and initially accumulated with sequential oil additions. The major process removing phenols from the microcosms was microbial degradation - other processes were negligible in comparison. After phenols attained maximum concentrations in the first 28 days of the study, degradation rates exceeded input rates in all microcosms during the second 28 days the study and total phenol concentrations decreased. Significant differences were apparent in the rates of degradation of various alkylphenol isomers and isomer groups, but no compounds were observed to be refractory. Upon discontinuation of oil inputs at day 56, dissolved phenols disappeared within several weeks. Microcosm exposure history and the presence of other phenol isomers affected the rate of removal of individual isomers, complicating prediction of the rate of removal of individual toxicants. (Author's abstract)
W85-05700

SILVER AND OTHER METALS IN SOME AQUATIC BRYOPHYTES FROM STREAMS IN THE LEAD MINING DISTRICT OF MID-WALES, GREAT BRITAIN,
Chelsea Coll., London (England). Dept. of Biological Sciences.
K. C. Jones, P. J. Peterson, and B. E. Davies.
Water, Air, Soil Pollution, Vol. 24, No. 3, p 329-338, March, 1985. 2 Fig, 5 Tab, 22 Ref.

Descriptors: *Bryophytes, *Silver, *Heavy metals, *Wales, Mines, Monitoring, Bioindicators, Cadmium, Copper, Lead, Zinc, Surface waters.

It is probable that wherever Pb mining has caused Pb pollution Ag is also present as a contaminant. Surface waters and three aquatic bryophytes (Scapania undulata, Hygrohypnum luridum and Polytrichum commune) in the mid-Wales Ag-Pb mining district were sampled for trace metals. This area is contaminated by heavy metals from past mining. Elevated levels of Ag, Cd, Cu, Pb, and Zn were found in water and plant tissue. Aquatic bryophytes which have been reported to accumulate Pb and other toxic metals also accumulate Ag in the same environments. This ability to accumulate these metals is especially important for Ag in view of the analytical difficulties in determining the dissolved metal which is found only at the ng/L level even in polluted waters. All the plants accumulated Ag and the other metals but Scapania appears the most suitable as a plant monitor of Ag-polluted waters. It is widely available in streams and rivers and can be collected throughout the year. (Moore-IVI)
W85-05702

INFLUENCE OF NITRATE ON THE PHOSPHORUS FLUX TO AND FROM OXYGEN DEPLETED LAKE SEDIMENTS,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2K.
W85-05716

SEASONAL DISTRIBUTION OF ENTEROVIRUSES AND ADENOVIRUSES IN DOMESTIC SEWAGE,
Institut Pasteur Hellenique, Athens (Greece). Dept. of Virology.
V. Krikelis, N. Spyrou, P. Markoulatos, and C. Serie.
Canadian Journal of Microbiology, Vol. 31, No. 1, p 24-25, January, 1985. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Seasonal variation, *Viruses, *Wastewater, *Athens, *Greece, Domestic wastes, Adenoviruses, Enteroviruses, Effluents, Poliovirus, Coxsackievirus, Echovirus.

A seasonal distribution of enteroviruses and adenoviruses in raw sewage effluents of Athens, Greece, was observed over a 15-month surveillance period. All 36 samples tested were positive for both virus groups. Adenovirus concentration levels ranged from 70 to 3200 cytopathic units per liter of sample, whereas the corresponding values for enteroviruses were 90-900 cytopathic units per liter. Peak values for adenoviruses were recorded during the months of April and June 1983, whereas for enteroviruses the peak was recorded in September 1983. All three types of poliovirus were present. Coxsackievirus types B-1, B-2, B-4, and B-5 and echovirus type 7 were also isolated. Adenovirus types 1, 2, 3, 5, 7, and 15 were detected as well. (Author's abstract)
W85-05742

FLUX OF LEAD IN SUBMERGED PLANTS AND ITS RELEVANCE TO A FRESHWATER SYSTEM,
Westfield Coll., London (England). Dept. of Botany.
M. Everard, and P. Denny.
Aquatic Botany, Vol. 21, No. 2, p 181-193, February, 1985. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Lead, *Submerged plants, Path of pollutants, Algae, Macrophytes, Mosses, Heavy metals, Epiphytes, Lake sediments, Sorption, Turbulence.

The fluxes of lead in submerged freshwater angiosperms, mosses and benthic algae were investigated by laboratory and field observations. Laboratory experiments showed that the initial uptake of lead

by angiosperm shoots and Navicula sp. was rapid (up to 0.07 mg Pb/g dry weight/min from a solution containing 1.0 mg Pb/l), and overwhelmingly passive. Mosses were especially efficient at sorbing lead from solutions containing less than 1.0 mg Pb/l. Rates of uptake increased with rising external concentrations, but decreased with time. Anatomical and morphological characteristics of plant tissues affected metal flux and an epiphytic covering of Navicula (i.e., an Aufwuchs community) sorbed metal and reduced uptake into tissue by a third. Up to 90% of the lead sorbed in the first hour by shoots of Elodea canadensis Michx from a solution containing 1.0 mg Pb/l was released within 14 days of transfer into a lead-free medium; 10% was irreversibly bound. Moss monitors placed in Ullswater, a lake with sediments containing up to 26 mg Pb/g dry weight, confirmed that the metal is brought into circulation during turbulence, but not in periods of calm. Shoots of Elodea collected from the lake contained up to 0.3 mg/g dry weight non-exchangeable lead. Young shoots tended to contain less than older shoots (0.12 compared with 0.3 mg Pb/g), and leaf more than stem tissues. The fluxes of lead from the environment through Aufwuchs and submerged plants are discussed. (Author's abstract)
W85-05745

DISTRIBUTION AND ISOTOPIC COMPOSITION OF SULFUR IN LAKE SEDIMENTS OF NORTHERN ONTARIO,
National Water Research Inst., Burlington (Ontario).
J. O. Nriagu, and Y. K. Soon.
Geochimica et Cosmochimica Acta, Vol. 49, No. 3, p 823-834, March, 1985. 5 Fig, 8 Tab, 77 Ref.

Descriptors: *Lake sediments, *Sulfur, *Isotope studies, *Water pollution sources, *Ontario, Sulfides, Sulfates, Detritus, Diagenesis, Organic matter, Sediments.

Sediments from unpolluted and highly polluted lakes in northern Ontario have been fractionated into acid volatile sulfide, HCl-soluble sulfur, elemental sulfur, pyrite sulfur, ester sulfate and carbon-bonded sulfur and the isotopic composition of each fraction determined. In general, reduced inorganic S constitutes 25-50% of the total S in the polluted surficial sediments, but is < 20% in the unpolluted samples, with pyrite formation being a minor process of S diagenesis in lake sediment ecosystems. Organic S in the form of ester sulfate and carbon-bonded S predominates and both the C/S ratios and the isotopic data suggest that, in unpolluted lakes, plant detritus can be a major contributor of organic-S to the sediments. The depth profiles observed suggest that the more labile ester sulfate is diagenetically converted to the carbon-bonded form. For the polluted sediments from the Sudbury basin, the isotopic data suggest that (a) the elemental S is derived from the oxidation of acid volatile sulfide in the aerobic surficial sediments, and (b) the isotopically light reduced S species are incorporated into the organic material. S diagenesis in lake sediments generally results in the release of S-34 to the overlying water. The suggestion is made that sulfate concentrations over 5 mg/l accompanied by an enrichment of surficial sediments with isotopically different S may signal significant inputs of pollutant S into the lake and its basin. (Author's abstract)
W85-05763

AMBIENT HYDROGEN SULPHIDE LEVELS AT A WASTEWATER TREATMENT PLANT,
National Univ. of Singapore. Dept. of Civil Engineering.
L. C. C. Koe.
Environmental Monitoring and Assessment, Vol. 5, No. 1, p 101-108, March, 1985. 4 Fig, 1 Tab, 2 Ref.

Descriptors: *Hydrogen sulfide, *Air pollution, *Wastewater treatment facilities, *Path of pollutants, Measuring instruments, Weather, Inlet structures, Clarifiers.

This paper describes a novel technique of measuring ambient hydrogen sulfide (H2S) concentrations simultaneously at several locations around a wastewater treatment plant. A commercially purchased H2S monitor is modified to operate in a 'static mode' to enable degree of darkening on pieces of lead acetate tapes to be correlated against the exposure duration and the ambient H2S concentration of sewage air. The technique can yield mapped contours of time - average H2S concentrations as low as 0.2 ppm. The methodology is exemplified for a wastewater treatment plant in Ipswich, Queensland. Isopleths of H2S concentration obtained at the wastewater site for two different meteorological conditions reveal that high levels of H2S are detected around the plant's inlet structure and primary clarifiers. (Author's abstract)
W85-05765

COMPARISONS OF SUCCESSIVE ITERATION AND DIRECT METHODS TO SOLVE FINITE ELEMENT EQUATIONS OF AQUIFER CONTAMINANT TRANSPORT,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. T. Yeh.
Water Resources Research, Vol. 21, No. 3, p 272-280, March, 1985. 5 Fig, 4 Tab, 38 Ref. DOE contract DE-AC05-840R21400.

Descriptors: *Aquifers, *Path of pollutants, *Mathematical analysis, *Groundwater pollution, *Finite element method, Computer models, Relaxation method, Gauss-Seidel method.

Iteration techniques, including successive underrelaxation (SUR), Gauss-Seidel (G-S), and successive overrelaxation (SOR) schemes, were adapted to solve finite element equations of aquifer contaminant transport. Numerical experiments were performed to assess the convergency of these iteration schemes. When the mesh Peclet number is much less than one, all three iteration schemes generate convergent computations. When the mesh Peclet number is greater than one, only SUR and G-S schemes yield convergent calculations, whereas the SOR scheme leads to divergent computations. The relative merits of the successive iteration to direct elimination methods in terms of CPU memory and CPU time requirements are compared through two simple examples. For all practical problems, successive iteration schemes offer substantial savings in the central processing unit (CPU) memory over the direct elimination scheme, without complicating the programming; the larger the problem, the more the saving. For small problems the successive iteration schemes, if convergent, require comparable CPU time to that required by the direct elimination scheme. However, for large problems, the successive iteration schemes consume only a small fraction of the CPU time used by the direct elimination scheme. (Author's abstract)
W85-05790

FINITE ELEMENT MATRIX AND MASS BALANCE COMPUTATIONAL SCHEMES FOR TRANSPORT IN VARIABLY SATURATED POROUS MEDIA,
GeoTrans, Inc., Herndon, VA.
P. S. Huyakorn, J. W. Mercer, and D. S. Ward.
Water Resources Research, Vol. 21, No. 3, p 346-358, March, 1985. 12 Fig, 4 Tab, 24 Ref, 2 Append.

Descriptors: *Unsaturated zone, *Mass balance studies, *Path of pollutants, *Finite element method, Porous media, Computer models, Soil water.

An upstream-weighted residual finite element formulation was developed for the numerical simulation of solute transport in variably saturated porous media. This formulation includes an influence coefficient scheme for element matrix evaluation and a mass balance computation scheme. These schemes are not only simple to implement but also cost effective. Three examples provided verification of the numerical techniques and demonstrate the utility of the computer model. These examples indicate that mass balance information serves a useful purpose as a screening device for examining the numerical solution. They also show certain behavior of the mass balance error as well as numerical difficulties associated with the manner in which the finite element formulation of the transport equation is performed. Information on the CPU time and cost required to solve the three example problems indicated the cost effectiveness of the transport model. Although the analysis considers only two dimensions, the scheme can be extended to three dimensions, where the time and cost savings are more significant. (Author's abstract)
W85-05798

ASSESSMENT OF BACTEROIDES FRAGILIS GROUP ORGANISMS AS INDICATORS OF HUMAN FAECAL POLLUTION,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
K. Allsop, and D. J. Stickler.
Journal of Applied Bacteriology, Vol. 58, No. 1, p 95-99, January, 1985. 1 Fig, 5 Tab, 14 Ref.

Descriptors: *Bacteroides, *Bacteria, *Feces, *Biological indicators, *Fate of pollutants, *River Thaw, *River Ely, *Wales, Water pollution sources, Pigs, Cows, Chickens, Ducks, Dogs, Cats

The role of Bacteroides fragilis group (BFG) organisms as indicators of fecal contamination was examined in natural, treated effluent and raw sewage water samples and their specificity as indicators of human fecal pollution was assessed by examining their numbers in the feces of various animals; membrane filtration techniques were used to enumerate BFG organisms and Escherichia coli. Water samples were collected from the relatively uncontaminated River Thaw and relatively clean coastal beach in the west of South Wales (Llantwit Major) and from the grossly polluted River Ely and the grossly polluted Penarth beach in the east of South Wales. Raw sewage and treated effluent were collected from a percolating filter plant, an activated sludge plant and a Pasveer Ditch. Fresh fecal samples from cows, pigs, chickens, ducks, dogs and cats were also collected. At a site 50 m below treated sewage input to the R. Thaw, the calculated mean density of presumptive (p) BFG was 199,000 100/ml with a pBFG:E. coli ratio of 2.29. The numbers of pBFG and the pBFG:E. coli ratio then decreased with distance so that at a site 2.4 km from the sewage outfall the ratio was 0.7. At sites on the R. Thaw above the sewage works, pBFG densities of 1000 100/ml were found with mean pBFG:E. coli ratios of 1.81 to 2.13. BFG were either absent or present in only small numbers in the animal feces samples. Pollution upstream of the sewage treatment plant on R. Thew is probably from domestic sources. The results suggest that BFG organisms die off more rapidly than E. coli in water and that animal feces are not a significant source of BFG. The ratio BFG to E. coli in water may be used to indicate the proximity of a source of human fecal contamination. (Collier-IVI)
W85-05808

ROLE OF IMMUNOASSAY IN THE ANALYSIS OF MICROCONTAMINANTS IN WATER SAMPLES,
Surrey Univ., Guildford (England). Dept. of Biochemistry.
For primary bibliographic entry see Field 5A.
W85-05811

5C. Effects Of Pollution

EFFECT OF METALS AND CYANIDE ON FERTILIZATION IN RAINBOW TROUT (SALMO GAIRDNERI),
Institut National de la Recherche Agronomique, Jouy-en-Josas (France). Lab. de Physiologie des Poissons.
R. Billard, and P. Roubaud.
Water Research, Vol. 19, No. 2, p 209-214, 1985. 6 Fig, 1 Tab, 27 Ref.

Descriptors: *Trout, *Water pollution effects, *Toxicity, *Metals, *Cyanide, *Fertilization, Growth stages, Fish eggs, Tris, Iron, Copper, Cyanide, Zinc, Life cycles.

ne effects of several heavy metals and cyanide on rtilization were studied in rainbow trout. Two sts were carried out. (1) The gametes were ex-ssed independently for 40 min to a test chemical ded into diluents. The ovum diluent (ID) was a aCl solution (osmotic pressure: 250 mOsm/kg), H 9.0, Tris 20 mM, glycine 50 mM. The sper-atozoa were diluted at 0.1 and 0.01 and the same luent with K(+) added; they were immobile in e diluent (CD). Insemination was carried out er the gametes had been washed. (2) Ova and ermatozoa were mixed together in ID containing e of the chemicals to be tested (insemination st). In test 1 in which gametes were exposed over extended time, the chemicals were only very ghtly toxic to ova compared to sperm. Iron came toxic for ova at a concentration of 0.073 g/l and the toxic thresholds of the other products ere higher than 1 mg/l. The chemicals had a ore marked toxic effect on sperm diluted at 0.01 the following decreasing order (in mg/l): chro-um 0.005, iron 0.005, cyanide 1, zinc 20. Insemi-tion sometimes revealed lower thresholds of tox-ty: chromium 0.005, iron 0.08, cyanide 0.001, ercury > 1. Copper had a favorable effect on rtilization. The tests, and particularly the insemi-tion test, could be used to monitor the toxic fect of a chemical on a stage of the life-cycle of h which has been little studied up to now. (Au-or's abstract)
85-04976

UTAGENIC ACTIVITY IN ORGANIC CON-ENTRATE FROM NISHITAKASE RIVER ATER IN KYOTO CITY, AND ITS FRAC-ONS SEPARATED BY USING LIQUID-QUID FRACTIONATION AND THIN LAYER HROMATOGRAPHY,
yoto City Inst. of Public Health (Japan).
or primary bibliographic entry see Field 5A.
85-04980

MPLE CULTIVATION UNIT FOR THE VALUATION OF ALGAL GROWTH POTEN-AL AND TOXICITY OF WATER,
eskoslovenska Akademie Ved, Trebon. Dept. of ydrobotany.
or primary bibliographic entry see Field 7B.
85-04983

DE EFFECTS OF 58 YEARS OF COPPER ULFATE TREATMENT OF THE FAIRMONT AKES, MINNESOTA,
innesota Univ., Minneapolis. St. Anthony Falls ydraulic Lab.
or primary bibliographic entry see Field 5G.
85-04996

PTAKE OF CADMIUM BY EGGS AND ALE-INS OF ATLANTIC SALMON (SALMO ALAR) AS INFLUENCED BY ACIDIC CONDI-IONS,
epartment of Fisheries and Oceans, St. Andrews lew Brunswick).
H. Peterson, J. L. Metcalfe, and S. Ray.
ulletin of Environmental Contamination and oxicology, Vol. 34, No. 3, p 359-368, March, 85. 1 Fig, 9 Tab, 11 Ref.

escriptors: *Cadmium, *Salmon, *Hydrogen ion oncentration, *Water pollution effects, Fish, Ab-rption, Fish eggs, Immature growth stages, eavy metals.

he uptake of cadmium by chorion, embryo and olk of Atlantic salmon eggs and of alevins result-g from three levels of Cd exposure, at each of ur incubation pH's was examined. Cd accumula-on by salmon eggs was strongly influenced by the H of the incubation medium. The Cd levels in gs exposed to various pH levels with no added d varied from 0.04 to 0.10 microg/g with no gnificant difference. For eggs exposed to Cd, owever, Cd accumulation was strongly influ-nced by the ambient pH. The Cd accumulation by e salmon egg is rapid with the concentrations pparently equilibrating within the first 24 hr of posure, compared with 48 hr for rainbow trout gs. The distribution of Cd in the Atlantic salmon egg, after exposure to 1-5 microg/L Cd in ambient water at pH 6.8, is similar to that described for rainbow trout eggs. Examination of mean alevin lengths for the various treatments indicates the nature of the effects of low pH and Cd. In the absence of Cd, alevins were progressively smaller at lower pH levels. Alevins hatching at pH 4.5 were larger at higher ambient Cd concentrations. (Baker-IVI)
W85-05012

NITRITE TOXICITY TO THE CRAYFISH PRO-CAMBARUS CLARKII,
Texas Dept. of Water Resources, Amarillo.
M. P. Gutzmer, and J. R. Tomasso.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 3, p 369-376, March, 1985. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Nitrites, *Toxicity, *Crayfish, Respiratory pigments, Oxidation, Hemocyanin, Chlorides.

The 24-, 48-, 72-, and 96-hr LC-50's of nitrite to crayfish of different weights and genders in freshwater were determined along with the LC-50's of nitrite to crayfish in water with elevated chloride concentrations and hemolymph nitrite concentrations in crayfish exposed to nitrite in freshwater and water with elevated chloride concentrations. Results indicate that nitrite is toxic to crayfish at concentrations similar to those which are toxic to many freshwater fishes. The primary mechanism of nitrite toxicity to crayfish, however, has not yet been identified. In vertebrates, nitrite causes the oxidation of hemoglobin to methemoglobin, a form not capable of binding and transporting oxygen. The animal then suffers from a functional hypoxia. Crayfish contain the respiratory pigment hemocyanin rather than hemoglobin. Hemocyanin regularly goes through oxidation-reduction reactions as it binds and releases oxygen. The reversibility of hemocyanin oxidation-reduction coupled with the observation of extremely high levels of nitrite in the hemolymph may indicate that nitrite toxicity in crayfish is not related to oxidation of the respiratory pigment as it is in vertebrates. (Baker-IVI)
W85-05013

MORTALITY OF EARLY LIFE STAGES OF LARGEMOUTH BASS, MICROPTERUS SAL-MOIDES DUE TO PENTACHLOROPHENOL EXPOSURE,
Queen's Univ., Kingston (Ontario). Dept. of Biology.
P. H. Johansen, R. A. S. Mathers, J. A. Brown, and P. W. Colgan.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 3, p 377-384, March, 1985. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Pentachlorophenol, *Bass, *Toxicity, Organic compounds, Mortality, Biocides, Chlorinated hydrocarbons, Phenols.

The toxicity of pentachlorophenol (PCP) to various life-cycle stages of a warm water species, the largemouth bass, is reported. Long term exposures to low concentrations of PCP are used to calculate the highest PCP concentration which causes no significant increase in mortality. Between 28 and 49 days of age largemouth bass fry become significantly less tolerant to PCP poisoning. PCP is a general metabolic poison which at low concentrations uncouples oxidative phosphorylation without retarding electron transport. At higher concentrations it reduces the activity of some glycolytic enzymes while increasing the activity of some enzymes of the HMP pathway and TCA cycle along with cytochrome oxidase. A shift in some facet of energy metabolism occurs at around 30 to 40 days of age which accounts for the reduction in PCP tolerance found at this time period. For the long term exposure tests the weekly length measurements of the first 5 weeks of PCP exposure were subjected to regression analysis and a slightly reduced growth was noted at the 3 higher PCP concentrations, but this was not significant. An ich infection occurred and was most severe on fish from 83 microg/L concentrations with over 102 white spots in total while all others, including controls, ranged between 32 and 0 though not in a dose related fashion. It would appear then that the highest concentration of PCP was definitely imposing a physiological load making the fish more susceptible to infection. (Baker-IVI)
W85-05014

PENTACHLOROPHENOL AND TETRACH-LOROPHENOLS IN WADDEN SEDIMENT AND CLAMS MYA ARENARIA OF THE JADE-BUSEN AFTER A 14-YEAR PERIOD OF WASTEWATER DISCHARGE CONTAINING PENTACHLOROPHENOL,
Oldenburg Univ. (Germany, F.R.).
W. Butte, J. Denker, M. Kirsch, and T. Hopner.
Environmental Pollution (Series B), Vol. 9, No. 1, 29-39, 1985. 4 Fig, 3 Tab, 22 Ref.

Descriptors: *Pentachlorophenol, *Tetrachlorophenol, *Jadebusen, *Germany (Federal Republic), *Wadden sediment, *Clams, Water pollution effects, Sediments, Chlorinated hydrocarbons, Anaerobic conditions. Mollusks.

Pentachlorophenol (PCP) and tetrachlorophenol (TCP) concentrations in anaerobic Wadden sediments and clams of the Jadebusen were determined two years after the end of a long-lasting discharge of PCP into the region. Concentrations of PCP were of the same order of magnitude as those determined in sediments and organisms of the Weser estuary; concentrations after acid hydrolysis were 2-5 times higher than those of free PCP. 2,3,4,5-TCP contents exceeded those of PCP eight times in sediments and fifteen times in clams. PCP and 2,3,4,5-TCP were accumulated in clams 100- to 1000-fold compared with sediments. It is assumed that, under anaerobic conditions, a reductive dechlorination of PCP occurs, resulting in 2,3,4,5-TCP, which is more persistent than PCP in the environment under study. (Author's abstract)
W85-05028

EFFECT OF SEWAGE WITH SPECIAL REFER-ENCE TO AQUATIC INSECTS IN THE RIVER KSHIPRA (INDIA),
Madhav Science Coll., Ujjain (India). Dept. of Zoology.
N. Mishra, and A. B. Saxena.
International Journal of Environmental Studies, Vol. 23, No. 3/4, p 191-208, October, 1984. 3 Fig, 18 Tab, 11 Ref.

Descriptors: *Water pollution effects, *Wastewater pollution, *Aquatic insects, *Kshipra, *India, Insects, Industrial wastes, Textile industry, Water quality, Monsoons.

Insects are important organisms in the aquatic biotype and occupy almost all conceivable habitats. The river Khan receives a load of 8.5 mgd of city sewage and textile industrial wastes. After a flow of 64 km the river joins with the river Kshipra at Triveni. During the monsoon season the industrial effluents for Indore city are drained to the stream, causing detrimental effects on insect fauna and water quality. At Gaughat, the tolerant organisms have been observed only in the monsoon season because the water quality is so poor. High densities with diversified fauna were observed in late winter and summer season. A reduction in the number of species at Chakrateertyha clearly shows that raw sewage causes deleterious effects on the insect community. Tolerant organisms of Eristalis spp., Psychoda spp. and Chironomidae spp. are well adapted to the poor water quality environment. At Gaughat a highly diversified insect fauna has been noticed which clearly indicates that the water quality is normal with few exceptions. Sewage causes drastic change in the insect community structure, indirectly affecting the fish production. (Baker-IVI)
W85-05029

INTERACTIONS OF COPPER AND LEAD WITH NOSTOC MUSCORUM,
Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-05040

EFFECT OF METAL-RICH SEWAGE SLUDGE APPLICATION ON THE BACTERIAL COMMUNITIES OF GRASSLANDS,
California Univ., Irvine. Environmental Analysis Div.
T. Barkay, S. C. Tripp, and B. H. Olson.
Applied and Environmental Microbiology, Vol. 49, No. 2, p 333-337, February, 1985. 3 Tab, 40 Ref.

Descriptors: *Water pollution effects, *Cadmium, *Metals, *Sewage sludge, *Grasslands, *Bacteria, *Land disposal, Wastewater disposal, Species diversity.

The effect of long-term application of heavy metal-laden sewage sludge on the total heterotrophic aerobic and the cadmium-resistant soil bacterial communities was studied. Gram-positive bacteria were completely absent from resistant communities. These findings suggest that this group is highly susceptible to Cd. Shannon's diversity indices estimated for total communities did not reveal negative effects on the communities that developed in the presence of sludge. However, Cd-resistant communities isolated form long-term sludge-amended soils were more diverse than the resistant communities from a control sample, suggesting that adaptation to Cd as a stressor had occurred in the presence of sludge constituents. This higher diversity was attributed to Cd resistance in pseudomonads and gram-negative fermenters. Resistance did not develop by dissemination of Cd resistance plasmids, because these were rarely detected in the genomes of resistant strains. (Author's abstract)
W85-05047

QUANTITY AND COMPOSITION OF PHYTOPLANKTON, PARTICULARLY CHLOROPHYTA, IN LAKES OF DIFFERENT TROPHIC LEVELS,
For primary bibliographic entry see Field 2H.
W85-05065

EFFECTS OF H2SO3 AND H2SO4 ON ANABAENA CYLINDRICA (LES EFFETS DU H2SO3 ET DU H2SO4 SUR ANABAENA CYLINDRICA (CYANOPHYTE)),
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium). Unite d'Ecologie et de Biogeographie.
C. Brauwers.
Bulletin de la Societe Royale de Botanique de Belgique, Vol. 117, No. 2, p 267-276, 1984. 1 Fig, 3 Tab, 34 Ref.

Descriptors: *Sulfuric acid, *Water pollution effects, *Anabaena, Cyanophyta, Chlorophyll, Nitrogenase, Toxicity, Nitrogen fixation.

The blue-green alga was exposed during 2 hours to pure solutions of pollutants, the effects of which were examined on the chlorophyll content and synthesis and on the nitrogenase activity. On the basis of the chlorophyll content measured one day after the treatment, the lethal dose 50 is 0.13 meq/l. The nitrogenase activity is more sensitive; a reduction of 35% is observed at 0.05 meq/1. At equal pH, H2SO4 is not so toxic as H2SO3. But the acidity is particularly harmful to Anabaena; at pH ranging from 4.6 to 5.0, H2SO4 severely injures the N2 fixation. (Author's abstract)
W85-05071

TOXICITIES OF BUTOXYETHANOL ESTER AND PROPYLENE GLYCOL BUTYL ETHER ESTER FORMULATIONS OF 2,4-DICHLOROPHENOXY ACETIC ACID (2,4-D) TO JUVENILE SALMONIDS,
California State Dept. of Fish and Game, Rancho Cordova. Pesticide Investigations Unit.
B. J. Finlayson, and K. M. Verrue.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 2, p 153-160, March, 1985. 2 Fig, 4 Tab, 25 Ref.

Descriptors: *Toxicity, *Fish, *Dichlorophenoxy acetic acid, Water pollution effects, Butoxyethanol ester, Propylene glycol butyl ether ester, Herbicides, Salmon, Trout, Immature growth stages.

Continuous flow toxicity tests were conducted to determine acute toxic effects of butoxyethanol ester (BOEE) and propylene glycol butyl ether ester (PGBEE) formulations of 2,4-dichlorophenoxy acetic acid (2,4-D) on juvenile chinook salmon and steelhead-rainbow trout. A chronic toxicity test with chinook salmon egg-to-fry was conducted to determine effects of BOEE on survival and growth. The hydrolysis in water of 2,4-D esters to 2,4-D acid was influenced by the presence of fish. The PGBEE proved to be slightly more acutely toxic to salmonids than BOEE. Chinook salmon were generally more sensitive to BOEE than steelhead-rainbow trout, and fry were as sensitive as smolts. The estimated MATC for BOEE is 40 micro-g/liter for chinook salmon during continuous egg-to-fry exposure. The dynamics of 2,4-D esters in water are greatly influenced by the presence of fish. The relationship between the organism's ability to hydrolyze (detoxify) BOEE and the toxicity of BOEE needs clarification. (Baker-IVI)
W85-05105

CHOLINESTERASE ACTIVITIES IN DEVELOPING AMPHIBIAN EMBRYOS FOLLOWING EXPOSURE TO THE INSECTICIDES DIELDRIN AND MALATHION,
Universidad Nacional del Comahue, Buenos Aires (Argentina). Dept. de Quimica.
M. C. de Llamas, A. C. de Castro, and A. M. Penchen de D'Angelo.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 2, p 161-166, March, 1985. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Malathion, *Dieldrin, *Amphibians, *Water pollution effects, Insecticides, Toads, Embryos, Behavior, Chloinesterase.

An attempt was made to determine the effect of malathion and dieldrin on amphibian embryo cholinesterase. Toad embryos were exposed to dieldrin and malathion during development. Dieldrin treatment induced hyperactivity in the swimming larvae. Malathion showed no detectable behavioral effects. In vivo adsorption of dieldrin by the oocyte produced delayed toxicity in the embryo. In vitro inhibition of AChE was not sigificant. Embryogenesis was interrupted by 47.3 mg/liter of malathion in the medium. But 0.47 mg/liter permitted the embryos to complete their development without the appearance of any observable malformations. (Baker-IVI)
W85-05106

DETECTION AND ANALYSIS OF INTERACTIONS BETWEEN ATRAZINE AND SODIUM PENTACHLOROPHENATE WITH SINGLE AND MULTIPLE ALGAL-BACTERIAL POPULATIONS,
Waterloo Univ. (Ontario). Dept. of Biology.
R. E. Burrell, W. E. Inniss, and C. I. Mayfield
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 2, p 167-177, March, 1985. 8 Fig, 3 Tab, 32 Ref.

Descriptors: *Toxicity, *Algae, *Bacteria, *Atrazine, *Sodium pentachlorphenate, Organic compounds, Insecticides, Water pollution effects, Microcosms.

A multispecies-multitoxicant batch culture test system was examined in detail through the study of its component parts. The toxicants used were sodium pentachlorophenate and atrazine and the test organisms were the green algae Ankistrodesmus braunii and Chlorella vulgaris, and the bacterium Chromobacterium violaceum. Amensalism occurred between the two algae in mixed cultures. A. braunii was inhibited by the C. vulgaris and the C. vulgaris was unaffected by A. braunii. Sodium pentachlorophenate and atrazine interacted additively, over a wide range of concentrations, with the individual algae. When both algae and both toxicants were in the microcosm, synergism was noted between Na-PCP and C. vulgaris; this synergistic interaction was modified by the presence of atrazine. The Na-PCP and atrazine interacted antagonistically with both algae as the net atrazine toxicity decreased significantly with increasing concentration of Na-PCP. The presence of the bacterium C. violaceum had no effect on the antagonistic interaction of the two toxicants with A. braunii. These results clearly demonstrate that the types of interaction observed in a complex population are directly related to several factors including the type and number of organisms and the type and number of toxicants present in the test system. The application of the graphical technique of Burrell and Corke (Bull. Environ. Contam. Toxicol. Vol. 25, p 554-561, 1980) simpified determinations of interactions in complex microcosms. (Baker-IVI)
W85-05107

IONOREGULATORY AND TOXICOLOGICAL RESPONSES OF STONEFLY NYMPHS (PLECOPTERA) TO ACIDIC AND ALKALINE PH,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
R. A. Lechleitner, D. S. Cherry, J. Cairns, and D. A. Stetler.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 2, p 179-185, March, 1985. 6 Fig, 1 Tab, 33 Ref.

Descriptors: *Toxicity, *Stoneflies, *Nymphs, *Acidic water, *Alkaline water, Water pollution effects, Hydrogen ion concentration, Bioassay, Aquatic insects.

In the present study 96 hr static bioassays were used to determine the toxicity of extreme pH to nymphs of three species of stoneflies. The effect of low pH on the regulation of major cations by Pteronarcys proteus was determined, and alterations in gill tissue ultrastructure were observed in nymphs of P. dorsata exposed to extreme pH. The acidic and alkaline 96 hr LC50 values were 2.8 to 3.3 and 12.1 to 10.3, respectively. Exposure to pH 3.0 for 72 hr or longer caused a significant loss of sodium from nymphs of P. proteus. Morphological changes, including distension of cuticular disk and increased number of vesicles, were observed in gill tissue from nymphs of P. dorsata exposed to pH 2.5 for 9 hr while minor changes were observed in nymphs exposed to pH 4.0 for 96 hr. Changes in gill tissue ultrastructure included an increase in number of vesicles and a decrease in number and size of mitochondria in nymphs exposed to alkaline pH of 11.75. (Baker-IVI)
W85-05108

METALS IN RIPARIAN WILDLIFE OF THE LEAD MINING DISTRICT OF SOUTHEASTERN MISSOURI,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
K. R. Niethammer, R. D. Atkinson, T. S. Baskett, and F. B. Samson.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 2, p 213-223, March, 1985. 2 Fig, 7 Tab, 30 Ref.

Descriptors: *Lead, *Mining wastes, *Wildlife, *Missouri, Vertebrates, Trophic levels, Fate of pollutants, Riparian zone, Water pollution effects, Birds, Muskrats, Frogs, Snakes.

Information was sought on heavy metals in riparian vertebrates primarily representing upper trophic levels within the Big River drainage. Big River is subject to metal pollution via erosion and seepage from large tailings piles from inactive lead mines. Bullfrogs, muskrats, and green-backed herons collected downstream from the source of metal contamination to Big River had significantly higher lead and cadmium levels than specimens collected at either an uncontaminated upstream site or on Black River. Elevated lead levels were noted in northern water snakes below the tailings source, but cadmium did not seem to be accumulated. Northern rough-winged swallows did not seem to have levels of lead, cadmium, or zinc related to collecting locality. Differences between zinc concentrations in vertebrates collected from contaminated and uncontaminated sites were less apparent than differences in lead and cadmium. Downstream from the source of tailings, bullfrogs had

narkedly higher levels of these metals in most of heir tissues. (Baker-IVI)
W85-05110

NATIONAL PESTICIDES MONITORING PROGRAM: RESIDUES OF ORGANOCHLORINE CHEMICALS IN FRESHWATER FISH, 1980-1981,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5B.
W85-05111

EFFECTS OF DEICING SALTS ON WATER CHEMISTRY AND VEGETATION IN PINHOOK BOG, INDIANA DUNES NATIONAL LAKESHORE,
National Park Service, Omaha, NE. Midwest Region.
D. A. Wilcox.
Research/Resources Management Report MWR-2, August 1982. 139 p, 32 Fig, 19 Tab, 127 Ref, 1 Append.

Descriptors: *Water pollution sources, *Salts, *Water pollution effects, *Peat bogs, *Ecological effects, *Fate of pollutants, *Path of pollutants, *Vegetation effects, Sodium chloride, Chemical properties, Path of pollutants, Mosses, Environmental effects, Environmental impact statement, Vegetation regrowth, Revegetation, Salt tolerance, Salinity, Salt intrusion, *Indiana, Deicers, *Road salting effects.

A study was conducted in 1979-1981 to identify the effects of salt intrusion from a road-salt storage pile on water chemistry and vegetation in Pinhook Bog, La Porte Co, Indiana, and to determine the fate of salt and any resulting yearly changes in water chemistry or vegetation patterns. The impacted area showed salt concentrations as high as 468 milligrams/liter Na and 1215 milligrams/liter Cl within the plant root zone of the peat mat. The salt concentrations in the root zone decreased significantly each year from 1979 to 1981. Analysis of salt movement suggested that the salt was transported vertically downward by water movement through the peat mat following snow melt and heavy precipitation events each spring. Vegetation surveys in 1980 showed an absence of numerous native species in the salt impacted area; these were replaced by invading species. By 1981, many extirpated species had become reestablished in the impacted area after declines in salt concentrations. Salt tolerance studies on Sphagnum recurvum showed reduced growth in length at NaCl concentrations found in the bog.
W85-05123

FINAL REPORT ON EFFECT OF FENTHION ON SELECTED ESTUARINE SPECIES RELATED TO FIELD STUDY,
Environmental Research Lab., Gulf Breeze, FL.
G. E. Walsh.
Report EPA-600/X-84-082, May 1984. 5 p, 1 Tab.

Descriptors: *Water pollution effects, *Estuaries, *Fenthion, *Sensitivity analysis, Cyprinodon variegatus, Menidia beryllina, Mysidopsis bahia, Paleomentes pugio, Penaeus duorarum, Fish, Invertebrates, Toxicity, Estuarine species, Sensitivity analysis.

Effects of the mosquito adulticide, fenthion, were studied through a series of acute tests with five estuarine species: Cyprinodon variegatus (Sheepshead minnow), Menidia beryllina (Inland Silverside), Mysidopis bahia (Mysid shrimp), Paleomentes pugio (Grass shrimp) and Panaeus duorarum (Pink shrimp). LC 50 values (calculated concentrations lethal to 50% of the test organisms) established the sensitivity of each organism and the range of concentrations at which these common test organisms might be affected. LC 50 values are reported in micrograms of fenthion in 1.0 l of seawater (ppb) after 24, 48, 72 and 96 h of exposure. Mysidopsia bahia and P. duorarum were approximate 3000-4500 times more sensitive than fishes in the 24 h static test. Fish showed an almost immediate response when exposed to fenthion. For M. Beryllina there were signs of distress within the 3rd or 4th h of exposure. Cyprinodon variegatus showed similar effects by the 8th h of exposure. Mortality occurred quickly in fish, between the 4th and 16th h, tapering off to almost no fatalities after 24 and 48 h. The only invertebrate to show effects before 8 to 16 h was the penaeid. Unlike fishes, mortality in invertebrates usually occurred after 16-24 h, with continued mortality to 48h (static test). Flow-through tests to the penaeid did not differ from the static test. However, the mysid was almost twice as sensitive in flow-through tests in static test.
W85-05124

ETHYLBENZENE, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W85-05126

EFFECTS OF CARCINOGENS, MUTAGENS, AND TERATOGENS ON NONHUMAN SPECIES (AQUATIC ANIMALS),
Environmental Research Lab., Gulf Breeze, FL.
J. A. Couch, W. P. Schoor, W. Davis, and L. Courtney.
Fourth Annual Report, NCI/EPA Collaborative Program, Fiscal Year 1982; Report EPA-600/9-83-005. 46 p, 5 Fig, 9 Tab.

Descriptors: *Carcinogens, *Mutagens, *Teratogens, Toxicity, Bioindicators, Pollutant Identification, Field Tests, Metabolisms, Water pollution effects.

Aquatic systems and organisms are under both laboratory and field study in order to develop indicator, screening, and modeling capabilities for detection and evaluation of risks of carcinogens, mutagens, and teratogens. Several advances have been made in the development of laboratory and field carcinogen assays, utilizing fishes such as the sheepshead minnow (liver lesions via benzidine and aflatoxin exposures), Menidia penisulae (liver lesions via aflatoxin exposures), and freshwater cat fish (papillomatous-like lesions via chlorinated effluent exposures). Emphasis is still placed on the development and utilization of critical life stage exposures (e.g., embryo and newly hatched fry exposures) in order to expedite carcinogen tests and minimize time required for tumorogenic responses. Preneoplastic hepatic lesions development in Menidia at 12 weeks suggests promise for this species and exposure method. A novel approach has shown that tiger salamanders may be good biochemical and histologic indicators of the presence of certain carcinogens (polycyclic aromatic hydrocarbons-PAH's). Considerable field monitoring work on mollusks and carcinogenic PAH's along the coast of Oregon has revealed a positive correlation between prevalence of cellular proliferation disorders in shell-fish and higher concentrations of certain PAH's in natural water. These studies reveal that fish have metabolic pathways similar to mammals for disposition of certain carcinogens. A brief study was conducted to determine possible interactions between the 9-OH BaP and salmon sperm DNA. The interaction between salmon DNA and 9-OH BaP was shown by relative fluorescence studies.
W85-05128

COMPARATIVE ANALYSES OF FISH POPULATIONS IN NATURALLY ACIDIC AND CIRCUMNEUTRAL LAKES IN NORTHERN WISCONSIN,
Columbia National Fisheries Research Lab., La Crosse, WI. Field Research Station
J. G. Wiener.
Report FWS/OBS-80/40.16, Air Pollution and Acid Rain Report 16, September 1983. 107 p, 6 Fig, 21 Tab, 151 Ref, 20 Append.

Descriptors: *Acid rain, Lake fisheries, *Hydrogen ion concentration, *Sublethal effects, *Water pollution effects, Heavy metals, Mercury, Lead, Population exposure, Wisconsin.

Fish populations in six naturally acidic (autumnal pH 5.1-6.0) and six circumneutral (autumnal pH 6.7-7.5) clear-water lakes in north central Wisconsin were studied, and characteristics of fish populations and communities in the lakes were compared. The two groups of lakes were morphologically similar and of the same hydrologic types, but differed substantially in pH, alkalinity, waterborne calcium, and related chemical characteristics. Fish communities in the acidic lakes contained fewer species, and common as well as rare species occurred with lower frequency in the acidic lakes than in the circumneutral lakes. Certain taxa, such as minnows and darters were well represented in the circumneutral lakes, but were absent or scarce in the acidic lakes. Growth, condition, and serum calcium concentrations of bluegills were negatively correlated with population density and were not related to either pH or waterborne calcium concentrations in these lakes. Results of serum calcium analyses suggested that white suckers were stressed in lakes with autumnal pH equal to or less than 5.6 and waterborne calcium equal to or less than 2.0 mg/l. Mean concentrations of Cd and Pb in whole, 4-year-old bluegills were inversely correlated with both pH and waterborne calcium concentration. Mercury levels in axial muscle tissues of walleyes from two acidic lakes were substantially higher than in walleyes of the same age from three circumneutral lakes and exceeded the 1.0 micro g/g USFDA Action Level in about 35% of the fish analyzed.
W85-05132

EFFECT OF OIL POLLUTION ON PROCESSES OCCURRING IN WATER BASINS,
V. V. Bogorodskii, and M. A. Kropotkin.
Water Resources, Vol. 11, No. 1, p 89-94, January-February, 1984. 3 Fig, 23 Ref. Translated by Vodnye Resursy, No. 1, p 161-168, January-February, 1984.

Descriptors: *Water pollution effects, *Oil spills, *Oil pollution, Evaporation, Marine environment, Solar radiation, Atmospheric physics, Toxicity, Waves, Gas exchange, Temperature effects, Melting.

Data on the effect of oil pollution on biological and physicochemical processes occurring in a water basin are reviewed and the results are presented of a study of the effect of oil pollution on the penetration of solar radiation into water masses and on the temperature of the water surface. Oil films slow the process of evaporation, still waves on the water surface, disturb gas exchange between the atmosphere and ocean, attenuate the ultraviolet and photosynthetic components of solar radiation penetrating the water, under certain conditions can lead to a change in the surface temperature by several degrees, and affect a number of other physicochemical processes occurring on the surface of the basin and in the water column. They also have a substantial effect on the thermal regime and process of melting of the snow-ice cover, on interaction of the atmosphere and ocean, and on marine fauna and flora. Thus, oil films pose a serious potential danger. (Baker-IVI)
W85-05151

OIL SPILLS: WHAT HAVE WE LEARNED,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
J. H. Vandermeulen.
In: Oil and Dispersants in Canadian Seas: Research Appraisal and Recommendations, EPS 3-EC-82-27, May 1982, Environmental Protection Service, Ottawa (Ontario). p 29-46, 3 Tab.

Descriptors: *Oil spills, *Water pollution effects, *Environmental effects, *Cleanup operations, *Dispersants, *Oil pollution, *Marine environment, *Fate of pollutants, Ecological effects, Oil slicks, Reviews, Salt marshes, Oil, Marine sediments, Bays.

Four oil spills in Canadian marine waters have been the site of research studies - the 1970 ARROW spill, the 1973 Alert Bay spill, the 1974 GOLDEN ROBIN spill and the recent 1979 KUR-

DISTAN spill. In the ARROW spill, the water column took the initial brunt of the oil spill. However, the underlying bottom sediments became the long-term reservoirs for the spilled oil. Wave erosion and other natural actions aided in the rapid cleanup of shorelines following the ARROW spill. Similarly, effects of the Alert Bay spill were well diminished 1 yr after the spill. The Chaleur Bay salt marsh which was oiled in the GOLDEN ROBIN spill has shown very little recovery. The KURDISTAN spill on the Cabot strait provided an opportunity to examine the interaction of oil with ice. Dispersants have been used experimentally during the ARROW spill cleanup and the GOLDEN ROBIN spill cleanup. A number of commerically available dispersants were tested during the ARROW operation for effectiveness and toxicology. It was concluded that BP1100B was effective in removing Bunker C crude oil on the surface. In the case of the GOLDEN ROBIN, none of the four dispersants tested enhanced oil penetration into marsh sediments. The AMOCO CADIZ spill and the METULA spill are foreign spills that provide information that may be applicable to Canadian shorelines. More research should be done on Canadian and foreign spills. Follow-up studies of countermeasures to handle oil spills should be undertaken along with long-term environmental impact studies.
W85-05223

SANITARY SIGNIFICANCE OF INCREASES IN FECAL COLIFORM COUNTS ACROSS A CATFISH AQUACULTURE SYSTEM,
Pape-Dawson, San Antonio, TX.
D. W. Bennett, and J. A. Gordon.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 39-45. 5 Fig, 10 Ref.

Descriptors: *Aquaculture, *Sanitation, Salmonella, Klebsiella, Shigella, Catfish farming, Gallatin, Tennessee.

The presence of Klebsiella pneumonia in the effluent of a pilot catfish facility, located at the TVA Gallatin Stream Plant near Gallatin, Tennessee, constituted a potential public health problem. This defined fecal coliform is not only an indicator organism, but is itself highly pathogenic. More than 50% of presumed fecal coliforms isolated for study were identified as K. pneumonia. Also, Salmonella and Shigella should increase across the system if they were present in the influent. This problem, however, exists only for 2-4 of the very warmest weeks of the growing season. The public health threat from this source is minimal. It was suggested that a cationic surfactant in the sedimentation pond be studied as a disinfectant, if needed. Another factor that may be employed to lower fecal coliform counts is to increase the food-to-fish ratio during this period of time. Maintenance of catfish density around 7.5 lb/cu ft was suggested.
W85-05228

ENVIRONMENTAL CONTAMINANTS ACT: HAZARD ASSESSMENT REPORT ON CADMIUM.
Environmental Protection Service, Ottawa (Ontario).
Report 83-EHD-101, EPS 3-EP-83-9, December 1983, 38 p, 27 Ref, 2 Append.

Descriptors: *Environmental protection, *Water pollution effects, *Environmental impact statement, *Cadmium, *Water pollution control, *Literature review, *Fate of pollutants, Lethal limit, Heavy metals, Toxicity, Hazardous materials, Toxins, Metabolism, Reviews, Population exposure, Drinking water, Waste disposal, Environmental Contaminants Act, Canada.

An investigation was made jointly by the Department of National Health and Welfare and the Department of the Environment under the authority of Subsection 3(3) of the Environmental contaminants Act to determine whether activities related to the production and use of Cd and its compounds in Canada represent a significant danger to human health or the environment. The methodology of hazard assessment included a critical review of recent published and unpublished information and a comparison of existing concentrations of Cd in a variety of environmental media, biota, and humans with those concentrations representative of significant danger. On the basis of the best available information, there is insufficient evidence of hazard to warrant the implementation of national regulatory control action pursuant to the Environmental Contaminants Act at this time. However, this determination does not preclude the future use of the Environmental Contaminants Act for the control of Cd, particularly for local pollution problems in the vicinity of large discharge sources; nor does it diminish the need for existing control program associated with other statutes, or for measures to minimize releases of Cd.
W85-05302

PLANKTON OF TWIN LAKES, COLORADO,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
For primary bibliographic entry see Field 2H
W85-05303

EFFECTS OF OPERATING THE MT. ELBERT PUMPED-STORAGE POWERPLANT ON TWIN LAKES, COLORADO: 1981 REPORT OF FINDINGS,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
For primary bibliographic entry see Field 2H.
W85-05304

HERBICIDAL RESIDUES AND ENVIRONMENTAL EFFECTS FROM THE EXPERIMENTAL APPLICATION OF TWO 2,4-D FORMULATIONS TO CONTROL EURASIAN WATERMILFOIL,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
N. E. Otto, J. C. Pringle, and D. Sisneros.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-83-1. July 1983. 97 p, 41 Fig, 36 Tab, 15 Ref, 2 Append.

Descriptors: *Aquatic weed control, *Aquatic weeds, *Weed control, *Herbicides, *Organic pesticides, *Pesticides, *Ecological effects, *Pesticide residues, *Fate of pollutants, Path of pollutants, Aquatic environment, Water quality, Phytoplankton, Zooplankton, Water analysis, Chemical analysis, Gas chromatography, 2-4-D, Eurasian Watermilfoil, Banks Lake, Fort Cobb Reservoir, Washington, Oklahoma, Myriophyllum spicatum.

In response to the need for an effective and environmentally acceptable herbicide to control eurasian watermilfoil, a serious aquatic weed problem and interagency research study was initiated involving the USBR (Bureau of Reclamation) and the COE (U. S. Army Corps of Engineers). The tolerance and label amendment efforts done by the USBR are reported. Experimental small-plot applications of 2,4-D dimethylamine (DMA) and butoxyethanol ester (BEE) at rates of 20 and 40 lb. acre (22.5 and 45 kg/ha) were made at Banks Lake, Washington and Fort Cobb Reservoir, Oklahoma with subsequent water, hydrosoil, invertebrate organism, and fish flesh sample collection and analysis for residues, through 56-days posttreatment. The temporary potable water tolerance of 0.1 milligram/liter was exceeded in three 1-day posttreatment samples (of 1680 water samples analyzed of 0.18% of the total samples). No dichlorophenols were found in water, but dimethylnitrosamines in the microgram/liter range were detected in a few pretreatment and posttreatment samples from both sites. Hydrosoil 2,4-D residues were low, with concentrations ranging from 0 to 0.316 micrograms/gram of soil resulting from a 45 kilogram/ha BEE application. Trace amounts of 2,4-D dichlorophenol in the microgram/liter range were found in some hydrosoil pretreatment and posttreatment samples. Herbicide residues in fish flesh were well within the 1 milligram/liter food additive tolerance, with no evidence of bioaccumulation.
W85-05308

LIMING OF ACIDIFIED WATERS: A REVIEW OF METHODS AND EFFECTS ON AQUATIC ECOSYSTEMS,
General Research Corp., McLean, VA.
J. E. Fraser, and D. L. Britt.
Fish and Wildlife Service Report FWS/OBS 80/40.13; Air Pollution and Acid Rain Report 13, December 1982. 189 p, 29 Fig, 43 Tab, 251 Ref, 3 Append.

Descriptors: *Acid rain, *Acidic water, Acidification, Acid streams, *Lime, *Neutralization, *Fish management, *Fish, *Ecosystems, Reviews, Ecological effects, Fisheries, Water quality management, Resources management, Water management, Environmental effects, Hydrogen ion concentration, Alkalinity, Acidity, Chemical properties, Project planning.

The Interagency Task Force on Acid Precipitation which was established under the Acid Precipitation Act of 1980 has analyzed mitigation methods for acidified surface waters as part of a 10-yr National Acid Precipitation Assessment Plan. The leaching of Al into surface waters under acid conditions has proven toxic to fish. Liming has been used successfully to enhance the biological recovery of aquatic ecosystems affected by acidification. Aglime is the preferred form of liming agent for surface waters due to its ease of handling and low cost. Cost for liming projects vary and depend on planning and material costs, method of application, size and location of the surface water body, quality of surface waters and their catchment areas, acid loading rate, reapplication rate and water quality monitoring costs. Several design aspects and problems associated with liming should be considered before such a project is initiated. Liming should be chosen as a management option only when surface water has low alkalinity and high acidic input, the lake or stream is an important source for food or game fish or represents an important recreational resource, there are few confounding physical, chemical or biological factors, or the project costs are favorable compared to other options.
W85-05310

MODELING OF TOTAL ACID PRECIPITATION IMPACTS.
Acid Precipitation Series, Vol. 9, 1984. Butterworth Publishers, Boston. Edited by Jerald L. Schnoor. 222 p.

Descriptors: *Model studies, *Model testing, *Acidification, *Water pollution sources, *Fate of pollutants, *Acid rain, *Acidic water, *Mathematical models, *Lakes, *Air pollution effects, Environmental impact statement, Environmental effects, Ecological effects, Chemical properties, Water pollution effects, Hydrogen ion concentration, Acidity, Neutralization.

This volume presents reports given at the American Chemical Society's symposium on acid precipitation held in Las Vegas in the spring of 1982. Report topics include: atomospheric trajectory models for diagnosing the sources of acid precipitation, Eulerian modeling of the transport and chemical processes affecting long-range transport of sulfur dioxide and sulfate, weak acid/base systems in dilute acidified lakes and streams of the Adirondack region of New York State, an overview of Norwegian models for surface water chemistry, modeling the interrelationship of groundwater and surface water, modeling the reacidification rates of neutralized lakes near Sudbury, Ontario, modeling impacts of acid precipitation for Northeastern Minnesota, development and calibration of the integrated lake-watershed acidification study model and a U. S./Canada aquatic impacts assessment through the integration of experimental studies, modeling and monitoring of acidic deposition effects.
W85-05313

WEAK ACID/BASE SYSTEMS IN DILUTE ACIDIFIED LAKES AND STREAMS OF THE ADIRONDACK REGION OF NEW YORK STATE,
Syracuse Univ., NY. Dept. of Civil Engineering.

For primary bibliographic entry see Field 2H.
W85-05316

U. S./ CANADA AQUATIC IMPACTS ASSESSMENT: INTEGRATION OF EXPERIMENTAL STUDIES, MONITORING AND MODELING OF ACIDIC DEPOSITION EFFECTS,
Institute of Ecology, Indianapolis, IN.
For primary bibliographic entry see Field 2A.
W85-05322

BIOLOGICAL EFFECT OF SOME POISONS ON CANTHOCAMPTUS (CRUSTACEA SPP),
All-India Inst. of Hygiene and Public Health, Calcutta. Dept. of Sanitary Engineering.
S. V. R. Rao, and K. J. Nath.
International Journal of Environmental Studies, Vol. 21, No. 3/4, p 271-275, October, 1983. 5 Tab, 9 Ref.

Descriptors: *Water pollution effects, *Toxicity, *Crustaceans, Water quality control, Bioassays, Manganese, Phenols, Copper, Larvae.

The biological effect of some toxicants which are usually present in industrial waste discharge are considered as they pertain to a crustacean larva, Canthocamptus spp. The toxicants tested included copper (as copper sulfate), phenol, manganese (as manganese sulfate), individually and in combination. When exposed to individual toxicant concentrations, manganese exerted its toxicity even at a very low concentration followed by copper and phenol. In combination with copper and phenol, manganese increased the toxicity even at very low concentrations. In combination with copper, manganese caused the death of the organisms even at a low concentration of 0.005 mg/l Mn. Conversely, copper in combination with manganese was able to cause the death of the organisms, even at low concentrations of 0.1 mg/l Cu. Mn (2+) in combination with phenol proved lethal to the organism at very low concentrations. Quality control standards must be designed for the discharge of the effluents into the aquatic ecosystems such that they should take into consideration the additive, antagonistic and cumulative effect of the toxicants. (Baker-IVI)
W85-05446

EUTROPHICATION AND THE BALTIC SEA: CAUSES AND CONSEQUENCES,
Stockholm Univ. (Sweden). Dept. of Zoology.
U. Larsson, R. Elmgren, and F. Wulff.
Ambio, Vol. 14, No. 1, p 9-14, 1985. 2 Fig, 7 Tab, 65 Ref.

Descriptors: *Eutrophication, *Baltic Sea, Phosphorus, Nitrogen, Nutrients, Denitrification, Sediments, Water pollution effects, Water pollution sources, Phytoplankton, Atmospheric deposition, Industrial wastes, Municipal wastewater, Rivers.

The Baltic Sea is a semi-enclosed, brackish sea surrounded by highly industrialized countries and close to major sources of air pollution in central Europe. Baltic pollution problems have been recognized for some time. Observations of the problem prompted the National Swedish Environment Protection Board to make a scientific assessment of the causes and consequences of eutrophication in marine waters surrounding Sweden. The primary effect of the increased nutrient load is a higher phytoplankton primary production, with blooms maintained during the whole vegetation period. For the open Baltic proper, the rapid decrease in oxygen content of the deep water following World War II and the prevailing anoxic conditions during the last 25 years may be a sign of eutrophication. The estimated total annual loads to the Baltic are 78,000 tons P and 1,190,000 tons N, including both land-based load and airborne deposition. For phosphorus, the main inputs are from rivers and municipal sources, whereas industry and atmospheric fallout play minor roles. For nitrogen, the atmospheric input is nxt in importance to the rivers. the internal source, through nitrogen fixation is about equal to the direct municipal input. Nutrient budgets indicate that a considerable phosphorus accumulation must be taking place in the Baltic sediments. For nitrogen, increased loading and nitrogen fixation may partly be counteracted by increased denitrification, resulting in a relatively small net accumulation. (Baker-IVI)
W85-05464

FISH DEFORMITIES AND POLLUTION IN SOME SWEDISH WATERS,
National Swedish Environment Protection Board, Nykoeping. Brackish Water Toxicology Lab.
B.-E. Bengtsson, A. Bengtsson, and M. Himberg.
Ambio, Vol. 14, No. 1, p 32-35, 1985. 2 Fig, 2 Tab, 43 Ref.

Descriptors: *Sweden, *Water pollution effects, *Fish, Animal pathology, Arsenic, Metals, Morphology, Deformities.

Results of studies on morphological and skeletal deformities in fish are reviewed. The use of morphological anomalies in fish to monitor water pollution has been suggested by several researchers. The Skelleftea Bay and Adjacent area of the Bothnian Bay have been contaminated by arsenic and metals from a complex of sulfide ore smelters. In a project called Fish and Metal Pollution, a set of methods developed in the laboratory was selected for a field monitoring program to detect possible sublethal effects of exposure to pollution in fish. Specific topics covered in the Fish and Metal Pollution project, and highlighted in this report, include: meristic and morphological characters used to detect pollution (anatomical asymmetry, spinal and vertebral deformities); choice of test species; observed effects (asymmetry and deformities of fins and gill rakers, and spinal and vertebral deformities). The four-horned sculpin was chosen as a test species. (Baker-IVI)
W85-05466

MODULAR INTERACTIVE SIMULATION SYSTEM FOR EUTROPHICATION AND REGIONAL DEVELOPMENT,
Minnesota Univ., Minneapolis. Dept. of Agricultural and Applied Economics.
K. Fedra.
Water Resources Research, Vol. 21, No. 2, p 143-152, February, 1985. 6 Fig, 11 Ref.

Descriptors: *Water resources development, *Water management, *Eutrophication, Simulation, Computers, Federal water projects, Cost anaysis, Financial aspects.

An interactive, policy-oriented simulation and information system including videographics is introduced. The system is designed as a tool for learning about large, complex, regional environmental systems. A high degree of flexibility is achieved through the use of simple modules, describing elements of the system at various levels of detail and resolution. Background information from a historical data base drives the default evolution of the system. Simulation of alternative courses of action is possible at various hierarchical levels of management or policy making. The simulations and the display of results are controlled by an interactive, dialogue-oriented, user interface. This includes videographics with geographical or statistical information. The approach is discussed in terms of a pilot application project, dealing with a lake-watershed system having conflicts between water quality and regional development goals. (Baker-IVI)
W85-05494

WATERBORNE DISEASE IN COLORADO: THREE YEARS' SURVEILLANCE AND 18 OUTBREAKS,
Colorado Dept. of Health, Denver. Disease Control and Epidemiology Div.
For primary bibliographic entry see Field 5F.
W85-05521

POLLUTION CONTROL IMPLICATIONS OF FLUIDIZED BED TECHNOLOGY FOR COAL-FIRED STEAM ELECTRIC POWER GENERATION.
CH2M Hill Canada Ltd., Calgary (Alberta).
Report No. EPS 3-WP-82-2, March 1982. Environmental Protection Service, Ottawa, Ontario. Water Pollution Control Directorate. 114 p, 20 Fig, 31 Tab, 1 Append., 46 Ref.

Descriptors: *Fluidized bed process, *Water pollution control, *Water pollution effects, *Electric power, *Electric power production, *Coal, Environmental protection.

Combustion of coal in conventional pulverized coal fired (PCR) steam-electric power generating stations results in the emission of atmospheric contaminants which include sulfur dioxide, particulates, and trace elements and compounds. To meet pending regulatory limits for the emission of sulfur dioxide, PCF stations will require flue gas desulfurization (FGD) facilities when burning medium to high-sulfur coals. While this technology has been successfully demonstrated, most FGD systems produce a wet, relatively hard-to-handle sludge, and significant problems with equipment reliability have been encountered. Fluidized bed (FB) combustion technology has been proposed as a viable alternative to conventional PCF combustion, since low-grade, high-sulfur coals can be burned in FB boilers without the problems associated with FGD. This study examines the energy conversion efficiency, air emissions, solid waste production, water requirements, wastewater production, and general environmental protection requirements of a model 400-MW atmospheric fluidized bed station. These aspects are compared to those of a conventional PCF station of the same size equipped with FGD and state-of-the-art environmental control facilities. The results suggest that FB technology is a feasible alternative to conventional PCF technology where FGD is required to control sulfur dioxide emissions. The greatest potential application appears to be with medium to low-sulfur coals, where moderate calcium-to-sulfur ratios are required.
W85-05575

ECOSYSTEM DEFINITION AND COMMUNITY STRUCTURE OF THE MACROBENTHOS OF THE NEMP MONITORING STATION AT PIGEON HILL IN THE GULF OF MAINE,
New Hampshire Univ., Durham. Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W85-05580

EFFECT OF WATER CHLORINATION ON THE TOXICITY OF COPPER TO PHYTOPLANKTON,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
J. G. Sanders.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-112151, Chesapeake Biological Laboratory, June 1982. 71 p. 12 Fig, 14 Tab, 1 Append, 39 Ref.

Descriptors: *Chlorination, *Copper, *Phytoplankton, *Toxicity, Powerplants, Aquatic plants, Metals, Organic carbon, Salinity, Oxidation, Estuaries.

The application of Cl to estuarine waters usually results in oxidation of a finite quantity of organic carbon, averaging 35 microM. The quantity of carbon oxidized is independent of the concentration of Cl added. The quantity of carbon associated with the smallest molecular weight fraction increased after chlorination. Field samples collected around an actively chlorinating power plant exhibited similarly sized differences in dissolved organic carbon (DOC) concentrations, about 20 microM, between intake and discharge areas. Mass balance calculations suggest that power plant chlorination could oxidize 2 x 10 to the 7th power, moles C/yr, about 11-40% of the total DOC entering the river in freshwater flow. Cu distributions within various size fractions of natural organics did not change significantly after chlorination. The quantity of carbon oxidized is small compared to the total complexation capacity of estuarine waters. Therefore, significant shifts in metal speciation should not occur due to loss of organic complexes. Copre-

cipitation of Cu with other metal oxyhydroxides does occur, may be enhanced by chlorination, and can represent a significant transport mechanism. Bioassays of relative Cu toxicity in control and chlorinated water were hampered by the extreme effect of the Cl itself. Even after 35 days, enough Cl residuals were present to impede growth of all but the most resistant algal species. Chemical dechlorination was unsuccessful because of Cu complexation reactions.
W85-05581

OIL AND DISPERSANTS IN CANADIAN SEAS: RESEARCH APPRAISAL AND RECOMMENDATIONS.
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W85-05583

MICROORGANISMS AND THE DEGRADATION OF OIL UNDER NORTHERN MARINE CONDITIONS,
Alberta Univ., Edmonton. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W85-05585

EFFECTS OF PETROLEUM HYDROCARBONS ON PHYTOPLANKTON AND MACROPHYTES,
Department of Indian Affairs and Northern Development, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W85-05586

ZOOPLANKTON,
Environmental Protection Service, Halifax (Nova Scotia).
P. G. Wells.
In: Oil and Dispersants in Canadian Seas: Research Appraisal and Recommendations, EPS 3-EC-82-27, May 1982, Environmental Protection Service, Ottawa (Ontario). p 65-80, 2 Tab.

Descriptors: *Oil pollution, *Water pollution effects, *Zooplankton, *Marine animals, *Oil spills, *Toxicity, *Dispersants, *Ecological effects, Bioaccumulation, Plankton, Marine environment, Arctic, Crustaceans, Invertebrates, Environmental effects.

A considerable number of studies have been conducted on the toxicity of oils, dispersants, and chemically dispersed oils to marine zooplankton in Canadian waters. Collectively, these studies show the moderately to highly acute toxicity of naturally dispersed oil to various groups of zooplankton. Most of the 4-day LC50's, based on measured concentrations, range from 0.1 to 12 mg/L. Numerous adverse sublethal effects have been observed among oil-exposed zooplankton at concentrations < 1 mg/L (total measured hydrocarbons) for exposures varying from several days to weeks. Many important zooplankton have not yet been studied and among the species already tested various life stages and exposure conditions have not yet been investigated. No general relationship is known between threshold effect concentrations for key species and concentrations measured under chemically dispersed spills in Canadian waters. The effect of oil spills on zooplankton communities depends on the location, size, extent and duration of the spill. Further research is needed on the toxicology of dispersants and dispersed oil on key species to allow selection of dispersants for use on oil spills in Canadian marine waters. Additional studies should also be conducted on the bioaccumulation of spill pollutants and the recovery of key species exposed to dispersed oils.
W85-05587

EFFECTS OF OIL HYDROCARBONS AND DISPERSANTS ON FISH,
Department of Fisheries and Oceans, St. John's (Newfoundland). Biological Station.
W. R. Penrose.
In: Oil and Dispersants in Canadian Seas: Research Appraisal and Recommendations, EPS 3-EC-82-27, May 1982, Environmental Protection Service, Ottawa (Ontario). p 81-86, 1 Tab.

Descriptors: *Water pollution effects, *Dispersants, *Oil pollution, *Fish, *Bioaccumulation, *Fish behavior, *Oil, *Toxicity, Marine animals, Oil spills, Surface active agents, Fish physiology, Hydrocarbons, Aromatic hydrocarbons, Ecological effects.

Although numerous laboratory studies document the toxicity of oil and oil fractions to fish, little data has been recorded of significant fish kills caused by oil spills. Studies show that toxicity is more a function of the solubility of the oil tested than the fish species. Sublethal effects of oil on fish include responses that are difficult to monitor. Tainting of fish by petroleum hydrocarbons has frequently been recorded but the petroleum components responsible for tainting have not been identified. Many fractions of oil are readily taken up by fish. The mechanisms of toxicity are not well understood, although the aromatic hydrocarbons are suspected of disturbing the function of membranes. The aromatic constituents of oil are readily metabolized by the liver and some other organs. The toxicities of oil dispersants are not directly related to their effectiveness. At sublethal concentrations, oil-dispersant mixtures can affect swimming activity and equilibrium. Chemically dispersed oil is no more specifically toxic than undispersed oil. Areas of known spawning activity should not be subjected to dispersal treatment until more is known about the possible sublethal effects of oil dispersants.
W85-05588

BENTHIC AND INTERTIDAL ORGANISMS,
Department of Fisheries and Oceans, Ste. Anne de Bellevue (Quebec).
J. A. Percy.
In: Oil and Dispersants in Canadian Seas: Research Appraisal and Recommendations, EPS 3-EC-82-27, May 1982, Environmental Protection Service, Ottawa (Ontario). p 87-104.

Descriptors: *Water pollution effects, *Benthos, *Benthic fauna, *Benthic flora, *Invertebrates, *Oil pollution, *Dispersants, *Toxicity, Marine animals, Marine plants, Ecological effects, Benthic environment, Metabolism, Bioaccumulation, Salt marshes, Hydrocarbons, Oil spills, Oil.

Data on the effects of oil on benthic flora have largely been derived from field studies. Annuals are generally more susceptible than perennials. Moderate single-pollution incidents caused less damage to salt marsh vegetation than did successive or continuous low-level pollution by petroleum. Weathered crude is generally less toxic than fresh crude oil under laboratory conditions. Many species of marine benthic organisms dipurate hydrocarbons rapidly when transferred to clean seawater. Much research is being done on the biotransformation of hydrocarbons in marine animals. Subtidal invertebrates were generally more sensitive to petroleum than intertidal ones and larval stages were usually more susceptible than adults. Petroleum products have been shown to both stimulate and depress the metabolic rate of benthic invertebrates. Carcinogens found in crude oils can induce neoplastic growth and lesions in marine benthic organisms. Growth may prove a useful indicator of oil pollution stress in benthic organisms although benthic crustaceans vary in the degree to which their growth is impaired by exposure to oil in the laboratory. Little is known about the action of dispersants in facilitating oil entry into the substratum. The lethal effects of compounds present in dispersants on benthic crustacea have been evaluated. More research on the sublethal effects of dispersants on benthic organisms is needed before any broad generalization can be made.
W85-05589

BIRDS, OIL AND THE CANADIAN ENVIRONMENT,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
R. G. Brown.
In: Oil and Dispersants in Canadian Seas: Research Appraisal and Recommendations, EPS 3-EC-82-27, May 1982, Environmental Protection Service, Ottawa (Ontario). p 105-112.

Descriptors: *Water pollution effects, *Oil pollution, *Oil slicks, *Oil spills, *Ecological effects, *Water birds, *Waterfowl, *Hatching, Marine environments, Birds, Eggs, Oily waters, Dispersants, Ducks, Gulls.

It is difficult to accurately estimate the number of birds killed by oil spills. Oil causes a matting of the feathers and derangement of the feather barbules which leads to the breakdown of waterproofing and insulation. Autopsies of oiled birds (mallard and scaup) show abnormal conditions of the lungs, pancreas, adrenals, nasal salt gland, gastrointestinal tract, kidneys, and liver and a reduced number of white blood corpuscles. Some evidence exists that oil exposure lowers the ability of birds to respond to other environmental stresses. There are conflicting claims about whether or not oil ingestion inhibits nutrient transfer across the intestinal wall. Crude oils with a high aromatic content have a narcotic effect on marine life which possibly inhibit their escape from oil slicks. Oil on egg surfaces reduces hatchability in many species of shore birds. The ingestion of crude oil reduces the growth rates of young Herring Gulls and Black Guillemots. Various methods could be tried to attract shore birds away from oil slicks, but the effectiveness of such techniques is still unknown. Oiled seabirds can be cleaned and rehabilitated, but only with difficulty and at a great expense.
W85-05590

EFFECTS OF OIL ON MARINE MAMMALS,
Institute of Ocean Sciences, Sidney (British Columbia).
B. D. Smiley.
In: Oil and Dispersants in Canadian Seas: Research Appraisal and Recommendations, EPS 3-EC-82-27, May 1982, Environmental Protection Service, Ottawa (Ontario). p 113-123.

Descriptors: *Water pollution effects, *Oil pollution, *Mammals, *Marine animals, *Toxicity, *Oil spills, *Oil slicks, *Animal behavior, Oily water, Hydrocarbons, Ecological effects, Seals, Dolphins, Whales, Behavior, Otters, Seals.

Sea mammals do not always avoid a floating oil slick or oil-stranded beach. Behavioral stimuli may overwhelm avoidance reactions. Contact fouling of mammals by heavy or weathered oil can cause sticking of appendages and plugged body opening of pinnipeds. Soiling and evaporation by light crude irritates eyes, nostrils and other mucous membranes of seals. Oil fouling of seals, otters and other fur/hair insulated mammals can cause chilling and hypothermia, loss of buoyancy, elevated metabolism, slowed growth rates, cessation of feeding and associated weight losses, increased solar heating of skin, and death. Pinnipeds can ingest oil when grooming, suckling or eating. Uptake of toxic hydrocarbon fractions by mammals is rapid but constitutes a reversible stress. Oil dispersants remove the natural skin oils of mammals and destroy the fur's water repellency. This is particularly dangerous to polar bears, sea otters, and fur seals who are buoyed by their body covering. Research on the oiling of sea mammals following oil spills is recommended due to the difficulties in oil experimentation using live sea mammals
W85-05591

COMMUNITIES AND ECOSYSTEMS,
New Brunswick Univ., St. John. Dept. of Biology.
M. L. Thomas.
In: Oil and Dispersants in Canadian Seas: Research Appraisal and Recommendations, EPS 3-EC-82-27, May 1982, Environmental Protection Service, Ottawa (Ontario). p 125-134.

Descriptors: *Oil pollution, *Water pollution effects, *Salt marshes, *Ecosystems, *Oil spills, *Dispersants, *Marine animals, *Shores, Oil slicks, Marine environments, Fish, Species composition, Ecological effects, Environmental effects, Aquatic

habitats, Species diversity, Marine algae, Littoral environment, Intertidal areas, Littoral zone.

Research involving the effects of oil on marine communities and ecosystem is fairly recent. The magnitude and persistence of ecological effects on shoreline ecosystems depends on the amount of oil retained in the habitat. Disappearance rates vary with type of oil, climate, and weather conditions. Planktonic ecosystems vary in their response to oil depending on the species present and the type and concentration of the oil. Circumstantial evidence suggests that fish species composition and diversity of the stock may change in an oil spill area. Benthic communities show increases in opportunistic species in oiled sites and take several years to return to normal. Shoreline ecosystems are often devastated by oiling. In general, shore algae are quite resistent to oil pollution, while severe oil pollution causes either extensive mortality or narcosis to shore animals. Disappearance of grasses in salt marshes may cause accelerated erosion and habitat degradation. The use of dispersants for cleanup of oil on shorelines or in very sheltered or shallow bodies of water generally results in more extensive ecological disturbance than the oil alone.
W85-05592

DIETARY ACCUMULATION OF PCBS FROM A CONTAMINATED SEDIMENT SOURCE BY A DEMERSAL FISH SPECIES (LEIOSTOMUS XANTHURUS),
Environmental Research Lab., Gulf Breeze, FL.
N. I. Rubinstein, W. T. Gilliam, and N. R. Gregory.
Technical Report D-84-6, November 1984. Final Report. US Army Long-Term Effects of Dreging Operations Program, Army Engineer Waterways Experiment Station, Vicksburg, MS. 25 p, 2 Fig, 4 Tab, 27 Ref.

Descriptors: *Accumulation, *Polychlorinated biphenyls, *Sediments, Pollutants, Fish, Leiostomus xanthurus, Food chains, Polychaetes, Harbors.

Accumulation and Dietary transfer of polychlorinated biphenyls (PCB's) from contaminated harbor sediments were studied in a laboratory food chain consisting of sediments, polychaetes (Nereis virens), and a predatory fish (Leiostomus xanthurus). The study conducted in two phases to distinguish dietary uptake from PCB accumulation resulting from sediment exposure alone. In Phase I, fish and polychaetes were separately exposed to field-collected PCB-contaminated sediments (5.2 microgram/g dry weight s Arocolor 1242 and 1254) in flow-through seawater systems for 40 days to allow organisms to approach steady-state concentrations. In Phase II, the dietary fraction of PCB accumulation was determined by selectively feeding exposed and control groups of fish polychaetes having a known PCB body burden. In addition, the effect of direct sediment contact on PCB accumulation by L. xanthurus was investigated. Results demonstrated that contaminated sediments can serve as a source of PCB's for uptake and trophic transfer in marine systems. Fish exposed to PCB-contaminate sediments and fed a daily diet of polychaetes from the same sediment accumulated more than twice the PCB whole-body residues than fish exposed to similar conditions but fed uncontaminated polychaetes. Following 20 days of feeding, the dietary contributed of PCBs accounted for 53% of the total body burden measured in fish, and this percentage appeared to be increasing. Results also indicated that fish isolated from a direct contact with PCB-contaminated sediment accumulate significantly lower PCB body burdens than fish allowed contact with sediment.
W85-05600

STUDIES ON THE BOTTOM SEDIMENTS AND EPIPELIC ALGAE OF THE RIVER ELY, SOUTH WALES, U.K.,
University Coll., Cardiff (Wales). Dept. of Plant Science.
S. E. Antoine, R. T. Esho, and K. Benson-Evans.
Limnologica, Vol. 16, No. 1, p 1-7, September, 1984. 1 Fig, 3 Tab, 32 Ref.

Descriptors: *Bottom sediments, *Nutrients, *River Ely, *Wales, *Algae, Algal growth, River sediments, Epipelon, Aquatic plants, Organic matter, Wastewater pollution, Calcium, Phosphorus, Silica, Sodium, Potassium, Chlorophyll a.

The sediments and their associated epipelon of the River Ely were collected and studied for the first time during spring 1980. The organic matter content of the sediments was found to be affected by the amounts of both autochthonous and allochthonous organic matter supply. Treated sewage effluents contributed the allochthonous part of the organic load. The nutrient contents were closely correlated with the organic matter content. Phosphate values were found to exceed those of the nitrate since the former tend to be firmly adsorbed on the sediment particles whereas the latter is easily lost into the deeper sediment layers. Both phosphate and calcium contents were positively correlated. The silica content was mainly affected by the amounts of diatom frustules in the sediments. The low calcium content of the study area was attributed to the predominance of drift deposits in the underlying strata of the area. Calcium and magnesium were positively correlated with the organic matter content. The decomposition of dead epipelic algae and settled phytoplankton replenished some of the magnesium content of the sediment. Sodium and potassium were found in adequate supply. The epipelic algae were generally dominated by the diatoms. Highest organic matter appears most favorable for the growth of the blue green algae. The diatoms and the blue green algae were generally directly correlated with calcium and the green algae showed a reverse relationship with organic matter and calcium contents. Diatoms generally grew better on sediments with high silica content. Very high organic matter seemed not favorable for the growth of the Euglenophyta. Chlorophyll-a contents were closely correlated with the epipelic algal cell counts. Diatoms contributed most chlorophyll-a at two stations and the Euglenophyta at the other two. (Baker-IVI)
W85-05611

SEASONAL VARIATIONS OF DISSOLVED ORGANIC MATTER IN THE RIVER ELY, SOUTH WALES, U.K.,
University Coll., Cardiff (Wales). Dept. of Plant Science.
R. T. Esho, and K. Benson-Evans.
Limnologica (Berlin), Vol. 16, No. 1, p 9-14, September, 1984. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Seasonal variation, *River Ely, *Wales, *Dissolved solids, *Organic matter, Rivers, Temperature effects, Runoff, Wind, Water pollution effects, Phytoplankton, Wastewater pollution, Photosynthesis.

Seasonal variations of dissolved organic matter (DOM) in the River Ely were studied. The DOM showed local variations due to factors such as phytoplankton abundance, surface runoff, wind action and pollution at each station. Decay of sewage fungus complex at one of the sites also increased the organic load of that site. The absolute and average DOM values also showed seasonal variations at each station. The average values showed trimodal seasonal variations with maxima in October, January, and May, the latter being the highest, whereas the absolute values either showed a bimodal or trimodal seasonal distribution at the individual stations with the May maximum also being the highest at most stations. The October maximum was mainly due to the allochthonous organic matter. The highest phytoplankton populations, as indicated by the chlorophyll-a content, were obtained in May due to favorable environmental conditions for growth. Appreciable amounts of photosynthetic products liberated by the healthy planktonic algae in that month increased the DOM content. Higher temperatures in May and other suitable environmental conditions seemed to have accelerated the decomposition of coarse particulate organic matter in the stored detritus (allochthonous organic matter) and resulted in a considerable increase in the DOM content. The January peak was mainly related to land runoff after heavy rainfall and to a decrease in the rate of decomposition of organic matter during the considerable drop in water temperature. Increased mineralization of the oxidizable organic matter and dilution of the river water by rain and floods resulted in a decrease in the DOM or produced DOM fluctuations during the other months of the year. The amounts of dissolved oxygen were considerably lower than those of the total oxygen values in the months during which the higher DOM values were recorded. (Baker-IVI)
W85-05612

STUDIES ON THE BOTTOM SEDIMENTS OF AL-HAMMARA MARSH AREA IN SOUTHERN IRAQ,
University Coll., Cardiff (Wales). Dept. of Plant Science.
For primary bibliographic entry see Field 2L.
W85-05613

AMMONIFICATION AS AFFECTED BY THE OXYGEN LEVEL OF WATER,
Kalyani Univ. (India). Dept. of Zoology.
B. B. Jana, and S. K. Barat.
Limnologica (Berlin), Vol. 16, No. 1, p 67-70, September, 1984. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Ammonification, *Ponds, *Dissolved oxygen, *Water pollution effects, Dissolved oxygen, Mesotrophic lakes, Ammonia, Nitrogen, Bacteria.

A mesotrophic, freshwater fish pond was selected for measurement of ammonification rates. Measurements of ammonification rates in pond waters at various concentrations of dissolved oxygen revealed a significantly high rate under greater oxygen tension than under relatively low oxygen level. The intensive rate of ammonification in the former was confirmed by the dominance of ammonifiers. The rate of ammonification was highly correlated with the density of ammonifying bacteria. (Baker-IVI)
W85-05615

EFFECTS OF THE MARSEILLES' SEWAGE OUTFALL ON MEIOBENTHIC POPULATIONS (EFFETS DU DEVERSEMENT EN MER DU GRAND COLLECTEUR DE L'AGGLOMERATION MARSEILLAISE SUR LES POPULATIONS MEIOBENTHIQUES),
Centre Univ. de Luminy, Marseille (France). Lab. de Biologie des Invertebres Marins.
M. Keller.
Comptes Rendus Hebdomadaires des Seances Academie des Sciences, Paris, Vol. 299, Serie III, No. 19, p 765-768, December, 1984. 12 Ref.

Descriptors: *Wastewater pollution, *Marine environment, *Marine animals, *Marseilles, *France, Coastal waters, Domestic wastes, Species diversity, Water pollution effects.

The effect of an important marine pollution of domestic origin (Marseilles' sewage) on the structure of meiobenthic populations was studied. Several sectors can be pointed out: the coastal zone, very polluted, with a very poor meiofauna population but however present; the intermediate zone, polluted, relatively rich but containing a small number of species mainly tolerant; then the off-shore zone, less rich but with higher species diversity than the previous zone, under attenuated effects of the outfall. The decreasing pollution gradient from the sewage overflow to the off-shore zone is expressed, in the populations studied, by the increasing of both species diversity and Motomura's constant. (Author's abstract)
W85-05619

RELATIONSHIPS BETWEEN PHOSPHORUS LOADING AND TROPHIC STATE IN CALCAREOUS LAKES OF SOUTHEAST WISCONSIN,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Limnology and Oceanography, Vol. 30, No. 1, p 123-145, January, 1985. 1 Fig, 11 Tab, 96 Ref.

Descriptors: *Phosphorus, *Trophic state, *Calcareous lakes, *Wisconsin, Eutrophication, Chlo-

rophyll, Lake sediments, Pollution load, Mathematical models, Oligotrophic lakes, Eutrophic lakes.

The relationships among external phosphorus loading, lake phosphorus concentrations, and indices of lake trophic state are investigated for four calcareous and one noncalcareous lake in southeast Wisconsin. The total P and molybdate-reactive P concentrations during the winter and spring overturn are significantly higher in the calcareous lakes than predicted by models based on regional studies of Canadian Shield (ELA) lakes and the central New York Finger Lakes. The calcareous Wisconsin lakes have relatively low phosphorus retention coefficients and are eutrophic despite their low or only moderate external P loadings. By contrast, noncalcareous Devils Lake is oligotrophic; it is also adequately represented by the ELA loadings vs. response equations. The calcareous Wisconsin lakes and edaphically similar Lake Minnetonka, Minnesota, have lower epilimnetic chlorophyll concentrations in summer than predicted by the Dillon and Rigler equation (based on lake mean total P at spring overturn). Because these stratified lakes are frequently phosphorus-limited in midsummer, the failure of the Dillion-Rigler model may be related to seasonal cycles of mixed-layer concentrations of total P (and SRP) and also to the seasonal patterns of loading. These observations may be part of a larger edaphic pattern related to low phosphorus binding tendencies of certain calcareous lake sediments. (Author's abstract)
W85-05620

PHYSICAL, CHEMICAL, AND BIOLOGICAL CONSEQUENCES OF EPISODIC ALUMINUM ADDITIONS TO A STREAM,
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
R. J. Hall, C. T. Driscoll, G. E. Likens, and J. M. Pratt.
Limnology and Oceanography, Vol. 30, No. 1, p 212-220, January, 1985. 3 Fig, 31 Ref.

Descriptors: *Snowmelt, *Aluminum, *Water pollution effects, Norris Brook, New Hampshire, Fate of pollutants, Streams, Acidity, Dissolved oxygen, Leaching, Hydrogen ion concentration, Organic carbon, Invertebrates, Drift.

To simulate an episodic increase during snowmelt, a stock solution of aluminum chloride (3.1 g Al/liter) was added to a second-order reach of Norris Brook in the Hubbard Brook Experimental Forest, New Hampshire. Experimental concentrations of aqueous Al were similar to those reported for acidic surface waters in the Adirondack Mountains of New York and for streams draining deforested watersheds in the White Mountains of New Hampshire. To simulate the pulsed input of Al leached from soil by daily snowmelt, a solution of AlCl3 was added at rates incremented hourly for 5 hr. Significant decreases in pH and dissolved organic carbon (DOC) and accumulation of foam at the surface accompanied a stepwise increase in Al in the water. In lab experiments added Al produced a 20% reduction in surface tension. The added Al may have associated with organic functional groups, rendering DOC more hydrophobic and less soluble. Some of these alumino-organic substances subsequently may have accumulated at the air-water interface. Terrestrial and aquatic invertebrate drift was also altered with elevated Al. Drift is attributed to responses to chemical changes in the stream such as Al and H(+) toxicity or to a physical change in surface film. (Baker-IVI)
W85-05621

EFFECT OF TEMPERATURE ON SURVIVAL OF CARP FRY, CYPRIUS CARPIO L., IN ACIDIC WATER,
Institute of Applied Biology, Siedlce (Poland).
M. Korwin-Kossakowski, and B. Jezierska.
Journal of Fish Biology, Vol. 26, No. 1, p 43-47, January, 1985. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Fish, *Survival, *Acidity, *Temperature effects, Dissolved oxygen, Respiration, Immature growth stages, Mortality.

An experiment was designed to determine the survival time of fry in water acidified to pH 4.1, at 18, 20, 24, 26, and 30 C, respectively. Carp fry mortality in water at pH 4.1 depended on temperatures. Within the temperature range of 18-26 C, the mortality was accelerated with an increase in temperature. However, at the temperature of 30 C, fish survived longer than at lower temperatures. At the temperatures studied the effect of a 26 hr accumulation period is beneficial. Carp fry obtained less oxygen in water at pH 4.0, as compared to pH 7.0. The differences, though insignificant, pointed to an adverse effect of acidification on the respiratory processes. (Baker-IVI)
W85-05623

CHANGES IN CLADOCERA COMMUNITY STRUCTURE AND FOSSIL PIGMENT STRATIGRAPHY AS COMPARED TO THE FIRE HISTORY OF ELK LAKE, CLEARWATER CO., MN, U.S.A.,
Indiana Univ. at Bloomington. Dept. of Biology.
D. S. Baas, and M. M. Boucherle.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1366-1371, December, 1984. 4 Fig, 20 Ref.

Descriptors: *Water pollution effects, *Fires, *Cladocera, *Elk Lake, *Minnesota, Fossils, Stratigraphy, Nutrients, Forest watersheds, Forest fires, Macrophytes.

Elk lake is located in Itasca State Park, Clearwater County, northwestern Minnesota. In a core dating back 30 years B.P., ten fires were identified based on charcoal evidence found in sediment samples. Effects of fire may be observed in samples containing evidence of fires. The Cladocera community changed fairly consistently in these samples. These changes concur with certain aspects of the fossil pigment stratigraphy. The two members of the planktonic Cladocera community, Bosmina longirostris and Daphnia longispina, together comprise over 80% of the total cladocerans throughout the core. At nearly all fires, littoral populations decrease relative to planktonic populations. This may represent decreased depth distribution of macrophytes resulting in a decrease in available habitat for littoral populations. This decrease in macrophytes may reflect a rise in turbidity due to increased erosional input of particulate matter, or an increase in phytoplankton resulting from nutrient influx. Pigment data exhibit somewhat variable results, but as in the Cladocera data, trends are noted. Increased sedimentary organic matter accompanied by a rise in pigment concentration indicates increased phytoplankton production. High levels of carbonates in the sediments may be indicative of either increased erosional inputs of terrestrial carbonates, or increased phytoplankton production resulting in in situ precipitation of carbonates. Fossil pigment diversity decreased in six samples containing evidence of fire. (Baker-IVI)
W85-05624

ACIDIFICATION HISTORY AND PREDICTION USING BIOLOGICAL INDICES,
Western Washington Univ., Bellingham. Inst. for Watershed Studies.
D. F. Brakke.
Verhandlung Internationale Vereinigung Limnologie, Vol. 2, No. 3, p 1391-1395, December, 1984. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Acidification, *Acid rain, *Lakes, *Water pollution effects, Diatoms, Cladocera, Prediction, History, Acidity, Water quality, Fish.

Changes in the chemistry of dilute freshwaters associated with acid precipitation have been reported from several areas. Diatom and cladocerans can be used to reconstruct the acidification history of lakes. The information produced on rate of pH change can be combined with steady state empirical models of acidification to predict lake water condition at specific times in the future. Given estimates of lakewater chemistry on a site or regional basis, empirical relationships can be used to predict fish status. Because the acidification model of Henriksen is driven by precipitation chemistry, various loading scenarios can be assessed in terms of fish population response. (Baker-IVI)
W85-05626

ANNUAL SEDIMENT ACCMULATION AND LAND USE HISTORY; INVESTIGATIONS OF VARVED LAKE SEDIMENTS,
Umea Univ. (Sweden). Dept. of Ecological Botany.
For primary bibliographic entry see Field 2J.
W85-05627

VARVE-DATED EUTROPHICATION HISTORY OF A SMALL LAKE,
Joensuu Univ. (Finland). Karelian Inst.
H. Simola, P. Huttunen, and J. Merilainen.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1404-1408, December, 1984. 3 Fig, 14 Ref.

Descriptors: *Lake Lankunlampi, *Finland, *Eutrophication, *Stratigraphy, *Varves, Diatoms, Chrysophyta, Lake sediments, Sedimentation, Sediments, Lakes, Pigments, History.

Lake Lankunlampi is situated in the rural district of Liperi in East Finland. The lake basin is a kettle-hole depression formed in a transverse ridge of glaciofluvial material. Microstratigraphy of diatoms and chrysophycean cysts was analyzed in tape peel preparations by 0.5 mm resolution in the sequence 0-30 cm, which was found to contain 68 varves. Sedimentary pigment concentrations were analyzed in 38 consecutive varves that were dissected from a freeze-dried sediment block. The sedimentary record of Lake Lankunlampi shows a rapid development of fairly eutrophic conditions. The human influence (mainly in the form of phosphate loading through the use of detergents and increased soil erosion) has been only weak or moderate all the time, but the effect appears cumulative, because the water exchange is very slow, mean annual rainfall being about 10% of the mean depth of the lake. The study clearly demonstrates the great sensitivity of this type of lake to even the mildest forms of human interference. (Baker-IVI)
W85-05628

AUTOMATED FISH RESPIRATORY MONITORING SYSTEM FOR STREAM ACIDIFICATION EPISODE ASSESSMENT,
Tennessee Technological Univ., Cookeville. Cumberland Biological Station.
For primary bibliographic entry see Field 5A.
W85-05629

EFFECTS OF URBAN STORMWATER RUNOFF ON RESERVOIR PHYTOPLANKTON,
George Mason Univ., Fairfax, VA. Dept. of Biology.
R. C. Jones, and G. W. Redfield.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1486-1492, December, 1984. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Urban runoff, *Storm runoff, *Reservoirs, *Phytoplankton, Suspended sediments, Heavy metals, Hydrocarbons, Water pollution effects.

The interactive effects of urban stormwater runoff are explored on a small recreational reservoir. Lab experiments and field observations are integrated to develop a conceptual model of the multiple interactions between urban stormwater and reservoir phytoplankton. A microcosm experiment in a small reservoir demonstrated that stormwater inflows can stimulate algal growth. Algal assays of stormwater found inhibition of growth due to heavy metals in runoff and isolated phosphorus as the limiting nutrient. Sediment laden stormwater lowered in situ primary productivity and other in lake measurements illustrated both the inhibitory and stimulatory influences of stormwater on lake phytoplankton. Urban runoff reduced light penetration, washed algae from the epilimnion, and inhibited productivity via heavy metals. The losses

f algal biomass are replaced by enhanced popula-
on growth rates and increasing densities as light
creases, washout subsides, and imported nutrients
e used. This cycle merits further research of
nderlying mechanisms and operation in other
kes, and is of management interest due to the
ver-increasing stress of watershed urbanization.
Baker-IVI)
W85-05633

EPENDENCE OF PHYTOPLANKTON ON OOPLANKTON IN A MAN-MADE LAKE,
olitechnika Slaska, Gliwice (Poland).
or primary bibliographic entry see Field 2H.
W85-05636

NFLUENCE OF EXPERIMENTAL ACIDIFI-ATION IN A LOTIC ENVIRONMENT OF HE BENTHIC INVERTEBRATE DRIFT (IN-LUENCE D'UNE ACIDIFICATION EXPERI-IENTALE EN MILIEU LOTIQUE SUR LA ERIVE DES INVERTEBRES BENTHIQUES),
aval Univ., Quebec. Dept. de Biologie.
. Allard, and G. Moreau.
erhandlung Internationale Vereinigung Limnolo-e, Vol. 22, No. 3, p 1793-1800, December, 1984. 2 ig, 2 Tab, 32 Ref.

Descriptors: *Acidification, *Invertebrates, Benthic fauna, *Drift, *Aluminum, Hydrogen ion oncentration, Streams, Mortality, Metals, Water ollution effects, Acidic water.

he effects of H(+) at different concentrations nd of H(+) with aluminum on the intensity of rift, the faunistic composition and the mortality ate of the organisms of the drift were studied in an xperimental channel. A colonization period of 64 ays preceded the experimental acidification. Vater was acidified using sulfuric acid to pH 3.5 nd 4.0, and aluminum sulfate was added to water t pH 4.0 to produce a concentration of 0.2 mg/l. n the control channel, the average number of rganisms in the drift for 24 hr was 1094 and the emporal variation was 14%. In the acidified chan-el the average number of drift organisms was pproximately the same, 1074, but the temporal ariation was greater (24%) and a maximum of 499 organisms was observed 60 hr after the begin-ing of the acidification. With acidification plus he addition of aluminum, the average number of rganisms was lower, 910, and the temporal varia-on was much greater (40%). A maximum of 1552 rganisms was observed 60 hr after the start of xposure. A comparison of the rate of mortality in he drift and the substrates indicates that the in-rease in the drift is due to the passive entrainment f dead organisms, which is of minimal importance o the dynamics of benthic populations. (Moore-VI)
W85-05660

ACTORS RELATED TO ALGAL BIOMASS IN MISSOURI OZARK STREAMS,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W85-05667

RECENT DEVELOPMENTS OF THE PHYTO-PLANKTON AND ITS ACTIVITY IN THE LOWER RHINE,
Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Dusseldorf (Germany, F.R.).
G. Friedrich, and M. Viehweg.
Verhandlung Internationale Vereinigung Limnolo-gie, Vol. 22, No. 3, p 2029-2035, December, 1984. 4 Fig, 13 Ref.

Descriptors: *Rhine River, *Germany (Federal Republic), *Netherlands, *Phytoplankton, Water pollution effects, Species composition, Population dynamics, Chlorophyll a, Diatoms, Chlorophyta, Eutrophication, Toxic inhibition.

Since 1979 the Lower Rhine has been investigated weekly with a biological program at 5 monitoring stations (4 in the Federal Republic of Germany and one where the Rhine runs to the Netherlands). Additional samples have been taken from a ship moving downstream with the flow. Parameters measured in the program have been phytoplankton (species composition and density), chlorophyll a and its activity expressed as oxygen production capacity. Centric diatoms dominate the plankton. Besides diatoms only chlorococcalian green algae are common. Phytoplankton standing comprises to 60,000 cells/ml, or 50 micro-g/liter chlorophyll a, with maxima regularly higher than 100 micro-g/liter. There is a direct correlation between chlorophyll, total radiation and flow. It is clear that the primary production in the Lower Rhine is limited by these abiotic conditions. There have been improvements in the general ecological situation of the Rhine in the last few years. A more detailed examination shows that the toxic inhibition, which has existed for 20 years, still exists on a lower level than before downstream from Dusseldorf. If this remaining inhibition disappears by improved sewage cleaning it can be expected that there will be increasing eutrophication in the Lower Rhine. (Baker-IVI)
W85-05683

BEHAVIOR OF CADMIUM IN SHORT-NECKED CLAM,
Chuo Univ., Tokyo (Japan). Dept. of Industrial Chemistry.
T. Ishii, T. Nishida, S. Midogohchi, T. Tokitake, and T. Kaneko.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 50, No 12, p 2055-2059, December, 1984. 7 Fig, 5 Tab, 8 Ref.

Descriptors: *Cadmium, *Clams, Heavy metals, Water pollution effects, Autoradiography, Cadmium radioisotopes, Sampling.

In order to obtain Cd-binding proteins in a concentrated form from mollusks, it is desirable to know in what organs in the body Cd is concentrated. Short-necked clams (Tapes japonica) were kept in sea water contained stable Cd and radioactive Cd-115m. The amount of Cd accumulated by a clam was measured with a NaI(Tl) scintillation counter one by one, without sacrificing the clam. The distribution of Cd in the body of a clam was determined by macroautoradiography. The accumulation of Cd by clams differs considerably from individual to individual. The amount of Cd in each clam scatters more as the period of Cd uptake becomes longer. As the period of Cd uptake becomes longer, the number of clams to be sampled must be gradually increased to estimate the amount of Cd with good accuracy. The main Cd-accumulating organ in clams is the Bojanus' organ; the mid-gut gland also accumulated Cd. (Moore-IVI)
W85-05686

OIL SPILL FISHERY IMPACT ASSESSMENT MODEL: SENSITIVITY TO SPILL LOCATION AND TIMING,
Rhode Island Univ., Kingston. Dept. of Ocean Engineering.
M. L. Spaulding, M. Reed, E. Anderson, T. Isaji, and J. C. Swanson.
Estuarine, Coastal and Shelf Science, Vol. 20, No. 1, p 41-53, January, 1985. 4 Fig, 3 Tab, 12 Ref. Dept. of the Interior contracts 14-12-0001-29154 and 14-12-0001-29181.

Descriptors: *Oil spills, *Marine fisheries, *Model studies, *Georges Bank, *Maine, Water pollution effects, Oil pollution, Simulation, Cod, Herring, Haddock, Spawning, Hydrodynamics.

An oil spill fishery impact assessment model system has been applied to the Georges Bank - Gulf of Maine region to assess the sensitivity of probable impact on several key fisheries to spill location and timing. Simulations of the impact on the fishery of tanker spills (20 million gallons released over 5 days), at two separate locations for each season of the year, and blowout spills (68 million gallons released over 30 days) at one location, with monthly releases and at six other locations with seasonal spills have been studied. Atlantic cod has been employed as the principal fish species throughout the simulations. Impacts on Atlantic herring and haddock have also been investigated for selected cases. All spill sites are located on Georges Bank with the majority in the general region of OCS (Outer Continental Shelf) leasing activity. The results of these simulations suggest a complex interaction among spill location and timing, the spatial and temporal distribution of spawning, the population dynamics of the species under study, and the hydrodynamics of the area. For the species studied, spills occurring during the winter and spring have the largest impact with cod being the most heavily impacted followed by haddock and herring. In all cases, the maximum cumulative loss to the fishery of a one time spill event never exceeded 25% of the annual catch with the exact value depending on the number of ichthyoplankton impacted by the spill and the compensatory dynamics of the population. (Author's abstract)
W85-05688

PHOSPHORUS CYCLING IN IONICALLY POLLUTED ONONDAGA LAKE, NEW YORK,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5B.
W85-05690

MERCURY-INDUCED BLOOD ANOMALIES IN THE FRESHWATER TELEOST,
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
T. S. Gill, and J. C. Pant.
Water, Air, and Soil Pollution, Vol. 24, No. 2, p 165-171, February, 1985. 10 Fig, 1 Tab, 14 Ref.

Descriptors: *Fish, *Mercury, *Toxicity, *Blood pathology, *Animal pathology, Heavy metals, Pathology, Water pollution effects, Chronic toxicity.

Experimental Hg poisoning in the fish, Barbus conchonius led to marked hematological anomalies. Acute exposure to 181 micro-g/L mercuric chloride (96 h LC50) led to erythrocytic anomalies including vacuolation, nuclear deterioration, microcytosis and collapsed cytoplasmic membranes. In addition, there was significant thrombocytosis and neutropenia together with a slight reduction in lymphocyte count. Chronic exposure to 36 and 60 micro-g/L mercuric chloride led to poikilocytosis, hypochromia, fragmentation and nuclear displacement in erythrocytes. The large lymphocytes revealed vacuolation, cellular and nuclear hypertrophy and cytoplasmic outgrowths. Thrombocytosis, lymphocytosis, neutropenia and mild basophilia were manifested in fish subjected to chronic poisoning. (Author's abstract)
W85-05692

NICKEL INDUCED HYPERGLYCEMIA IN THE FRESHWATER FISH, COLISA FASCIATUS,
Gorakhpur Univ. (India). Dept. of Zoology.
H. S. Chaudhry, and K. Nath.
Water, Air, and Soil Pollution, Vol. 24, No. 2, p 173-176, February, 1985. 1 Tab, 38 Ref.

Descriptors: *Hyperglycemia, *Fish, *Nickel, *Toxicity, Water pollution effects, Fish behavior, Blood, Stress.

Blood glucose has been reported as a reliable and sensitive indicator of environmental stress in fish. The effect of nickel sulfate at a sublethal dose (64 ppm - 0.8 of LC50 96 hr) on the blood glucose levels of the freshwater fish, Colisa fasciatus, was studied over a period of 96 hr. After exposure to Ni the fish became restless, coming to the surface of the water every 2 to 3 minutes. The toxic reaction also resulted in the formation of a mucus layer at the opercular region. The blood glucose level exhibits a steady increase due to Ni toxicity. A maximum increase of 85.08% is observed at 96 hr ($P < 0.001$). The hyperglycemia in C. fasciatus, caused by exposure to nickel sulfate, is possibly a reflection of stress-induced hormone mediated response. The blood glucose level may be a reliable indicator of Ni toxicity to fish. (Moore-IVI)
W85-05693

EFFECT OF THE CARBAMATE PESTICIDE SEVIN ON THE INTESTINAL ABSORPTION OF SOME NUTRIENTS IN THE TELEOST FISH, CHANNA PUNCTATUS,
D.A.V. Coll., Muzaffarnager (India). Dept. of Zoology.
K. V. Sastry, and A. A. Siddiqui.
Water, Air, and Soil Pollution, Vol. 24, No. 3, p 247-252, March, 1985. 4 Tab, 40 Ref.

Descriptors: *Fish, *Pesticide toxicity, *Sevin, Intestinal absorption, Carbamate pesticides, Toxicity, Digestive system, Nutrition.

The effect of four concentrations (0.1, 1, 10 and 100 ppm) of Sevin on the rate of uptake of two sugars (glucose and fructose) and an aminoacid (tryptophan) by the intestine of the fresh water snake-head fish, Channa punctatus has been investigated. All four concentrations of the pesticide decreased the rate of transport of the three nutrients. No direct relationship could be established between the concentration of Sevin in the medium and decrease in the rate of transport of nutrients, although increase in the concentration of Sevin reduced the absorption of nutrients by the intestine to a greater extent. Experiments conducted in vivo and in vitro showed that in both cases the pesticide decreased the brush border enzyme activity. (Author's abstract)
W85-05697

INTEGRATED USE OF PHYSICAL AND MATHEMATICAL MODELS TO EVALUATE ECOLOGICAL EFFECTS,
State Univ. of New York Coll. at Plattsburgh. Center for Earth and Environmental Science.
J. L. Malanchuk, and H. P. Kollig.
Water, Air, and Soil Pollution, Vol. 24, No. 3, p 267-281, March, 1985. 5 Fig, 4 Tab, 16 Ref.

Descriptors: *Cycling nutrients, *Model studies, *Mathematical models, *Water pollution effects, Simulation, Nutrients.

Nutrient cycling is of central importance in the health and maintenance of all ecosystems, thus it is argued that greater emphasis be placed on the impact of hazardous materials on nutrient cycling. To investigate this concern, flowthrough aquatic microcosms were used in conjunction with a simple, multi-element, mathematical model to initiate the development of a large scale model capable of predicting the effects of xenobiotics on ecosystem nutrient cycling. Potential toxicant effects were imposed on the model to determine whether changes in dissolved nutrient concentrations could be noted. Simulation results demonstrated that toxicant effects on dissolved nutrient concentrations were observable. The model also was employed to study the effect of different aufwuchs C:N:P ratios on dissolved nutrient concentrations. Although experimental data indicated that the aufwuchs C:N:P ratio was not constant, the use of constant stoichiometry in the model did not alter its utility. (Author's abstract)
W85-05699

TEMPORAL RESPONSES OF THE MACROPHYTE, POTAMOGETON PERFOLIATUS L., AND ITS ASSOCIATED AUTOTROPHIC COMMUNITY TO ATRAZINE EXPOSURE IN ESTUARINE MICROCOSMS,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
J. J. Cunningham, W. M. Kemp, M. R. Lewis, and J. C. Stevenson.
Estuaries, Vol. 7, No. 4B, p 519-530, December, 1984. 6 Fig, 2 Tab, 61 Ref. EPA grant R805932010.

Descriptors: *Atrazine, *Potamogeton, *Estuarine environment, *Chesapeake Bay, *Water pollution effects, Macrophytes, Phytotoxicity, Herbicides, Aquatic plants, Biomass, Chlorophyll a.

Effects of the herbicide, atrazine, on the submersed vascular plant, Potamogeton perfoliatus, were monitored for 4 wk in 700 L microcosms containing water, sediments and plants from upper Chesapeake Bay. Two atrazine treatments (plus controls) were employed in duplicate systems, with water column concentrations averaging about 0.13 and 1.20 micro-g/L, respectively. Atrazine concentrations at low dose were in the range of the highest values reported in Chesapeake Bay, and significant decreases in apparent O2 production (Pa) of P. perfoliatus were observed immediately following treatment. However, significant recovery of Pa was evident at low dose within 2 wk, even though atrazine levels remained relatively constant. At the higher atrazine treatment, phytotoxic effects were even more pronounced, with no recovery occurring during the study period. Integrated community production and consumption of O2 followed patterns similar to those for P. perfoliatus alone, with some minor increases in relative contributions of other autotrophic groups (phytoplankton, epiphytes, benthic microalgae). While areal densities of plant shoots for the experimental populations were unaffected by the lower treatment, total biomass decreased significantly, lagging 2-4 wk after the initial decrease in Pa. Morphology of individual shoots was markedly influenced by atrazine, with significant increases in mean shoot length and decreases in weight per unit length. Furthermore, chlorophyll a content of leaves increased 5-fold with atrazine treatment. These effects are similar to previously reported shade adaptations of this and other submersed plants. (Author's abstract)
W85-05708

DISTRIBUTION AND ABUNDANCE OF SUBMERGED AQUATIC VEGETATION IN CHESAPEAKE BAY: AN HISTORICAL PERSPECTIVE,
Virginia Inst. of Marine Science, Gloucester Point.
R. J. Orth, and K. A. Moore.
Estuaries, Vol. 7, No. 4B, p 531-540, December, 1984. 6 Fig, 39 Ref. EPA grants R805951, X003201 and X003246.

Descriptors: *Submerged plants, *Distribution, *Abundance, *Chesapeake Bay, *History, Eelgrass, Watermilfoil, Water pollution effects, Eutrophication, Turbidity, Tropical storms, Aquatic plants.

An historical summary of the distribution and abundance of submerged aquatic vegetation (SAV) in the Chesapeake Bay is presented. Evidence suggests that SAV has generally been common throughout the bay over the last several hundred years with several fluctuations in abundance. The decline of Zostera marina (eelgrass) in the late 1930's and the rapid expansion of Myriophyllum spicatum (watermilfoil) in the late 1950's and early 1960's were two significant events involving a single species. Since 1965, however, there has been a significant reduction of all species in most sections of the bay. Declines were first observed in the Patuxent, Potomac and sections of other rivers in the Maryland portion of the Bay between 1965 and 1970. Dramatic reductions were observed over the entire length of the bay from 1970 to 1975. Particularly severe losses were observed at the head of the bay around Susquehanna Flats as well as in numerous rivers along Maryland's eastern and western shores. Changes in the lower, Virginia portion of the bay occurred primarily in the western tributaries. Greatest losses of vegetation occurred in the years following Tropical Storm Agnes in 1972. Since 1975 little regrowth has been observed in the Chesapeake Bay. Other areas along the Atlantic Coast of the U.S. during the same period have experienced no similar widespread decline. It thus appears that the factors affecting the recent changes in distribution and abundance of submerged vegetation in the bay are regional (related to the bay) in nature. Causes for this decline may be related to changes in water quality, primarily increased eutrophication and turbidity. (Author's abstract)
W85-05709

FERTILIZATION SUCCESS AND SPERM MOTILITY OF ATLANTIC SALMON (SALMO SALAR L.) IN ACIDIFIED WATER,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
P. G. Daye, and B. D. Glebe.
Aquaculture, Vol 43, No. 1/3, p 307-312, December, 1984. 2 Fig, 22 Ref.

Descriptors: *Salmon, *Reproduction, *Acidic water, *Water pollution effects, Hydrogen ion concentration, Fish fertilization.

Fertilization success of Atlantic salmon, Salmo salar, eggs by large sea-run males and precocious male parr in acidic water (pH 6.8-3.4) was determined. There was no effect on fertilization success at pH 5.0 or above. Fertilization success did decline from pH 5.0 to 4.0. No eggs were fertilized in tests below pH 4.0. The pH LL50 was 4.5 for fertilization success. Duration of spermatozoan motility constantly declined at all tested levels until about pH 4.5 where the decline became extremely rapid with no motility occurring near pH 4.0. The duration of spermatozoan motility of precocious male parr was longer than that for the large sea-run males at pH levels about 4.4. The recruitment of young Atlantic salmon into fish populations in acid stressed waters is reduced at pH levels below 5.0. In waters of pH 4.5 and below, Atlantic salmon populations probably do not exist. (Author's abstract)
W85-05712

EFFECTS OF SEWAGE POLLUTION ON CORAL-REEF COMMUNITIES,
Tetra Tech, Inc., Bellevue, WA.
R. A. Pastorak, and G. R. Bilyard.
Marine Ecology - Progress Series, Vol. 21, No. 1-2, p 175-189, January, 1985. 4 Fig, 3 Tab, 112 Ref.

Descriptors: *Wastewater pollution, *Coral reefs, *Water pollution effects, Marine environment, Lagoons, Nutrients, Sediments, Algae, Primary productivity, Invertebrates, Particulate matter, Corals, Toxicity.

Sewage pollution is an increasing problem in tropical marine environments. In this review, present knowledge of the effects of sewage pollution on coral-reef communities is synthesized and directions are suggested for future research. A wide range of sewage impacts on coral-reef communities has been reported. Little or no impact has been observed on some reefs in well-flushed waters that receive small quantities of effluent, whereas large discharges of effluent into poorly-flushed lagoons and bays have caused major changes in species composition and abundance. The 3 components of sewage effluent most detrimental to coral communities are nutrients, sediments, and toxic substances. Nutrient enrichment by sewage effluent may enhance benthic algal biomass and primary production in the water column. Increased primary production in the water column favors benthic filter-feeding invertebrates which, with the benthic algae, may out-compete corals and other reef-building organisms. Anthropogenic inputs of dissolved nutrients and organic particulate matter may also depress oxygen levels. While heavy sediment loads on corals may be lethal, lesser quantities may inhibit growth, cause changes in the growth forms of colonies, decrease coral cover, alter species composition of reef-building organisms, and inhibit coral recruitment. Toxic substances may induce metabolic changes in corals, decrease rates of growth and reproduction, or reduce viability of corals. Although further research is needed on all three major components of sewage effluent, the most critical need is for comprehensive, long-term studies of sewage impacts. The combined effects of particulate and toxic substances are especially poorly documented at this time. (Author's abstract)
W85-05714

ELEVATED PLANKTONIC ROTIFER BIOMASS IN ACIDIFIED METAL-CONTAMINATED LAKES NEAR SUDBURY, ONTARIO,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
N. D. Yan, and W. Geiling.
Hydrobiologia, Vol. 120, No. 3, p 199-205, January, 1985. 1 Fig, 3 Tab, 34 Ref.

Descriptors: *Rotifers, *Crustaceans, *Biomass, *Clearwater Lake, *Swan Lake, *Ontario, Trace metals, Acid lakes, Water pollution effects, Zooplankton.

Planktonic rotifer biomass and abundance in two trace metal-contaminated, acidified lakes (Clearwater and Swan Lakes) were compared with that of six non-acidic lakes in central Ontario which had low levels of metals. Swan and Clearwater Lakes have been severely impacted by the smelting of sulfide ores by industries in the Sudbury area. Eighteen taxa of rotifers were identified in Swan and Clearwater Lakes. Keratella taurocephala was the most important rotifer species. It occurred in all samples and formed 80-95% of the average rotifer biomass in Clearwater Lake and 77% in Swan Lake. Total (rotifer plus crustacean) zooplankton biomass was greater in the non-acidic lakes (33-93 mg/cu m dry weight) than in the acidified lakes (9-29 mg/cu m), because of greater crustacean zooplankton biomass. Rotifer biomass was much greater in the acidified lakes (averaging 6.0 mg/cu m) than in the non-acidic lakes where it averaged only 0.5 mg/cu m. Rotifers formed 16-51% of the total zooplankton biomass in the acidified lakes but only 0.5-1.3% of the total in the non-acidic lakes. The great abundance of rotifers in the acidic lakes may be attributable to a reduction in densities of crustacean competitors. (Moore-IVI)
W85-05715

AUTECOLOGY OF CYATHURA CARINATA (CRUSTACEA : ISOPODA) IN A COOLING WATER DISCHARGE LAGOON,
Central Electricity Generating Board, Southampton (England). Marine Biological Lab.
R. N. Bamber.
Journal of the Marine Biology Association, Vol. 65, No. 1, p 181-194, February, 1985. 8 Fig, 2 Tab, 23 Ref.

Descriptors: *Isopods, *Thermal pollution, *River Medway, *England, Habitat, Cooling water, Lagoons, Water temperature, Effluents, Reproduction, Growth.

A population of Cyathura carinata living in the thermal effluent outfall lagoon of Kingsnorth Power Station, River Medway, Kent, England was studied from monthly samples over 33 months. The habitat was a coarse muddy sand substrate, in an enhanced temperature regime ranging from a minimum of 13 C in January to a maximum of 27 to 30 C in August. The population shows recruitment from May to August, winter growth, and no growth during the breeding season, with a 3 year life span, high female bias in the 1 + sex ratio, and almost all 2 + individuals are male. Production reflects growth in size, amounting to an annual production of 750 mg/sq m. The number of embryos in a brood ranged from 14 to 45 (mean 29.8) with no detectable brood mortality; embryo size is not influenced by brood number of female size, but brood number is related to the length of the female. It is concluded that a 3rd year of life, low numbers of 1 + males and protogynous hermaphroditism are advantageous strategies for northern (colder water) populations of C. carinata. From evolutionary characteristics the Kingsnorth lagoon supports a northern population which, in the enhanced temperature regime of the outfall water, achieves growth rates and a breeding cycle typical of a southern population. (Author's abstract)
W85-05719

IMPACT OF A MASSIVE DOMESTIC POLLUTION ON THE BIOLOGY AND MORPHOMETRY OF THE ECHINOID PARACENTROTUS LIVIDUS: PRELIMINARY DATA (IMPACT DE LA POLLUTION DOMESTIQUE SUR LA BIOLOGIE ET LA MORPHOMETRIE DE L'ECHINOIDE PARACENTROTUS LIVIDUS (LAMARCK). DONNEES PRELIMINAIRES),
Aix-Marseille-3 Univ. (France). Lab. de Zoologie Marine.
P. Delmas, and M.-B. Regis.
Comptes Rendus Hebdomadaires des Seances, Academie des Sciences, Paris, Vol. 300, Serie III, No. 4, p 143-146, 1985. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Water pollution effects, *Wastewater pollution, *Sea urchins, *Marseilles, *France, Marine environment, Organic matter, Growth, Mortality.

Paracentrotus lividus populations, within the plume generated by the Marseilles (France) conurbation outlet, display along the seashore a decreasing gradient of domestic pollution from E to W. The density of populations tends to increase in proportion as it gets nearer the discharge point. In the two nearest stations investigated (500 and 1,200 m) from the outlet, the average size of the sea-urchin is reduced and the test diameter usually does not exceed 30 mm; by contrast the spine-length enlarges up to about half of test diameter. This lengthening may be considered as a morpho-functional adaptation to a more active and efficient taking up of the plentiful organic material - dissolved and chiefly suspended - existing in the water column. Thanks to this adaptative strategy this sea-urchin not only is able to live within such a highly polluted environment but also to flourish therein. The smaller average size of the specimens in the two stations closest to outlet must be ascribed either to the early mortality of subadult and adult individuals, or to a case of dwarfing, like the population which formerly lived in the brackish water Berre lagoon. (Author's abstract)
W85-05723

LONGTERM STUDIES ON ALKALINE PHOSPHATASE ACTIVITY (APA) IN A LAKE WITH FISH-AQUACULTURE IN RELATION TO LAKE EUTROPHICATION AND PHOSPHORUS CYCLE,
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
R. J. Chrost, W. Siuda, and G. Z. Halemejko.
Archiv fur Hydrobiologie, Supplement 70, No. 1, p 1-32, December, 1984. 11 Fig, 3 Tab, 81 Ref.

Descriptors: *Alkaline phosphatase, *Aquaculture, *Phosphorus, *Eutrophication, *Lake Glebokie, *Poland, Cycling nutrients, Phytoplankton, Bacteria, Trout, Water pollution effects.

The alkaline phosphatase activity (APA) of microplankton from the photic and profundal zones of Lake Glebokie (Poland) was studied in relation to the P cycle and eutrophication from intensive rainbow trout culture. APA was measurable throughout the study period and fluctuated considerable from month to month. Higher APA was found in the photic zone than in the profundal zone of the lake. Phytoplankton blooms increased APA. The highest specific APA in the photic zone was observed during the summer stagnation; it corresponded well to the lowest concentration of dissolved inorganic P (DIP). The relationship between APA and DIP in the photic zone was an inverse non-linear function. Alkaline phosphatase in the photic zone had an inductive property, while in the profundal zone of the lake is was constitutive in nature. The contribution of phytoplankton and bacteria to APA, and P-32 PO4(-3) uptake, showed that bacteria are superior competitors for orthophosphate in lake waters. APA is an important source of internal DIP loading for the lake. The rapid eutrophication of Lake Glebokie is apparently due to the intensive cultivation of trout by live-box culture. (Moore-IVI)
W85-05726

TOXICITY OF COPPER TO THE MARINE BACTERIUM VIBRIO ALGINOLYTICUS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
D. R. Schreiber, A. S. Gordon, and F. J. Millero.
Canadian Journal of Microbiology, Vol. 31, No. 1, p 83-87, January, 1985. 7 Fig, 1 Tab, 26 Ref. ONR grant N00014-80-C-0042 and NSF grant GA40532.

Descriptors: *Copper, *Marine bacteria, *Vibrio, Toxicity, Heavy metals, Anaerobic conditions, Aerobic conditions, Toxicity, Cytostatic, Water pollution effects, Organic compounds.

The toxicity of copper to the marine bacterium Vibrio alginolyticus was examined. Experiments were conducted with both aerobic and anaerobic cultures. Calorimetric and radiochemical techniques were used to examine the effect of copper on heat production, respiration, and carbon assimilation by the cultures. Plate counts were used to determine the number of viable cells present. Copper was more toxic to the bacterium in anaerobic culture (mean toxic concentration (TC50) = 2.1 micro-M) than in aerobic culture (TC50 = 6.4 micro-M). Both cytotoxic and cytostatic effects were observed. The cytotoxic effect was not significantly different under aerobic and anaerobic conditions. The cytostatic effect, observed only in anaerobic culture, resulted in a decrease in the rate of metabolism of the surviving cells. The magnitude of the cytostatic and cytotoxic effects were dependent on the copper concentration, exhibiting saturation at higher concentrations. Organic chelators EDTA and nitrilotriacetic acid protected the anaerobic cultures from the copper, indicating that Cu-organic complexes are not toxic to the organism. (Author's abstract)
W85-05743

RELATIONSHIP BETWEEN THE GROWTH OF ALGAE AND AQUATIC MACROPHYTES IN BRACKISH WATER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
W. Van Vierssen, and T. C. Prins.
Aquatic Botany, Vol. 21, No. 2, p 165-179, February, 1985. 4 Fig, 5 Tab, 36 Ref.

Descriptors: *Brackish water, *Algae, *Macrophytes, *Plant growth, Eutrophication, Aquatic plants, Allelopathy, Anabaena, Zannichellia.

Many brackish-water ecosystems in coastal areas of western Europe are being threatened by severe eutrophication and algal blooms. Eutrophication causes a decline in aquatic macrophytes and as a result, a decline in the associated animal communities. The decline in macrophytes may be a result of the growth inhibition of aquatic macrophytes by algae by means of allelopathy. Allelopathic interactions between the growth of planktonic algae and the growth of aquatic macrophytes were studied under experimental conditions. Addition of algal filtrate to cultures of the macrophyte Zannichellia peltata had a clearly negative effect on the net oxygen production of this macrophyte. The algal culture mainly consisted of Anabaena. The number of algal cells and the biomass of the aquatic macrophytes in the experiments were of the same order of magnitude as in the field. The release of allelopathic substances by certain algae may play an important role in macrophyte decline under eutrophic conditions. (Moore-IVI)
W85-05744

COMBINED EFFECT OF SALINITY AND TRIETHYL STANNIC CHLORIDE ON THE DEVELOPMENT OF THE MARINE FORMS OF THREE-SPINE STICKLEBACK, GASTEROSTEUS ACULEATUS (GASTEROSTEIDAE),
Moscow State Univ. (USSR). Dept. of Biology.
S. G. Soin, O. P. Danil'chenko, and A. S. Khandal.
Journal of Ichthyology, Vol. 24, No. 4, p 26-34, 1984. 4 Tab, 6 Ref. Translated from Voprosy Ikhtiologii, No. 3, p 481-489, 1984.

Descriptors: *Stickleback, *Salinity, *Triethyl stannic chloride, *Development, Toxicity, Mortality, Pathology, Embryonic growth stage.

The development of the marine form of three-spine stickleback, Gasterosteus aculeatus, were studied in freshwater and in water with 25 and 5 0/00 salt content, as well as at each of these salinity levels with triethyl stannic chloride solutions at the concentrations of 0.000001 - 10 mg/liter. The morphological changes in the embryos and prolarvae, their survival, heart beat and extent of development of the individual body parts were investigated. The stickleback develops normally in freshwater, showing a tendency for a slight reduction in growth and some irregularity in heart beat. Triethyl stannic chloride (TESC) manifested similar toxicity as in the case of freshwater bonyfishes which is expressed in the level of lethal concentrations and in stoppage of development at the morula stage. On the whole, the stickleback was found to be less resistant to the TESC action than other teleost fishes previously studied. With simultaneous action of reduced salinity and TESC, the intensity of

development increases with decreased salinity. (Author's abstract)
W85-05750

EFFECT OF HARMFUL FACTORS ON THE POSTTRAUMATIC MITOTIC ACTIVITY IN THE LENS EPITHELIUM OF RAINBOW TROUT, SALMO GAIRDNERI (SALMONIDAE),
Vsesoyuznyi Zaochnyi Inst. Pishchevoi Promyshlennosti, Moscow (USSR).
Y. G. Simakov.
Journal of Ichthyology, Vol. 24, No. 4, p 35-39, 1984. 12 Ref. Translated from Voprosy Ikhtiologii, No. 3, p 490-494, 1984.

Descriptors: *Trout, *Mitotic activity, *Toxicity, *Lens epithelium, Eye, Traumatization, Water pollution effects, Dibutyl sebacyanate, Polyterpenes, Aminopropyl triethoxysilane.

In the natural environment, fish are rarely exposed to the action of a single unfavorable factor. Traumatization can stimulate mitotic activity and make the organism more vulnerable to pollutants. To study the effect of trauma and toxicants in acute and chronic experiments, the lens epithelium can be a very convenient tissue, as it constantly undergoes mitotic division and is a regular single-layer cellular structure. The effects of dibutyl sebacyanate, polyterpenes and aminopropyl triethoxysilane (AMG-9) were studied in chronic experiments on the posttraumatic mitotic activity of the lens epithelium of rainbow trout, Salmo gairdneri. Tributyl sebacyanate and polyterpenes act as mitotic inhibitors at concentrations of 10 and 0.1 mg/liter, while AGM-9 stimulates mitotic activity. Two days before the termination of the experiment, the lens epithelium was traumatized by being pricked with a needle. Traumatization of the lens leads to a higher mitotic index in the germinative zone of epithelium. The combined effect of a substance stimulation mitotic division and traumatization increases the mitotic index in the germinative zone more than two-fold as compared to controls. (Moore-IVI)
W85-05751

USE OF LARGE ENCLOSURES FOR PERTURBATION EXPERIMENTS IN LENTIC ECOSYSTEMS: A REVIEW,
Wyoming Water Research Center, Laramie.
F. S. Sanders.
Environmental Monitoring and Assessment, Vol. 5, No. 1, p 55-99, March, 1985. 2 Fig, 6 Tab, 151 Ref. Electric Power Research Institute contract RP 1822-6.

Descriptors: *Water pollution effects, *Ecosystems, *Enclosure studies, Toxicity, Lentic environment, Marine environment.

A fundamental goal of aquatic ecotoxicology is the prevention of undesirable ecological change resulting from release of effluents into surface waters. Field enclosure studies provide an experimental bridge between laboratory test systems and natural ecosystems. Literature on use of field enclosures in freshwater and marine systems is reviewed to assess how accurately enclosures mimic ecological conditions and process rates occurring in adjacent open habitat. Among- and within-replicate variability of ecological parameters in field enclosures is compared to those in laboratory microcosms and open field habitat respectively. Studies using field enclosures can provide defensible data at the population and community levels over time periods of several months and spatial scales of tens of meters. The degree of ecological realism that can be achieved is variable. Chronic effects of some pollutants may be difficult to separate from nonspecific effects due to enclosure. Physical separation of part of a natural habitat from its surroundings produces a set of artificial stresses that affect the enclosed system's behavior before and during the application of a toxicant stress. Enclosure experimentation, together with supplemental laboratory studies, will significantly aid in establishing causality in impact relationships observed in the open field. Field enclosures are especially suited for the evaluation of the persistence of toxicity. (Moore-IVI)
W85-05764

QUANTITATIVE STRUCTURE-ACTIVITY RELATIONSHIPS AND MIXTURE TOXICITY OF ORGANIC CHEMICALS IN PHOTOBACTERIUM PHOSPHOREUM: THE MICROTOX TEST,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicology.
J. Hermens, F. Busser, P. Leeuwangh, and A. Musch.
Ecotoxicology and Environmental Safety, Vol. 9, No. 1, p 17-25, February, 1985. 2 Fig, 7 Tab, 24 Ref.

Descriptors: *Toxicity, *Bacteria, *Photobacterium, *Organic chemicals, *Microtox test, *Bioassays, Bioluminescence, Partition coefficient, Water pollution effects.

Quantitative structure-activity relationships were calculated for the inhibition of bioluminescence of Photobacterium phosphoreum by 22 nonreactive organic chemicals. The inhibition was measured using the Microtox test and correlated with the partition coefficient between n-octanol and water (P sub oct), molar refractivity (MR), and molar volume (MW/d). At log P sub oct < 1 and > 3, deviations from linearity were observed. Introduction of MR and MW/d improved the quality of the relationships. The influences of MR or MW/d may be related with an interaction of the tested chemicals to the enzyme system which produces the light emission. The sensitivity of the Microtox test to the 22 tested compounds is comparable to a 14-day acute mortality test with guppies for chemicals with log P sub oct < 4. The inhibition of bioluminescence by a mixture of the tested compounds was slightly less than was expected in case of concentration addition. The Microtox test can give a good estimate of the total aspecific 'minimum toxicity' of polluted waters. When rather lipophilic compounds or pollutants with more specific modes of action are present, this test will underestimate the toxicity to other aquatic life. (Author's abstract)
W85-05809

USE OF COHORTS AND POPULATIONS IN CHRONIC TOXICITY STUDIES WITH DAPHNIA MAGNA: A CADMIUM EXAMPLE,
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands). Lab. for Ecotoxicology.
C. J. van Leeuwen, W. J. Luttmer, and P. S. Griffioen.
Ecotoxicology and Environmental Safety, Vol. 9, No. 1, p 26-39, February, 1985. 7 Fig, 4 Tab, 39 Ref.

Descriptors: *Toxicity, *Daphnia, *Cadmium, *Heavy metals, Crustaceans, Water pollution effects, Water quality standards, Ecological effects.

Two semistatic life table experiments with Daphnia magna were carried out on reconstituted and Lake IJssel water. The 'nontoxic concentrations' for cadmium with respect to the intrinsic rate of natural increase, derived from age-specific survival and fecundity were 1 and 3.2 micro g/liter, respectively. Body length appeared to be a sensitive parameter. A third intermittent-flow experiment was started with small, exponentially growing populations. These populations had a stable age distribution, were composed of cohorts of different ages and showed an almost perfect logistic growth. Cadmium was shown to reduce the upper numerical limit (carrying capacity) for D. magna and was inversely related to this parameter: log $Y = 2.85 - 0.20$ log(concentration of Cd); $r = -0.99$. A 'nontoxic concentration' could not be established. Based on the 'background' concentration of cadmium, a freshwater quality criterion of 0.1 micro g/liter was proposed. The results indicate several shortcomings of the current methods. Introduction of the concepts of population dynamics in reproduction tests with D. magna is a realistic step towards ecotoxicology. (Collier-IVI)
W85-05810

TOXIC IMPACT OF EFFLUENTS FROM P TROCHEMICAL INDUSTRY,
National Board of Waters, Helsinki (Finland).
E. Nikunen.
Ecotoxicology and Environmental Safety, Vol. No. 1, p 84-91, February, 1985. 1 Fig, 4 Tab, Ref.

Descriptors: *Bioassays, *Toxicity, *Industrial fluents, *Oil industry, Trout, Daphnia, Salmonel Ames test, Fish, Bacteria, Crustaceans, Water p lution effects.

The toxicity of effluents from a petrochemi industry center in southern Finland was tested conducting bioassays on organisms from three ferent trophic levels. In fish tests, rainbow tr (Salmo gairdneri) were caged at the discharge s and, simultaneously, at a reference area. The o clear differences, among the measurements of metabolic parameters, were observed in fish li where activities of two detoxication enzymes we significantly increased in the exposed group. T water flea (Daphnia magna) was used both in ac (EC50) and long-term reproduction tests. No ac lethal toxicity was detected in any of wastewater samples investigated. A combined fluent, however, caused a reduction in the rep duction rate with EC50 of 3%. No mutage activity was observed with the Ames test (Salm nella typhimurium, strains TA 97, TA 100) concentrated effluents, in sediment samples, or liver samples from predator fish caught from discharge site. (Author's abstract)
W85-05812

COMBINED ACTION OF CARBARYL AN PHENTHOATE ON TISSUE LIPID DERIV TIVES OF MURREL, CHANNA PUNCTAT (BLOCH),
Sri Venkateswara Univ., Tirupati (India). Dept. Zoology.
K. S. Prasada Rao, K. R. S. Sambasiva Rao, I. K Ahammad Sahib, and K. V. Ramana Rao.
Ecotoxicology and Environmental Safety, Vol. No. 1, p 107-111, February, 1985. 1 Fig, 2 Tab, Ref.

Descriptors: *Carbaryl, *Phenthoate, *Murr *Toxicity, *Bioassays, *Fish physiology, *Pes cides, *Synergistic effects, Organophosphorus secticides, Insecticides, Acaricides, Phenthoat Water pollution effects.

The levels of total lipids, free fatty acids, cholest ol, and lipase activity were studied in select tissues of Channa punctatus Bloch during indivi ual and combined exposures of carbaryl a phenthoate. The total lipid levels decreased w elevated levels of free fatty acids and lipase acti ty during all exposures, suggesting increased li hydrolysis to derive energy as an attempt to fa the pesticide toxic stress. The cholesterol lev showed an elevated trend. These results were d cussed in relation to induced glyconeogenesis a diversion of acetyl-coA to cholesterol synthe during pesticide treatment. The effect produced carbaryl + phenthoate treatment remained high than either of the pesticides alone, suggesting manifestation of an additive effect. (Author's stract)
W85-05813

EFFECTS OF VARIOUS ORGANIC CHEM CALS ON THE REGREENING OF RED CO ORED CHLORELLA ZOFINGIENSIS.
Hamburg Univ. (Germany, F.R.). Inst. fuer Allg meine Botanik.
For primary bibliographic entry see Field 5A.
W85-05814

ECONOMIC ASPECTS IN THE INVESTIG TION OF GROUND-WATER CONTAMIN TION EPISODES.
Haifa Univ. (Israel).
M. Shechter.
Ground Water, Vol. 23, No. 2, p 190-197, Marc April, 1985. 4 Tab, 20 Ref.

Descriptors: *Groundwater pollution, *Economic aspects, *Risk assessment, *Price Landfill, *New Jersey, Path of pollutants, Cost-benefit analysis, Water pollution.

Some economic aspects of ground-water pollution were examined, focusing on the exploitation of an aquifer as a source of drinking water. Using the contamination episode at Price Landfill, New Jersy, as a case study, analytical and information issues which characterize ground-water pollution were addressed. Involved here are uncertainties associated with the environmental medium (especially knowledge of solute-transport processes), and health risk assessment (principally dose-response relationships). The field application employed two approaches to the modeling of the physical-chemical processes to derive mortality risk estimates. These estimates in turn form the basis for preliminary assessment of expected damages: reduced longevity, and cost of control and remedial measures. The results are useful as an essential informational input for a benefit-cost analysis of ground-water protection and management policies. (Author's abstract)
W85-05840

5D. Waste Treatment Processes

SLUDGE DEWATERING IN A CONVENTIONAL PLANT WITH PHOSPHORUS REMOVAL - I; ANALYSIS OF ADDITIONAL COSTS,
Istituto di Ricerca sulle Acque, Rome (Italy).
G. Mininni, R. Passino, M. Santori, and L. Spinosa.
Water Research, Vol. 19, No. 2, p 143-149, 1985. 1 Fig, 6 Tab, 5 Ref, 1 Append.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Sludge drying, *Costs, Economic aspects, Municipal wastewater, Ferrous sulfate, Aluminum sulfate.

Wastewater phosphorus removal and sludge dewatering field tests were run at the Cesenatico (Italy) municipal plant where phosphorus is removed in summer by precipitation with aluminum or ferrous sulfate in the aeration tanks simultaneously with the biological oxidation of organic matter. Characteristics of the sludge produced with or without phosphorus removal were compared. Dewatering tests were carried out on a pilot-scale centrifuge and filter-press mounted on a trailer specifically designed for this type of test. Phosphorus could be removed up to residual concentration of 1.6 mg/l without detrimental effects on the biological process, with an increase of sludge production of 21 and 36% using aluminum or ferrous sulfate respectively. A cost analysis was carried out to assess the costs for phosphorus removal, including the additional one for sludge conditions, dewatering and cake transport to landfill. Additional costs vary from 3290 to 6380 Lit per capita year (29-54%); the higher costs refer to smaller plants (50,000 inhabitants), in which aluminum sulfate is used and sludge dewatered by centrifuge. If costs of chemicals and equipment for phosphorus removal are considered, ferrous sulfate is cheaper than aluminum sulfate (average saving 25%) and the total costs consequent upon phosphorus removal by ferrous sulfate range from 3290 to 4950 Lit per capita per year (+29 to +41% of the total treatment cost). Use of ferrous rather than aluminum sulphate allows savings of 1300-1600 Lit per capita per year. (Collier-IVI)
W85-04970

SLUDGE DEWATERING IN A CONVENTIONAL PLANT WITH PHOSPHORUS REMOVAL - II; STUDY ON CENTRIFUGE AND FILTER-PRESS PERFORMANCE,
Istituto di Ricerca sulle Acque, Rome (Italy).
G. Mininni, R. Passino, M. Santori, and L. Spinosa.
Water Research, Vol. 19, No. 2, p 151-156, 1985. 6 Fig, 3 Tab, 7 Ref.

Descriptors: *Sludge drying, *Wastewater treatment, *Filter press, *Centrifugation, *Sludge filters, Phosphorus removal, Pressure filtration Municipal wastewater.

Dewatering tests were carried out at the Cesenatico sewage treatment plant to point out the influence of phosphorus removal on sludge charateristics, using either aluminum or ferrous sulfate. Equipment performance was studied in different conditions to determine the influence of machine operational variables. As far as centrifugation is concerned, the results showed that the most significant variables the dewatered sludge concentration depends on are the beach residence time and liquid ring height. The feed sludge concentration proved a significant variable if all the data obtained in the three phases are considered together. A pressure filtration model for the prediction of final cake concentration was set up based on the correlations of coefficients a and b of the filtrate flow curve (0 = a x t to the b power) with sludge characteristics (concentration, specific resistance to filtration) and with maximum operating pressure. (Author's abstract)
W85-04971

BATCH AND CONTINUOUS CULTURE EXPERIMENTS ON NUTRIENT LIMITATIONS AND TEMPERATURE EFFECTS IN THE MARINE ALGA TETRASELMIS SUECICA,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
V. Weiss, Z. Gromet-Elhanan, and M. Halmann.
Water Research, Vol. 19, No. 2, p 185-190, 1985. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Limiting nutrients, *Algae, *Tetraselmis, *Batch culture, *Continuous culture, *Wastewater treatment, *Marine algae, Nitrogen, Nutrients, Light intensity, Population density, Water temperature.

Batch growth and chemostat culture experiments were carried out with the marine alga Tetraselmis suecica (Kylin), a unicellular alga which is potentially useful for wastewater treatment by controlled eutrophication. In natural (Mediterranean coastal) seawater enriched with nutrients, at 22 C, under illumination at 12 h/12 h light/dark, with an intensity of 500 ft-candles, the maximal specific growth rate was mu sub max = 0.61/day (base e), measured both in batch and in chemostat experiments. Cell population densities were determined as a function of temperature at fixed dilution rates. The optimal growth temperature was between 25 and 27 C. With an abundant supply of nutrients, it was possible to sustain substantial population densities in the temperature range of 15-32 C. (Author's abstract)
W85-04973

INHIBITORY EFFECT OF REFRACTORY ORGANIC COMPOUNDS PRODUCED BY ACTIVATED SLUDGE MICRO-ORGANISMS ON MICROBIAL ACTIVITY AND FLOCCULATION,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Chudoba.
Water Research, Vol. 19, No. 2, p 197-200, 1985. 7 Fig, 3 Tab, 7 Ref.

Descriptors: *Refactory organic compounds, *Activated sludge, *Microorganisms, Chemical oxygen demand, Growth kinetics, Saccharidic polymers, Molecular weight.

Production of soluble refractory organic compounds by activated sludge micro-organisms is a common phenomenon, the intensity of which depends on the initial or influent concentration of substrate and the growth conditions of a given culture. The effect of accumulation of these refractory products in a cultivation medium on the activity of activated sludge micro-organisms was investigated. Semicontinuous cultivation of activated sludge micro-organisms was carried out in such a way that all microbial waste products were accumulated in the cultivation medium. Microbial waste products in higher concentrations adversely affected the kinetic activity and the flocculating and settling properties of activated sludge micro-organisms. As a measure of these properties, COD in settled (0.5 h, CODs) and centrifuged (1000 g, CODc) samples can be used. During the waste product-accumulation period, values of CODc and CODs increased from 71 to 2320 mg/l and from 127 to 8320 mg/l, respectively; thus at the end of the experiment biomass did not settle at all. Specific rates of COD removal decreased as a result of waste products accumulation; these rates fell from 100 to 55 mg/g/h during the waste product-accumulation period. The waste products had the following distribution of molecular weights: 39% below 700, 16% 700-10,000, 35% 10,000-50,000 and 10% above 50,000. Approximately 33% of the fraction with molecular weights above 10,000 were saccharidic polymers. (Collier-IVI)
W85-04974

WASTEWATER TREATMENT IN A DEEP AERATION TANK,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert, and H. S. Raghunandana.
Water Research, Vol. 19, No. 2, p 257-264, 1985. 3 Fig, 5 Tab, 20 Ref.

Descriptors: *Wastewater treatment, *Aeration, *Flotation, Kinetics, Microorganisms, Chemical oxygen demand.

Pilot-scale experiments were conducted to investigate the performance of a deep aeration tank (DAT) (10 m deep) treating a high-strength synthetic wastewater and DAT biokinetics. With a mean cell residence of 2 days with a ratio of food to microorganisms of 1.41 and less, the DAT reactor operating continuously completely mixed and without cellular recycle removed more than 95% of the chemical oxygen demand of the wastewater. The treatment kinetics were observed to follow the Lawrence and McCarty's models in which the values of the kinetic constants Y, kd, k and Ks for this particular operating condition were found to be 0.53, 0.085, 9.25/day and 259 mg/l, respectively. The results of solid separation by flotation, using the hydrostatic pressure developed in the DAT reactor, were satisfactory. However, better flotation results can be expected with the proper design and operation of the flotation tank. (Author's abstract)
W85-04981

ULTRAFILTRATION PROCESSES FOR THE CHARACTERIZATION AND SEPARATION OF LANDFILL LEACHATES,
Manhattan Coll., Bronx, NY. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5A.
W85-04985

STUDIES ON A SELECTED INDUSTRIAL EFFLUENT AND THE RECEIVING STREAM,
Ife Univ. (Nigeria). Dept. of Civil Engineering.
O. Ogedengbe, H. O. Fapohunda, and M. B. Gotau.
International Journal of Environmental Studies, Vol. 23, No. 3/4, p 229-234, October, 1984. 1 Fig, 3 Tab, 6 Ref.

Descriptors: *Nigeria, *Developing countries, *Industrial wastes, *Water pollution sources, Water quality control, Wastewater treatment, Food processing industry.

Many developing countries seem to be unable to establish water quality standards. The only reasonable hope for the foreseeable future seems to lie in voluntary action by industries prompted, perhaps, by gentle persuasion by public-spirited individuals or groups. An effort is this direction was made using an interplay of data collection and analysis and dialogue. Effluents from a bottling and canning factory complex have impaired the quality of Ona stream to such an extent that the water of the stream is unsuitable for irrigation, or any other use. Simple lab treatability studies showed that the canning waste is amenable to biological treatment, preferably aerobic, or possibly facultative. These results were brought to officials of both industries. The studies are to continue covering both effluents, separately and mixed. In the meantime,

treatment options that are being considered include the use of a shallow pond and an oxidation ditch system. Wastewater ponds are easy to build and operate and they perform well in tropical environments. However, they require large areas of land, and this may be a limiting factor. No plant should be constructed unless and until there is proof that it would make a positive difference to downstream users. (Baker-IVI)
W85-05031

REMOVAL OF PHENOL FROM WASTE WATER BY DOUBLE EMULSION MEMBRANES AND CREEPING FILM PERTRACTION,
Bulgarian Academy of Sciences, Sofia. Central Lab. of Chemical Engineering.
L. Boyadzhiev, E. Bezenshek, and Z. Lazarova.
Journal of Membrane Science, Vol. 21, No. 2, p 127-144, November, 1984. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Phenols, *Creeping film pertraction, *Double emulsion membranes, Membrane processes, Organic compounds.

The efficiency of two promising pertraction techniques was compared: the double emulsion method (DEM) and the recently proposed creeping film pertraction (CFP). Both methods can be successfully applied for water dephenolization using C10-C13 normal paraffins as intermediate phase. The solvent is water insoluble, non-toxic and relatively inexpensive. DEM provides higher output per unit apparatus volume. More than 80% of the agitator volume is occupied by the treated liquor, against 20 to 25% in CFP. The overall mass transfer coefficient is higher in the case of DEM batch operation than in CFP. If the goal is the production of a more concentrated product solution, continuous CFP shows higher KFa values. The DEM process consists of three steps; the two auxiliary operation, emulsion preparation before and emulsion destruction after the principal mass transfer operation, are both energy consuming. Emulsion breakup, F phase swelling and water occlusion into the emulsion during water treatment are important shortcomings of the DEM technique. They decrease the process efficiency and deteriorate the selectivity of the process, increasing the content of non-extractable species in the R phase. In addition, the use of emulsifiers makes the process more expensive and more complicated, even from the ecological point of view. (Baker-IVI)
W85-05036

WASTEWATER FILTRATION WITH THE AID OF A QUASICONTINUOUSLY-FED COMPACT FILTER FACILITY (ABWASSERFILTRATION MIT HILFE EINER QUASIKONTINUIERLICH BETRIEBENEN KOMPAKTFILTERANLAGE),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergutewirtschaft und Abfalltechnik.
M. Roth, and R. Wagner.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, p 221-228, 1984. 15 Fig, 2 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Filtration, *Compact filters, Quasicontinuous feed, Grain size, Suspended solids, Costs.

An experimental compact filter facility for advanced wastewater treatment was tested during two long periods between 1979 and 1982. The facility differs from conventional sand and multilayer filters in the size of its filter granules (round plastic grains with low density 0.5-1.0 mm) and its quasicontinuous feed together with external flushing of used granular material. The fine filter material makes filter speeds possible that are twice as high as those of conventional sand filters. High filter speeds allow smaller facilties and thus reduced investment costs. Experiments were performed at constant flow-through of 4.0 or 10.0 cu m/hr at filter speeds of 14 or 35 m/hr, respectively. During the experiment at 14 m/hr, 5-day BOD sludge load in the biological-treatment stage that precedes filtration was 0.09-0.21 kg/(kg.day) with an activated-sludge index of 130-180 ml/g; for the run at 35 m/hr, corresponding values were 0.20-0.35 kg/(kg.day) and 100 mg/l - to test the filter at higher inflow pollution levels, biologically treated water was taken from various depths of the basin. At 14 m/hr, median suspended-solids removal rate was 67.5%, and the filter was more effective than a sand filter operated at 15 m/hr, corresponding in its removal rate to a sand filter at 5 m/hr. At 35 m/hr, median suspended-solids removal rate was 45.3%; with far greater spread than at 14 m/hr in contrast to conditions at 14 m/hr, there was no relationship between inflow pollution level and removal rate. Use of the new filter in municipal wastewater treatment will only be possible with trained personnel. (Gish-IVI)
W85-05041

PILOT SCALE STUDIES ON ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL IN AN ACTIVATED SLUDGE TREATMENT PLANT WITH NITRIFICATION AND PREDENITRIFICATION (UNTERSUCHUNGEN UBER DIE BIOLOGISCHE PHOSPHOR-ELIMINATION IN EINER HALBTECHNISCHEN VERSUCHSANLAGE MIT WEITGEHENDER NITRIFIKATION UND VORGESCHALTETER DENITRIFIKATION),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergutewirtschaft und Abfalltechnik.
P. Kainrath, K. Krauth, W. Maier, and R. Wagner.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 17, p 245-251, 1984. 5 Fig, 5 Tab, 23 Ref.

Descriptors: *Phosphorus removal, *Biological treatment, *Nitrification, *Denitrification, *Activated sludge, Chemical precipitation, Wastewater treatment.

In activated sludge treatment the enhanced biological removal of phosphorus from domestic sewage is possibly an alternative to the established method of phosphorus precipitation with ferric, aluminum or calcium salts. However it is not yet clear, whether or not this method might be practicable in Central-Europe with the wastewater and temperature conditions existing there. The results of experiments in a pilot-scale activated sludge treatment plant are presented the influence of the composition of the influent, the retention time in the various basins, the variation of the organic sludge load and the seasonal profiles were investigated in ten different experimental periods during the past two years. The process design was also changed during the investigations in order to examine the influence of the system configuration. The aim of these experiments, which are still in progress, is to investigate the possibilities for the technical realization of the method presented. (Author's abstract)
W85-05042

FLOCCULATION EFFECTS ON BOUND WATER IN SLUDGES AS MEASURED BY NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY,
Delaware Univ., Newark. Dept. of Civil Engineering.
J. B. Carberry, and R. A. Prestowitz.
Applied and Environmental Microbiology, Vol. 49, No. 2, p 365-369, February, 1985. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Nuclear magnetic resonance spectroscopy, *Flocculation, *Sludge, Wastewater treatment, Spectroscopy.

Flocculation of biological sludges is not well understood mechanistically or quantitatively: the ease of dewatering is related to flock particle formation. Properties of bound water in sludges of various degrees of flocculation were investigated by nuclear magnetic resonance spectroscopy (NMR). NMR relaxation times (T1 and T2) were measured for flocculated and unflocculated samples of activated sludge. The weight of water and solids in the sludge samples was found and related to T1 to find the relative percentage of bound water. The results suggest that the amount of bound water increases as the samples become more unflocculated. The values of T1 and T2 also indicate that unflocculated individual particles are characterized by loose packing of shorter molecules and that the addition of larger molecules may induce flocculation. Sample preparation is important in determining the results; even mild centrifugation is not recommended for sample concentration. (Collier-IVI)
W85-05049

COMPARING PRIORITY POLLUTANTS IN MUNICIPAL SLUDGES,
Camp, Dresser and McKee, Inc., Annandale, VA.
C. Gricke, C. Clarkson, E. Lomnitz, and T. O'Farrell.
Biocycle, Vol. 26, No. 1, p 35-37, January/February, 1985. 2 Tab, 1 Ref.

Descriptors: *Sludges, *Chemical composition, *Municipal wastewater, *Priority pollutants, Pollutant identification, Polychlorinated biphenyls, Pesticides, Acids, Organic compounds, Selenium, Beryllium, Zinc, Copper, Metals, Volatile compounds.

In 1978 a program was initiated by the US EPA to study the fate and occurrence of 129 priority pollutants in 50 Publicly Owned Treatment Works (POTW). A key finding of this study was that some pollutants found in POTW influents at low frequencies of occurrence were measured at higher frequencies in the corresponding sludge streams. An analysis of the EPA study results was made in comparison with results of other available municipal sludge data bases. This comparison brings into clearer focus what pollutants are present in municipal sludges nationwide, and characterizes their frequency and concentration. With the exception of selenium and beryllium, all the metals examined in this analysis were detected at virtually all of the plants with zinc appearing in the highest concentrations. Of the three acid compounds, phenol was the most prevalent but was found at lower concentrations than pentachlorophenol and 2,4,6-trichlorophenol. Bis(2-ethylhexyl)phthalate was the most prevalent base/neutral compound and was also found at a concentration higher than any of the other base/neutral compounds. As a group, the pesticides and PCB's were detected less frequently and at a lower concentration than any of the other compounds. Chlordane was the most frequently detected at 36% of the POTWs with PCB's next at 31%. (Baker-IVI)
W85-05057

REMOVAL OF ORGANIC AND TOXIC SUBSTANCES FROM DEBARKING AND KRAFT PULP BLEACHING EFFLUENTS BY ACTIVATED SLUDGE TREATMENT,
J. Junna, R. Lammi, and V. Miettinen.
Vesientutkimuslaitoksen Julkaisuja, No. 49, p 17-29, 1982. 7 Fig, 9 Tab, 21 Ref.

Descriptors: *Pulp wastes, *Kraft mills, *Wastewater treatment, *Bleaching wastes, *Activated sludge, *Toxicity, Bioassays, Biological oxygen demand, Trout, Water pollution effects.

Bleaching is presently the most significant source of pollution in pulp mill processes in Finland. Pilot plant experiments were carried out in a Finnish kraft mill to test the treatment of combined debarking and bleaching effluent by the activated sludge method. The kraft mill used a typical multistage chlorine bleaching method and conventional wet debarking drums were used for debarking. The tests were run with a normal one-stage activated sludge system. The organic load of the pilot plant was about 1 kg/cu m BOD7. The best BOD7-reduction obtained was 60-80%. Ether-soluble compounds were removed from the combined effluent at an efficiency of 51%. Resin acids, an important group of toxic compounds, were reduced efficiently, the average reduction being 75%. The reduction of chlorinated phenolics was usually 30-40%, and at best about 60%; these compounds form during the bleaching process from chlorine, and chlorine dioxide, and lignins. During the overall period, the reduction of fatty acids was 53% and that of sterols 54%. Acute toxicity (LC-50 96 h) to trout was reduced by at least 70%. Long term toxicity tests (20 d) revealed that the treatment reduced sublethal effects and the accu-

ulation of resin acids in trout. In fish exposed to eated effluent, the concentrations were only half f the concentrations measured in fish exposed to ntreated effluent; concentration levels were deter- ined with bile and blood plasma analyses. Com- ounds tainting fish fillets were also reduced. (Col- er-IVI)
V85-05061

VATER REUSE: WHERE ARE WE HEADED,
Orange County Water District, Fountain Valley, CA.
). G. Argo.
Environmental Science and Technology, Vol. 19, lo. 3, p 208-214, March, 1985. 1 Fig, 4 Tab, 21 ef.

Descriptors: *Water reuse, *Drinking water, *Aq- ifer recharge, *California, Water supply develop- ent, Water supply, Water treatment, Reverse os- osis, Artificial recharge.

For the past 60 years, Californians living in the outhern portion of that state have been importing ater to supplement the inadquate local supply. reliminary studies indicate that recharge of the roudwater supplies for this area through a series f injection wells would require as much as 6,990,000 cu m of water per year. After weighing ll the factors, including consideration of the avail- bility of supply, reliability, environmental prob- ems, quality, and program costs, it was determined at the best source of barrier injection would be eclaimed water. Water Factory 21 (WF21) was onceived and constructed to provide a source of echarge water for the injection barrier. It has been operation since October 1976 and has produced ine trillion gallons of treated, reclaimed water. The treatment process includes lime clarification ith sludge recalcining, air stripping, recarbona- on prechlorination, mixed-media filtration, granu- r activated carbon adsorption with regeneration, nal chlorination, and reverse osmosis demineral- ation. WF21 has demonstrated its reliability in eeting EPA drinking water standards. Especially hen RO is included, the treatment processes have one beyond existing standards and have shown e ability to reduce the concentration of priority ollutants below mandated health criteria. (Baker- VI)
V85-05116

ETHYLBENZENE, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontar- o).
Envirotips Manuals, February 1984. 93 p, 28 Fig, 8 Tab, 195 Ref.

Descriptors: *Water pollution control, *Benzenes, Aquatic Life, Environmental Quality, Pollutants, Problem Spills, Cleanup, Skimming, Ethylbenzene, Hazardous materials, Toxicity, Contamination, Bioaccumulation, Sewers.

Technical and environmental information for han- ling and preventing problem spills of ethylben- ene are presented. Ethylbenzene is a colorless quid with a sweet, gasoline like odor. Its syno- yms include Phenylethane, Ethylbenzol, and EB. Ethylbenzene is a flammable liquid; its vapors form xplosive mixtures in air at concentrations of 1.0 to .7%. It is moderately toxic by inhalation, contact nd ingestion to humans. Ethylbenzene is harmful o some species of aquatic life at concentrations as ow as 0.4 mg/l. An ethylbenzene slick could pose n immediate hazard to waterflow and marine ani- nals. It is harmful to aquatic life in low concentra- ions, but has not been shown to be bioaccumula- ive or bioconcentrative. Immediate action for spill ontrol requires access restriction to the spill site, alling the fire department, and notification of the nanufacturer. Sources of ignition, including traffic nd equipment, need to be eliminated. It is neces- ary to keep contaminated water from entering ewers or watercourses. Emergency control proce- lures in water include: contain with booms, weirs r natural barriers. Use skimming equipment to emove the slick, followed by the application of orbents.
W85-05126

PROCESS DESIGN MANUAL FOR LAND APPLICATION OF MUNICIPAL SLUDGE,
SCS Engineers, Inc., Long Beach, CA.
K. LaConde, C. Schmidt, H. V. Lam, T. Boston, and T. Dong.
Environmental Protection Agency, Report EPA-625/1-83-016, October 1983. 410 p, 53 Fig, 125 Tab, 398 Ref, 5 Append.

Descriptors: *Sludge Utilization, *Municipal Wastes, Land Disposal, Land Reclamation, Design Standards, Site Selection, Sludge Disposal, Public Participation, Agriculture, Surface Water, Groundwater.

A rational procedure for the design of municipal sludge land application systems is presented. The utilization of sludge in agriculture, forestry, the reclamation of disturbed and marginal lands, and dedicated high rate surface disposal practices are discussed in detail, with design concepts and criteria presented where available. A two phased planning approach to site identification, evaluation, and selection along with information on field investigations are also presented. The manual includes examples of each land application option and case studies of sludge utilization in agriculture and for reclamation of disturbed mining lands.
W85-05127

DESIGN MANUAL, MUNICIPAL WASTEWATER STABILIZATION PONDS,
Clemson Univ., SC.
E. J. Middlebrooks, J. H. Reynolds, C. Middlebrooks, R. W. Schneiter, and R. J. Stenquist.
Environmental Protection Agency, Report EPA-625/1-83-015, October 1983. 327 p, 99 Fig, 55 Tab, 253 Ref, 1 Append.

Descriptors: *Wastewater Facilities, *Design Criteria, Municipal Wastewater, Suspended Solids, Cost Analysis, Ponds, *Stabilization Ponds, Aerated Lagoons, Municipal wastes, Wastewater treatment.

A concise overview of wastewater stabilization pond systems is provided through a discusssion of factors affecting treatment, process design principles and applications, aspects of physical design and construction, suspended solids (SS) removal alternatives, and cost and energy requirements. A review of physical and biological factors associated with wastewater stabilization ponds is provided. Empirical and rational design equations, and their ability to predict pond performance, are also discussed. Actual design examples employing the rational equations are provided. These examples encompass essentially all types of wastewater ponds currently in use in the United States. Physical design and construction criteria are discussed. These criteria are vital to effective pond performance regardless of the design equation employed and must be considered in facility design. High SS concentrations in pond effluents have traditionally represented a major drawbacks to their use. Alternatives for SS removal and control are presented. Cost and energy requirements are useful to aid in process selection and justification. An evaluation of various facultative and aerated pond design methods is presented in an Appendix. This evaluation was performed using data collected on the 4 facultative and 5 aerated pond systems presented.
W85-05133

HANDBOOK FOR IDENTIFICATION AND CORRECTION OF TYPICAL DESIGN DEFICIENCIES AT MUNICIPAL WASTEWATER TREATMENT FACILITIES.
Municipal Environmental Research Lab., Cincinnati, OH.
Report EPA-625/6-82-007, April 1982. 409 p.

Descriptors: *Municipal Wastewater, *Wastewater Facilities, *Design Standards, Activated Sludge, Sludge Drying, Sludge Disposal, Lagoons, Aerobic Digestion, Anaerobic Digestion, Lagoons.

The handbook was prepared for use by engineers involved in the design of publicly-owned treatment works (POTWs). Its intent is to identify design deficiencies found to limit the performance of POTWs. Design considerations are developed that eliminate the deficiencies during the design phases of the project. Typical design deficiencies found in POTWs are identified and associated methods to correct each of the deficiencies noted are presented. The handbook describes design deficiencies that contribute to performance and reliability problems, poor safety practices, and/or decreased flexibility of plant process control. The result of such deficiencies may be any combination of increased plant operations and maintenance, cost, and energy requirements. The handbook is intended to provide design engineers with guidance that will make their designs more operable and maintainable at less cost, as well as more flexible in providing adequate performance during times of changing influent characteristics. The topics include: design considerations, preliminary treatment, primary treatment, air activated sludge, oxygen activated sludge, trickling filter, disinfection, anaerobic digestion, aerobic digestion, sludge dewatering, lagoons, land application, sludge disposal, sludge reduction, and rotating biological contactors.
W85-05135

REMOVAL OF VOLATILE CHLORINATED HYDROCARBONS FROM GROUNDWATER (ENTFERNUNG LEICHTFLUCHTIGER CHLORKOHLENWASSERSTOFFE AUS GRUNDWASSER),
For primary bibliographic entry see Field 5G.
W85-05136

ION-EXCHANGE PROCEDURES (IONENAUSTAUSCHVERFAHREN).
For primary bibliographic entry see Field 5F.
W85-05137

CALCULATING REFERENCE LEVELS FROM MAXIMUM LEVELS (BEZUGSWERT-ERRECHNUNG AUS HOCHSTWERTEN).
For primary bibliographic entry see Field 6E.
W85-05138

ADAPTED MICROORGANISMS REPLACE DESTROYED BIOMASS (ADAPTIERTE MIKROORGANISMEN ERSETZEN ZERSTORTE BIOMASSE),
W. Rucken.
Wasser, Luft und Betrieb, Vol. 28, No. 3, p 14-16, March, 1984. 2 Fig.

Descriptors: *Microorganisms, *Biomass, *Biological wastewater treatment, Industrial wastewater, Plastics industry, Wastewater treatment.

Specially bred mutated microorganisms were used to replace biomass destroyed by an unexpected sudden increase in volume and pollution level of wastewater at the Ruhle wastewater-treatment facility on the Ems River (Federal Republic of Germany). Biomass destruction by a rush of wastewater from a synthetic-resin plastic manufacturing plant occurred in 1982 just after the original biomass had been pumped into a new activation basin. Activated sludge brought in as inoculating sludge failed to rebuild an effective biomass despite introduction of only small quantities of the heavily polluted wastewater to be treated. Mutated adapted microorganisms (noggies) were applied to the system. A marked improvement in degradation capacity was seen on day 3. Application of noggies was stopped after 30 days to discover whether the basin had developed its own biomass; it was found that the facility could run smoothly and effectively without further application (total quantity of noggies used in 30 days was 30 kg). Since noggies can be stored for years in a dry place, a supply was retained for possible future problems. (Gish-IVI)
W85-05139

BIOZWEI TUBE-REACTOR PROCEDURE (DAS ROHRREAKTOR-VERFAHREN BIOZWEI),

Messer Griesheim G.m.b.H., Duesseldorf (Germany, F.R.).
W. Mack.
Wasser, Luft und Betrieb, Vol. 28, No. 6, p 18-21, June, 1984. 5 Fig, 2 Ref.

Descriptors: *Biological wastewater treatment, *Biozwei tube reactor, Wastewater treatment, Industrial wastewater, Oxygen, Aeration, Activated sludge process.

The Biozwei tube reactor is suited to the biological treatment of heavily polluted industrial wastewater due to its high specific-load capacity, ability to handle highly variable pollution levels in inflow, and low sludge index. The horizontal tubular shape of the reactor, which differs markedly from conventional activation basins, together with pressurized aeration with pure oxygen, allows a chronological separation of substrate and endogenous respiration by microorganisms. The flow of the wastewater/activated-sludge mixture horizontally through the reactor is superimposed by a spiral flow about the horizontal axis to achieve an even horizontal flow and minimize backflow. This results in substrate degradation at higher speeds than in conventional facilities. When the substrate is fed in, intensive respiration begins spontaneously (high substrate concentrations cause the microorganisms to synthesize increased quantities of enzymes), reaching a peak after about 15 min and decreasing only when almost all the substrate has been decomposed. The high performance level of Biozwei is made possible by the use of pure oxygen rather than air; its enclosed design makes it possible to capture and reapply to the activated sludge any unused oxygen, resulting in a 95% exploitation rate. A transportable experimental Biozwei reactor was used to treat wastewater from a pulp factory, garbage-dump percolating water, wastewater with high carbohydrate content, and wastewater from an animal-products plant. Results were good in all cases: e.g., COD removal in pulp wastewater and dump percolating water was > 90%. (Gish-IVI)
W85-05141

WASTEWATER PURIFICATION IN THE HIDE GLUE INDUSTRY (ABWASSERREINIGUNG BEI DER HAUTLEIMINDUSTRIE),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergutewirtschaft und Abfalltechnik.
K. F. Staab, M. Roth, M. R. Stuttgart, and R. Binder.
Wasser, Luft und Betrieb, Vol. 28, No. 7-8, p 15-18, July/August, 1984. 4 Fig, 6 Tab, 6 Ref.

Descriptors: *Biological wastewater treatment, *Industrial wastewater, *Glue industry, Percolating filters, Wastewater treatment, Nitrification.

A wastewater-treatment plant at a hide-glue factory was originally designed for 3,600 cu m/-day wastewater, 5-day BOD sludge and volume loads of 0.4 kg/(kg.day) and 1.0 kg/(cu m.day), and a residence time of 12 hr. Effluent quality varied greatly, but was satisfactory for 5 yr until 5-day BOD in inflow had more than doubled, resulting in a higher sludge index and increased levels of 5-day BOD and COD in effluent. Experiments with a submerged, plastic-filled percolating filter resulted in a 52% decrease in 5-day BOD and a 46% decrease in COD at a 5-day BOD volume load of 2.5 kg/(cu m.day) and corresponding decreases of 44.4% and 40.4% at a volume load of 6.0 kg/(cu m.day); at the latter volume load, the filter was stopped up by lime deposits after 1 mo despite high rinse speeds of 1.9 m/hr. The filter therefore reduced organic pollution satisfactorily but lacked operational stability, so the facility was expanded by adding a further activation basin. The expanded biological stage was designed for a 5-day BOD load in inflow of 4,200 kg/day with a wastewater volume of 3,600 cu m/day. By introducing nitrification in the second stage, the strongly alkaline wastewater was neutralized to the extent that the original neutralization basin was no longer needed. Results of expansion were good with sludge index being reduced from 200 to about 50 ml/g, and the quality of effluent being so high that the factory was considering using it as wash water. (Gish-IVI)
W85-05142

MATHEMATICAL MODEL OF THE PROCESS OF POLLUTANT REMOVAL IN ROTATING DISK BIOFILTERS,
V. A. Vavilin, and S. S. Kuz'min.
Water Resources, Vol. 11, No 2, p 163-168, March-April, 1984. 6 Fig, 1 Tab, 16 Ref. Translated from Vodnye Resursy, No. 2, p 143-149, March-April, 1984.

Descriptors: *Wastewater treatment, *Biofilters, Filtration, Biological treatment, Industrial wastewater, Municipal wastewater, Mathematical models, Rotating disk biofilters.

Biodisks (rotating disk biofilters) are modifications of biofilters which provide a greater waste-treatment time. Biodisks have recently become popular for treating both domestic and industrial wastewaters. The polluting organic matter is consumed by the biofilm covering the surface of the rotating disks. Due to rotation of the disks the biofilm receives the necessary amount of oxygen. Usually the rotational speed does not exceed 2-10 rpm. The functioning of a complex community of microorganisms underlies the biological treatment process. Despite this, relatively simple formal models based on aggregated variables can be used in an engineering calculation of the volume of a treatment plant. The earlier proposed unified model of biological treatment for various types of reactors can be used successfully for calculations for rotating disk biofilters. Unlike biodisks with transverse rotation of the shaft, in biodisks with longitudinal rotation a succession of attached microoganisms along the waste liquid flow occurs. It is as though the successive removal of components of a multicomponent pollutant occurs. Such specialization of microorganisms leads to greater effectiveness of treatment. (Baker-IVI)
W85-05160

PROCESS DESIGN MANUAL, LAND TREATMENT OF MUNICIPAL WASTEWATER,
Metcalf and Eddy, Inc., Sacramento, CA.
R. W. Crites, E. L. Meyer, R. G. Smith, M. Walker, and K. Alston.
Environmental Protection Agency, Report EPA 625/1-81-013, October 1981. 458 p, 88 Fig, 141 Tab, 262 Ref, 7 Append.

Descriptors: *Municipal wastewater, *Wastewater facilities, Site selection, *Land disposal, Hydraulic loading rate, Subsurface drainage, Groundwater, Disposal, Design standards, Infiltration, Overland flow, Environmental effects, Toxicity.

A rational procedure for the design of land treatment systems is presented. Slow rate, rapid infiltration, and overland flow processes for the treatment of municipal wastewaters are discussed in detail, and the design concepts and criteria are presented. A two-phased planning approach to site investigation and selection is also presented. The manual includes examples of each process design. Information on field investigations is presented along with special considerations for small scale systems. Equations and procedures are included to allow calculations of energy requirements for land treatment systems. Potential health and environmental effects and corresponding mitigation measures are discussed.
W85-05194

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NEW TECHNOLOGY FOR WASTEWATER TREATMENT AND SEWERAGE IN RURAL AND SUBURB AREAS.
Tampere Univ. of Technology (Finland). Dept. of Civil Engineering.
October 3-6, 1983, Hanasaari, Finland. 1984. 449 p. Rantala, P., Santala, E., and Vikman, H., Editors. 95 Fig, 68 Tab, 204 Ref.

Descriptors: *Wastewater treatment, *Conferences, *Regulations, *Rural areas, *Sewer systems, *Water policy, *Septic tanks, *Composting, *Land disposal, *Absorption, *Wastewater disposal, *Education, Reviews, Symposium, Pulp and paper industry, Sewers, Wastewater management, Septic wastewater, Wastewater, Septic sludge, Soil amendments, Soil treatment, Waste disposal, Scandinavia, United States, Pulp wastes, Wastewater renovation.

This international conference was organized by the Tampere University of Technology to enable the exchange of experiences, ideas and plans for water pollution control in rural areas where conventional sewerage systems are not feasible. The proceedings cover six areas of wastewater treatment technology: policy and regulations, sewerage and septic tanks, composting toilets and package treatment plants, the soil as a renovating medium for wastewater, the design, construction and function of soil absorption systems, and training and research programs. Most of the papers given at the conference focus on sewerage and wastewater treatment systems in rural areas of the United States or Scandinavian countries. Municipal and industrial wastes are cited as the main sources of water pollution and eutrophication of lakes and rivers. In Scandinavia and North America, the pulp and paper industry has been the major polluter. Special emphasis was put on experiences and future trends in different types of soil absorption systems.
W85-05195

OVERVIEW OF ON-SITE WASTEWATER TREATMENT AND DISPOSAL,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. W. Seabloom.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 15-22, 2 Ref.

Descriptors: *Wastewater treatment, *Land disposal, *Septic wastewater, *Wastewater disposal, *Soil absorption, *Sewer systems, Wastewater management, Rural areas, Developing countries, Absorption, Septic tanks, Sewers.

The implementation or lack of implementation of on-site wastewater disposal systems in developed countries has been influenced by many factors and decisions of many different parties. On-site wastewater disposal systems were generally perceived as inadequate and temporary and regulations to manage them were often biased and unnecessarily restrictive. Centralized systems required large federal subsidies, the cost of which were not always borne by those creating the water pollution problem. Engineers and regulatory officials in general have been unaware of the cost and performance of on-site wastewater disposal systems due to the traditional education scheme which focuses on conventional wastewater treatment systems. Extensive growth inducing properties common to conventional gravity sewers are not generally a serious concern with on-site systems. Engineers must recognize that properly sited, designed, constructed and maintained on-site systems are cost effective and in many cases are the preferred solution.
W85-05196

POLICY AND REGULATIONS IN SCANDINAVIA,
National Board of Waters, Helsinki (Finland). Office for Water Supply and Sewerage.
H. Vikman.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 23-29.

Descriptors: *Wastewater treatment, *Regulations, *Water policy, *Wastewater management, *Land disposal, *Scandinavia, *Water pollution control, *Local governments, Pulp and paper industry, Water quality standards, Soil absorption, Absorption, Sweden, Denmark, Finland, Norway, Sewer systems, Wastewater disposal, Rural areas, Acidification.

Differences in topography and population density have made wastewater treatment practices differ in

the Scandinavian countries. In Denmark, the municipal government maintains strict regulations for the treatment and disposal of rural wastewaters. In Finland, more emphasis will be put on the reduction of pollution load from pulp and paper industry in the 1980's. The municipal water boards and boards of health are responsible for small-scale wastewater systems in Finland. The protection of the marine ecosystem is considered vitally important in Norway where water pollution is controlled at the regional level by the municipal boards of construction. In Sweden, a water acidification problem exists in the south. The responsible authority in Sweden is the board of health. Quality standards for effluents from individual or small-scale sanitation utilities have not been applied in Scandinavia, but are substituted by certain technologies to be used in various circumstances or setting of standards on minimum distances between on-site treatment utilities and groundwater intakes or watercourses. New guidelines on soil absorption methods are to be released as a result of a joint venture by Norway and Sweden.
W85-05197

ONSITE WASTEWATER SYSTEMS POLICY AND REGULATIONS IN THE USA,
Municipal Environmental Research Lab., Cincinnati, OH.
J. F. Kreissl.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 31-45, 15 Ref.

Descriptors: *Wastewater treatment, *Land disposal, *Soil absorption, *Wastewater disposal, *Local governments, *Waste management, *Public health, *Regulations, *Septic tanks, Water pollution control, Waste disposal, Design criteria, Site selection, Water law, Septic wastewater, Reviews, Runoff, Sanitation.

With the passing of the Clean Water Act of 1977 in the United States, on-site wastewater disposal systems were to receive increased government funding in communities with populations of < 3,500 or in sparsely populated areas of larger communities. Most state codes for the design of conventional on-site systems are based on the premise of protecting public health. Soil absorption systems must have proper siting, design and construction to prevent contamination of groundwater or overland runoff. With improved site evaluation capability and availability of new technologies to provide sanitation for almost any site, flexible guidance criteria has replaced the use of restrictive codes in many circumstances. In Maine, licensed state evaluators provide extensive soil evaluations prior to system identification, design and installation. Other states are increasing their emphasis on qualified site evaluations thus reducing the lag time between technological advances and code changes.
W85-05198

LOCAL WATER AND SEWAGE SYSTEM PLANNING,
EFEM A.B., Goeteborg (Sweden).
H. Bjur, and B. Malbert.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 47-63.

Descriptors: *Legal aspects, *Social aspects, *Wastewater treatment, *Rural areas, *Sweden, *Wastewater disposal, *Project planning, *Local governments, Waste disposal, Water policy, Economic aspects, Regulations, Sewer systems, Septic tanks, Wastewater management.

In Sweden, the construction of underground sewers in towns commenced in the 1860's in response to industrialization. Refuse collection by law was initiated in 1905. In the late 1950's, all dwellings in urban areas had to be connected to centralized water and sewage plants. In 1962, the National Road Board called for the use of septic tanks and sand filter trenches in rural areas. In rural areas, the problem exists of choosing the best small-scale water and sewage technique. Municipal planners should conduct water-sewer (WS) surveys to see where and when the municipal network can be extended and where and when a special WS survey must be made. The choice of a WS system depends on the extent of development of the area being considered, its natural resources, and the social situation of the physical environment. In 1974 the Plant Act was issued to assist and control the implementation of private installations. It regularizes the formation of one joint installation for several properties. Great demands are made on the competency of the project consultants and contractors. The need for maintenance and regular inspection increases in accordance with plant size. The utilization of local resources in the operation of the WS plant should also be considered.
W85-05199

QUANTITY AND CHARACTERISTICS OF RESIDENTIAL WASTEWATER,
National Board of Waters, Helsinki (Finland). Planning Office.
E. Santala.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 67-78, 7 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Septic tanks, *Wastewater disposal, *Finland, Rural areas, *Municipal wastewater, Septic wastewater, Municipal wastes, Effluents, Wastewater, Wastewater management, Water use, Water use efficiency, Consumptive use, Nonconsumptive use, Land disposal.

In Finland, the per capita consumption of water is generally lower in smaller towns and rural areas than in Helsinki. The main uses of water and production of wastewater within a household are use of water for personal hygiene, laundering, dishwashing, and drinking, food preparation and cleaning. Water consumption is best reduced by using minimum-flow fixtures and low-flush toilets. In rural and suburban residences, wastewater flow is nearly equal to water use. Pollutant load in residential wastewater depends mostly on family size, toilet type and water use habits. The wastewater influent to septic tank or on-site treatment plant has higher pollutant concentrations than those in influent to municipal treatment plants due to the quantity of leakage water. Results of a 1981-82 study of septic tanks in Finland showed that the effluent from both blackwater and graywater septic tanks was strong and quite similar for suspended solids, biological oxygen and total phosphorus. Total nitrogen values were much lower in graywater effluent even though they were higher than expected.
W85-05200

ALTERNATIVE SEWER SYSTEMS IN THE UNITED STATES,
Municipal Environmental Research Lab., Cincinnati, OH.
J. F. Kreissl.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 79-115, 5 Fig, 6 Tab, 17 Ref.

Descriptors: *Sewers, *Wastewater treatment, *Sewer systems, *Design criteria, *Sewer hydraulics, *Pressure conduits, *Domestic wastes, Vacuum sewers, Small-diameter gravity sewers, Pressure sewers, Capital costs, Operating costs, Maintenance costs, Comparison studies, Septic tanks, Cost analysis, Conduits, Wastes, United States.

In rural areas in the United States, monthly sewerage charges above twenty dollars/mo are considered excessive. Usually on-site systems cost less than this and therefore have been used in rural areas. Three types of alternative collection systems for human wastes-pressure, vacuum and small-diameter gravity (SDG) sewers are discussed. Pressure sewers have low installation costs. Since pressure sewers are sealed conduits, infiltration is eliminated and treatment plants can be designed to handle only domestic sewage. Pressure sewers may incur higher operational and maintenance costs. There are two types of SGD sewers, those with relatively constant grade and those with variable grade. SGD sewers incur lower capital costs than conventional gravity sewers but they require continued maintenance of septic tanks and corrosion and odor control. The vacuum sewer also offers reduced capital costs due to the small plastic pipe used and reduced depth of installation. Wastewater from a vacuum sewer has a higher dissolved oxygen content. However, vacuum systems require more energy for operation per unit volume of wastewater transported, greater potential for infiltration, and special design requirements for grade alignment and allowable system lift. The choice of one of these sewer systems over the other depends upon topography, geology/hydrology, available management, power, habitation, termination facilities, climate, and population density and growth and treatability.
W85-05201

SEPTIC TANK DESIGN,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. W. Seabloom, D. A. Carlson, and J. Engeset.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 117-134, 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Septic tanks, *Septic wastewater, *Wastewater treatment, *Wastewater disposal, Wastewater, Septic sludge, Domestic wastes, Biological wastewater treatment, Waste disposal, Suspended solids, Sedimentation, Biological oxygen demand, Pathogens, Phosphorus compounds, Nitrogen compounds.

The septic tank provides for the separation, storage, and digestion of suspended solids as well as for the growth, reproduction, and death of large numbers of anaerobic organisms. A septic tank with greater surface area is more effective than one with a smaller surface area if the volume is the same. Septic tanks for residential use are usually made of concrete and are precast for installation in the field. They are sized on the expected number of bedrooms served. Septic tanks should be equipped with inlet and outlet devices to minimize turbulence and carry-over of solids. They should be pumped out of sludge and scum every three to five years. Recent studies suggest no advantages in septic tank compartmentation. Septic tanks appear to be unaffected by hydraulic stressing produced by wash day, vacation and a weekend party of house of guests. The effluent from a septic tank contains suspended solids, biological oxygen demand, and P compounds, as well as pathogens which prohibit its discharge into water courses or on land. Septic tank effluent always requires additional treatment in the soil by a subsurface soil absorption system.
W85-05202

EXPERIMENTS WITH TESTING OF SEPTIC TANKS,
Teknologisk Inst., Tastrup (Denmark).
I. Faldager.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 135-145, 3 Fig, 4 Tab, 2 Ref.

Descriptors: *Septic tanks, *Comparison studies, *Artificial sludge, *Design criteria, *Performance evaluation, Wastewater treatment, Septic sludge, Septic wastewater, Suspended solids, Sludge.

The ability of four types of septic tanks (one chamber, two chamber, small Emcher, and big Emcher)

to detain settleable solids and sludge already settled was examined. A polystyrene artificial sludge was used in the tests. Results showed that the one-chamber tanks gave the worst performance. A cap on the outflow of the one-chamber tank had a favorable effect on the outflow concentration. Insertion of a second chamber diminished the total outlet of particles by more than 50%. A traditional 1 m septic tank succeeded by a smaller septic tank (second chamber) gave the best results. Characteristically, all the one-chamber tanks showed a high concentration of artificial sludge in the beginning of testing while the insertion of a second chamber resulted in the largest sludge concentrations in the outflow appearing at the end of testing. The insertion of even a small second chamber takes away the peak of the large concentration in the outflow at the few big outflows and thus improves the function of the tank considerably.
W85-05203

SEPTAGE QUANTITY, CHARACTERISTICS AND TREATMENT METHODS,
Norsk Inst. for Vannforskning, Oslo.
A. S. Eikum.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 147-166, 8 Fig, 8 Tab, 13 Ref.

Descriptors: *Wastewater treatment, *Septic tanks, Sludge digestion, Aerobic digestion, *Anaerobic digestion, *Municipal wastewater, *Septic sludge, *Septic wastewater, Norway, Wastewater disposal, Germany, Sweden, Biological wastewater treatment, United States, Municipal wastes, Sludge drying, Dewatering, Sludge thickening, Sludge solids.

In Norway specific septage quantity was found to be 0.35 cu m/person/yr. In Sweden a value of 0.20 cu m/person/yr has been recommended for design purposes. The amount of septage from a septic tank will depend on the volume of the tank, how often the tank is emptied, and the procedure used when emptying the tank. Calculated volumes of septage are inadequate for designing the treatment capabilities of municipal wastewater facilities. The maximum daily volume of septage was almost 5 times the average daily volume based on one year's observations at three municipal treatment plants. In Europe and the United States, septage handling varies considerably from one municipality to another. Usually the septage is either added directly to the treatment plant inlet, to the sewer upstream from the treatment plant or directly to the sludge treatment facility at the municipal treatment plant. Germany has developed guidelines covering process as well as management aspects that seek to minimize operational problems. In Norway it is customary to add septage directly to the sludge handling facility of a municipal treatment plant. Pretreatment or anaerobic digestion or lime stabilization are usually required. Careful engineering evaluations must be made to avoid difficulties caused by sludge return liquor to the wastewater treatment plant and odor problems.
W85-05204

DISPOSAL AND UTILIZATION POSSIBILITIES OF SEPTAGE,
National Board of Waters, Helsinki (Finland). Office for Water Supply and Sewerage.
J. Puolanne.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 167-173, 1 Fig.

Descriptors: *Wastewater treatment, *Finland, *Septic wastewater, *Sludge thickening, *Sludge disposal, *Wastewater disposal, *Rural areas, *Landfills, *Liquid sludge, Wastewater, Sludge drying, Sludge utilization, Wastewater renovation, Soil amendments, Land disposal, Dewatering, Sanitary landfills, Liquid wastes, Sludge, Domestic wastes.

The climatic and geographic conditions, quantity and quality of septage and the high water pollution control objectives account for the septage problems encountered in Finland. Regulatory measures include the restriction of disposal on sanitary landfills or underwater sludge, specifications for soil injection, and guidelines for the application of liquid or frozen sludge to selected sites. Dewatered sludge may be applied to sanitary landfills. Farmers may practice on-site septage disposal by the spreading of liquid slurry by farm equipment. For sparsely populated rural areas, mobile dewatering containers or lime stabilizing dewatering equipment are recommended. More work on the design and operation features of septage handling alternatives is still required.
W85-05205

PRINCIPLES OF COMPOSTING,
Helsinki Univ. (Finland). Dept. of Microbiology
For primary bibliographic entry see Field 5E.
W85-05206

TESTING OF BIOLOGICAL (COMPOSTING) TOILETS AND PRACTICAL EXPERIENCES IN NORWAY,
Norges Landbrukshoegskole, Aas. Inst. for Georesources and Pollution Research.
O. Molland.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 191-206, 8 Fig, 2 Tab, 5 Ref.

Descriptors: *Toilets, *Composting, *Solid wastes, *Waste disposal, *Domestic wastes, *Biological toilets, Water closets, Sludge, Waste paper, Biological degradation, Liquid wastes, Evaporation, Water pollution control, Rural areas, Norway, Sweden.

The biological toilet which does not use water is a sewer-less system where excess liquid is evaporated and solid materials are decomposed to a soil-like and hygienically safe compost. Since the capacity and function of the various models of biological toilets varies widely, the pollution authorities in Sweden and Norway have introduced approval tests for toilets. Of the 7 biological toilets tested for all-year houses, 3 were approved while 9 out of 13 for cabins were approved. The capacity for water evaporation of the toilets varies from 2 to 5 persons for toilets used in all-year houses and from 2 to 8 for toilets used in cabins. Of the toilets approved for marketing, all first required modifications. The most common problems were the water evaporation capacity, emptying of solid wastes, complicated instructions, and care and maintenance, and leakage. Of the large toilet models, the inclined-floor type did not function satisfactorily and could not be recommended for continuous use. The carousel toilet features four chambers which may be rotated to expose a new chamber when one chamber is filled. The Camo-do toilet operates with a bucket that is tilted and emptied into a larger tray when filled. All small toilets must be equipped with a ventilation fan, heating element and a mechanical mixer.
W85-05207

BARK CHIP DECOMPOSITION LATRINES,
Kymi Provincial Environmental Conservation Bureau, Kouvola (Finland).
J. Louvo.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 207-226, 1 Fig.

Descriptors: *Latrines, *Composting, *Bark, *Finland, *Domestic wastes, *Decomposition, *Waste disposal, *Liquid wastes, Biodegradation, Feces, Urine, Animal wastes, Odor, Food-processing wastes, Microbial degradation, Solid wastes.

Bark is used as a covering substance and imparts a pleasant odor while serving to absorb urine in latrines. Bark chip latrines have two containers one placed on top of the other. The one on top ha perforations so the urine trickles into the lowe container. After each use the waste is covered wit bark chips. The waste containers must be emptie into the primary composting container well befor it is filled up. After 2-6 weeks in the primary composting chamber, the waste is transferred t the secondary composting racks. Another latrin covering medium contains a set of living microor ganisms dried and spored in it. The biologica covering-substance latrines do not give sufficien decomposting of the wastes. The present covering substance latrines show drawbacks in capacity urine evaporation, transport of wastes, and inabil ity to be easily emptied. A ping-pong ball idea fo a covering substance is being studied as a substanc which wastes will stick to, decompose and then fal off. This kind of inactive medium requires a stirrer heating unit, and aeration device in the latrine. A microprocessor controls and regulates moistur and temperature in the prototype latrine. In Fin land, the biological dry toilets functioned well i tests at summer cottages. Bark chips used as litte for animal wastes eliminated odors. The Finnish armed forces have successfully used bark chips i large encampment latrines, warm climate latrines and in isolated shelter conditions and for compost ing food wastes. The bark latrine toilet may sprea less viruses onto bathroom surfaces than conven tional water closet toilets.
W85-05208

PACKAGE WASTE WATER TREATMENT PLANTS,
Ekofinn Oy A.B., Lahti (Finland).
A. Salokangas.
In: Proceedings of the International Conference o New Technology for Wastewater Treatment an Sewerage in Rural and Suburb Areas, Hanasaari Finland, October 3-6, 1983. Tampere Univ. o Technology, Finland. 1984 p 227-237, 5 Fig.

Descriptors: *Rural areas, *Wastewater treatment *Wastewater facilities, *Wastewater management *Suburban areas, *Package treatment plants, Wate law, Municipal wastes, Wastewater, Maintenance Waste storage, Biological wastewater treatment

Package treatment plants are units fabricated o plastic, concrete, or steel elements which do no constantly contain maintenance personnel. In rura areas, package treatment plants should be suitabl for private houses, isolated small communities country schools, country hospitals or boardin houses, restaurants, seasonal campsites, toile wastes from industrial establishments, farms, serv ice stations with cafeterias and small scale foo stuff industry. The package treatment plant shoul feature sludge storage capabilities, centralized con trol with the aid of alarm systems, simple contro and adjustment processes and educated mainte nance people. Public relations and information fo developing user's attitudes for the package treat ment plant would be required. Also essential fo the acceptance of package treatment plants ar changes in water laws, clearer definitions of stat and municipal responsibilities, development of mu nicipal control, operation and maintenance o package treatment plants and education of expert operation and maintenance personnel.
W85-05209

PRACTICAL EXPERIENCES ON PACKAGE TREATMENT PLANTS,
National Swedish Environment Protection Board Solna.
A. Lind.
In: Proceedings of the International Conference o New Technology for Wastewater Treatment an Sewerage in Rural and Suburb Areas, Hanasaari Finland, October 3-6, 1983. Tampere Univ. o Technology, Finland. 1984. p 239-254.

Descriptors: *Wastewater treatment, *Packag treatment plants, *Biological wastewater treat ment, *Comparison studies, *Chemical treatment *Biological membranes, *Wastewater facilities *Waste management, Septic tanks, Waste disposal Scandinavia, Phosphorus removal, Organic matter

/astewater disposal, Biofilters, Infiltration, Sand lters.

1 the Nordic countries many studies have been onducted on package treatment plants in the last) years. In package plants the available treatments clude septic tank, biological treatment with aero- c units, biological-chemical treatment, and chem- al treatment. From the results of studies which sted function, reliability of service, attendance equirements, and reasons for breakdowns, it was oncluded that plants with biological processes perating on the basis of fixed biofilms have major dvantages compared to other methods. Fixed bio- lm processes exist in biofilter and biodisc. This ethod is less sensitive to variations in hydraulic id pollution load. The thickness of the biofilm an adjust to the supply of organic matter in the ewage and recover rapidly after periods of dis- rbances or periods with no load. Biofilm sludge isplays good sedimentation qualities and requires o return pumping of sludge. For plants servicing ss than 75 people, infiltration and sand filter enches are recommended. However, it should be oted that sand filter trenches give low reductions f phosphorus.
V85-05210

UITABILITY AND HYDRAULIC CAPACITY OF DIFFERENT SOILS,
.SE, Inc., Madison, WI.
.. J. Otis, and D. L. Hargett.
n: Proceedings of the International Conference on lew Technology for Wastewater Treatment and ewerage in Rural and Suburb Areas, Hanasaari, inland, October 3-6, 1983. Tampere Univ. of echnology, Finland. 1984. p 257-272, 6 Fig, 3 ab, 8 Ref.

Descriptors: *Wastewater treatments, *Septic anks, *Soil types, *Soil properties, *Soil porosity, Permeability coefficient, *Wastewater disposal, Soil physical properties, Soil texture, Land dis- osal, Soil water, Soil horizons, Moisture tension.

The physical properties of different soils are dis- ussed to evaluate their performance for use in vastewater disposal systems such as septic tank- oil absorption systems commonly used in nsewered areas. Aeration and drainage of soil are losely related to soil texture. Soil structure affects he soil's permeability and also influences the di- ection of water movement. The basic soil struc- ures are columnar, prismatic, angular blocky, su- angular blocky, platy, and granular. Soils with igher bulk density tend to be less permeable than oils of the same texture with lower bulk density. The mineralogy of the clay particles in soil can trongly influence permeability. The arrangement nd number of soil horizons in a soil profile may ffect permeability and water movement. The gravitational and matric potentials of soil are com- onents of the total soil moisture potential which ffects the adsorption of wastewater by the soil. Water movement in soil is dependent on hydraulic onductivity which can change dramatically with hanges in soil moisture tension. Soil layers of arying pore-size distributions and permeability nay interfere with vertical water movement in oth the saturated and unsaturated phases. The ecommended application rates (cm/day) of vastewater in conventional systems were 3.2-4.0 or coarse to medium sand, 2.5-3.2 for fine and oamy sand, 2.1-2.5 for sand and porous loam, 1.4- 2.1 for loam and silt loam, 0.4-1.0 for clay loams nd 0-0.6 for clays.
W85-05211

SOME ASPECTS ON REDUCTION OF PHOSPHORUS IN SOIL TREATMENT SYSTEMS,
Lund Inst. of Tech. (Sweden). Dept. of Environmental Engineering.
P. Nilsson.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 273-290, 16 Fig.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Soil filters, *Wastewater disposal, *Biological wastewater treatment, *Adsorption, *Chemical treatment, *Physicochemical treatment, *Sand filters, Phosphorus, Septic tanks, Soil treatment, Domestic wastes, Biofilters, Flocculation, Separation techniques.

Sand filters differ from soil infiltration sites in that they have a defined volume of filter media, a known media substance and an outlet that goes to a surface water. In Scandinavia, the input of P from wastewater into a soil treatment system is about 2.5 g/person/day. The reduction of P in septic tanks is usually very low. Orthophosphorus accounts for 75-100% of the P in septic tank effluent. P is removed physically by filtration, biologically by the growth of bio-mass in filter media, and chemically by the creation of microflocs which can be filtered, by the adsorption of P to the surface of filtermedia particles or by direct precipitation. A three-step pretreatment of wastewaters helps to lower the concentration of P in the effluent. The IVL Institute of Sweden studied an Al(OH)3 sludge and granulated coal slag for P removal. The granulated coal slag was very soon inactivated due to biological growth. A fullscale sand filter bed with layers of Al(OH)3 sludge was operated in a small village called Bunn for 80 permanent residents and 30 summer residents. Results after 1 yr showed a 90% P removal.
W85-05212

REDUCTION OF NITROGEN,
Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Mikrobiologi.
M. Pell, and H. Ljunggren.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 291-308, 5 Fig, 3 Tab, 27 Ref.

Descriptors: *Nitrogen removal, *Sand filters, *Wastewater treatment, *Nitrification, *Soil filters, *Microbial degradation, *Biological wastewater treatment, *Denitrification, Nitrogen, Septic tanks, Nitrates, Soil treatment, Wastewater renovation, Bacteria, Pilot plants, Filters, Wastewater disposal, Nitrites, Ammonia, Nitrogen compounds.

Nitrogen-transforming processes were investigated in a newly started pilot sand filter and in two previously loaded columns. To attain better control over the water parameters, artificial sewage water was added after a 24-hr period of pretreatment in a septic tank. The pilot sand filter was loaded with 6.7 cm/day for 100 days, followed by 13.3 cm/day for 25 days. The columns were loaded with 10 cm/day and 20 cm/day, respectively, for 203 days. A complete steady-state nitrification was attained in the pilot sand filter after 45 days of operation. The nitrifying bacteria continued to increase in number for another 25-55 days. Though the denitrifying bacteria were present in high numbers and constituted a considerable fraction of the total bacterial population, a nitrogen reduction of only 17% was observed. When the loading rate was doubled, the nitrification was inhibited and the total bacterial number decreased, but the nitrate reduction increased to 51%. In order to enhance the nitrogen reduction, the columns were constructed with two separate nitrification-denitrification processing steps. One column reached nitrogen reduction exceeding 60% for the whole period of the operation; the other reduced more than 50% of nitrogen for over two months. (Author's abstract)
W85-05213

REDUCTION OF ORGANIC MATTER WITH FOCUS ON THE CLOGGING PHENOMENON,
Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Mikrobiologi.
M. Pell, and H. Ljunggren.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 309-327, 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Organic matter, *Organic compounds, *Biological wastewater treatment, *Soil filters, *Hydraulic permeability, *Bacteria, *Wastewater composition, Wastewater renovation, Septic tanks, Biodegradation, Infiltration, Hydrolysis, Proteins, Carbohydrates, Starch, Sand filters, Percolation rate.

The influence of wastewater quality, especially its content of organic matter, on the clogging mechanisms and the hydraulic capacity of infiltration systems was investigated. The active bacterial population and its possible adaptation to various compositions of wastewater were also studied. Small columns packed with sand were loaded once a day with an artificial septic tank effluent containing different concentrations of protein, starch or fat. Six columns loaded with protein-rich water, ranging in COD from 100 mg/liter to 3200 mg/liter, gave a straight-line relationship, showing that if high concentrations were dosed, larger amounts of organic matter could be taken by the surface before ponding. No adaptation of the bacterial population to the quality of water loaded on the columns was found. The highest number of proteolytic bacteria was found in the surface layer, while fat- and starch-hydrolysing bacteria were most numerous 10 cm below the surface. A large number of isolates of proteolytic bacteria also had the capacity to hydrolyse fat and starch. The interpretation is that there is no need for the creation of a specialized bacterial population when these water qualities are used. (Arthor's Abstract)
W85-05214

REDUCTION OF PATHOGENIC MICROORGANISMS IN SOIL INFILTRATION SYSTEMS,
National Bacteriological Lab., Stockholm (Sweden).
T. A. Stenstrom.
In: Proceedings of the Internationl Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 329-344, 5 Fig, 3 Tab.

Descriptors: *Pathogens, *Wastewater treatment, *Adsorption, *Separation techniques, *Filtration, *Soil filters, *Sand filters, Feces, Bacteria, Salmonella, Enteric bacteria, Coliforms, Infiltration, Ionic strength, Filters, Pathogenic bacteria, Filter media, Wastewater.

The number of bacteria in feces is from about one times 10 to the 10th power to one times 10 to the 12th power bacteria per g. In viral infections, the number of excreted viral particles may exceed 10 to the 6th power viral particles per g. An initial dilution and die-off of some of these pathogens will occur in wastewater. Although pretreatment of wastewater before soil infiltration will reduce the number of fecal microorganisms to a certain extent, it may affect the efficiency of the sand filtration due to partial clogging and a concentration of bacteria in the surface layer. By extending the adsorption surface by using finer grain sizes, a better reduction of microorgansims will be achieved. If the ionic strength of the filter media is lowered, the organisms may desorb. The electrostatic effects of adsorption may also be influenced by the composition of the sand. Al, which is used as a flocculent in water treatment, is part of the crystal gitter of some normal sand minerals. Experiments with 100% muscovite gave a very good adsorption of Salmonella. However, this effect is reduced with time due to shielding.
W85-05215

SHORT TERM AND LONG TERM EFFECTS ON GROUNDWATER BY WASTEWATER INFILTRATION IN SUBSOIL SYSTEM,
National Swedish Environment Protection Board, Solna. Research Dept.
U. v. Bromssen.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of

Technology, Finland. 1984. p 345-352, 2 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Soil filters, *Septic tanks, *Infiltration, *Phosphorus, *Groundwater pollution, *Eutrophication, *Fate of pollutants, Sand filters, Nitrogen, Models, Organic compounds, Domestic wastes, Water pollution control, Suspended solids, Path of pollutants, Detergents, Iron, Chlorine, Boron, Biological oxygen demand.

The reduction of P, N, organic compounds, suspended solids, and microbial organisms in septic tank subsoil systems serving households of 4-5 persons was examined. A risk assessment for groundwater pollution by such systems and the possibility of eutrophication of nearby watercourses in rural areas are also discussed. Soil close to ground surface with high Al and Fe oxide content gives better P retention. The retention of P in Sphagnum peat is less than in non-organic sand or moraine. A slurry of Al(OH)3 gave 90% reduction of P after 1 yr when mixed in sand filter beds. A microbial denitrification process gives N reductions of 67-70%. The reduction of BOD is usually 90-97% while the reduction of suspended solids ranges from 85-90%. Reduction of microorganisms after passage of 0.5-0.8 m of unsaturated soil and the clogging mat at the infiltration surface yields about 100-fold reduction. To protect groundwater from wastewater infiltration, wells must be surrounded by a protection zone in which the location of septic tanks is prohibited. Levels of N, P, Cl, B, Fe and detergents may increase in groundwater located near soil infiltration systems. A model has been developed to calculate critical limits for P in lakes and streams. For lakes, the P content is not recommended to exceed 25 micrograms total P/liter if the N/P ratio is > 10. Usually about 1.5 sq km of discharge area is required for every family's sand filter bed.
W85-05216

SUBSURFACE ADSORPTION SYSTEMS - FROST PROBLEMS AND PREVENTION OF FROST,
Norges Landbrukshoegskole, Aas. Inst. for Georesources and Pollution Research.
T. Osteraas.
Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 355-364, 7 Fig.

Descriptors: *Septic tanks, *Soil filters, *Frost prevention, *Clogging, *Frost, *Frost protection, *Sand filters, *Freezing, Wastewater disposal, Wastewater treatment, Absorption, Frost heaving, Frost thrusting, Heat transfer, Snow cover, Soil adsorption capacity, Soil temperature, Septic wastewater.

Frost can cause damage to subsurface adsorption systems by cracking pipes and tanks or clogging pipes and soil by frozen wastewater and sludge. Many frost problems in standard house sewers can be avoided if construction is done properly. Frost in the effluent pipe can also be avoided by avoiding stagnation areas during construction. To prevent freezing of the adsorption fields in areas with extreme frost, heat conservation action such as insulation or heat supply may be necessary. Laboratory tests carried out at GEFO show that frozen absorption fields under certain circumstances will work even when the temperature in the sand is below freezing. The risk of freezing temperatures penetrating the backfill to the infiltrative surfaces can be calculated if the frost quantity, annual mean temperature, snow cover thickness and quality, backfill thickness and thermal diffusion and heat capacity, and heat transfer from wastewater to the adsorption system are known. When these parameters are known, the need for insulation material and electrical heat wires can be assessed.
W85-05217

DESIGN AND CONSTRUCTION OF CONVENTIONAL AND MOUND SYSTEMS,
RSE, Inc., Madison, WI.
R. J. Otis.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ of Technology, Finland. 1984. p 365-399, 6 Fig, 12 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Soil treatment, *Design criteria, *Site selection, *Adsorption, *Permeability coefficient, *Trenches, Septic tanks, Sand pits, Wastewater facilities, Soil profiles, Wastewater disposal, Construction methods, Topography, Soil properties.

In order to prevent groundwater contamination, careful site selection for wastewater treatment systems should be carried out. Client contact must be made to determine the location and description of the lot, whether the use will be domestic, commercial or industrial, and the volume and characteristics of the wastewater. A preliminary evaluation should be made of available resource data of the area and of records of onsite systems in surrounding areas. Field testing of the intended area of the treatment system should include examinations of topography and landscape feature, soil profiles and hydraulic conductivity. If necessary, site suitability for evaporation or discharge to surface waters should also be evaluated. All data collected should be compiled into a usuable form. Trenches are usually more desirable than beds due to increased sidewall adsorption, ease of construction and less excavation disturbances. Shallow systems are preferred over deep systems where there are problems of freezing. Alternating fields may extend the life of an adsorption system. The three basic methods of wastewater distribution (gravity flow, dosing and uniform application) each have their own advantages and disadvantages. The selection of a distribution method depends on whether improved adsorption or improved treatment is the objective. The mound system offers adsorption into the more permeable topsoil, less restrictive clogging mat, and minimum construction damage. A mound system is usually preferrable in areas with shallow water tables. The mound should be oriented relative to the bedrock rather than the ground surface.
W85-05218

SCANDINAVIAN GUIDELINES AND TRAINING PROGRAMS FOR DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF SEWERAGE TREATMENT SYSTEMS IN RURAL AREAS,
Norges Landbrukshoegskole, Aas. Inst. for Georesources and Pollution Research.
T. Osteraas.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 403-407, 1 Fig.

Descriptors: *Wastewater treatment, *Wastewater management, *Rural areas, *Scandinavia, *Wastewater disposal, *Education, *Training, *Standards, Regulations, Norway, Sweden, Water law, Water pollution control, Absorption, Sand filters, Soil filters.

When the guidelines for wastewater treatment systems in Norway and Sweden were updated recently, the goal was to reduce differences in the existing laws and regulations as much as possible between the two countries. A cooperative three-year research program among the Scandinavian countries produced a report in 1983 upon which the new guidelines are based. A Scandinavian reference group was established with the Norwegian State Pollution Control Authority as a secretariat to perform the practical work of the guidelines. The main chapters of the new guidelines will be on on-site treatment methods, types of equipment used in construction, and operation and maintenance of the systems. To obtain correct sizing of the absorption field, the guidelines prescribe the use of a Md/So-diagram. A similar diagram has been designed for the evaluation of sand for sand filters. In Norway the Ministry of Environment and the State Pollution Control Authority have established training programs for the technical staff at the country and community level and for constructi engineers of wastewater treatment sytems.
W85-05219

ONGOING AND RECENT RESEARCH ON O SITE TREATMENT AND DISPOSAL MET ODS IN SWEDEN,
National Swedish Environment Protection Boa Solna. Research Dept.
U. v. Bromssen.
In: Proceedings of the International Conference New Technology for Wastewater Treatment a Sewerage in Rural and Suburb Areas, Hanasa Finland, October 3-6, 1983. Tampere Univ. Technology, Finland. 1984. p 409-418.

Descriptors: *Standards, *Regulatio *Wastewater treatment, *Wastewater dispos *Infiltration, *Groundwater pollution, *Swed *Research priorities, Soil treatment, Absorpti Soil bacteria, Pathogens, Path of pollutants, F of pollutants, Septic tank, Wells, Water polluti control.

The National Swedish Environment Protecti Board (SNV) has numerous ongoing and rec research projects for the protection of groundw er resources from pollution by on-site wastewa treatment and disposal systems. Much of the search is funded by the Swedish Infiltrati Project started in 1977. Past projects determi the characteristics of sewerage water, and extent of pollution of groundwater from on- systems. Laboratory as well as field studies w conducted. Some ongoing studies financed SNV deal with sand filter trenches, microor nisms in sewage infiltration systems, and the tra port of pollutants in groundwater. Projects carr out from 1977 to 1982 studied a pilot scale deni fication sand filter, adsorption of heavy metals i Swedish soils, pond infiltration as a final step municipal treatment plants, development of ad tives to enhance P adsorption, survival and tra port of microbial pathogens and indicators in and groundwater, models of pollutant transport groundwater, improvement of big three-cham septic tanks, and critical limits of P in lakes streams. The Swedish Infiltration Project ended June 1982 but publications from the project continue until 1984, culminating in the issuance a new guidelines manual for infiltration syste and the protection of groundwater wells.
W85-05220

RESEARCH OF ON-SITE WASTEWAT TREATMENT AND DISPOSAL IN FINLAN
National Board of Waters, Helsinki (Finlan Technical Research Office.
M. Melanen.
In: Proceedings of the International Conference New Technology for Wastewater Treatment Sewerage in Rural and Suburb Areas, Hanasa Finland, October 3-6, 1983. Tampere Univ. Technology, Finland. 1984. p 419-425, 2 Tab Ref.

Descriptors: *Finland, *Wastewater treatme *Wastewater disposal, *Research priorit *Septic tanks, *Soil treatment, Regulations, C posting, Package treatment plants, Wastewa renovation, Project planning, Wastewater mana ment.

In Finland, the amount of funds allocated to study of on-site wastewater treatment and dispo has been modest so far. In 1981, some 150- thousand Finnish marks were used in research development projects dealing directly with on- wastewater treatment. Roughly one million Fi ish marks were used in projects which dealt w on-site treatment and disposal. Some general to of these projects were policy and regulations, s erage and septic tanks, composting and pack treatment plants and soil as a renovating medi for wastewaters. In the 1980's, the areas targe for further research include toilets, package tr ment plants, soil absorption systems, septic closed tanks, guidelines for construction, operat and maintenance of on-site systems and devel

t of monitoring systems for package treatment
ts.
5-05221

GOING AND RECENT ON ON-SITE
EATMENT AND DISPOSAL METHODS IN
E U.S.A.,
hington Univ., Seattle. Dept. of Civil Engi-
ing.
V. Seabloom.
Proceedings of the International Conference on
v Technology for Wastewater Treatment and
erage in Rural and Suburb Areas, Hanasaari,
and, October 3-6, 1983. Tampere Univ. of
hnology, Finland. 1984. p 427-440, 9 Fig, 2

criptors: *Wastewater treatment, *Wastewater
osal, *Research priorities, *United States, *Soil
tment, *Waste disposal, *Data collections,
d filters, Evapotranspiration, Septic tanks,
nches, Waste management, Data transmission,
filters, West Virginia, Oregon.

cted research projects either underway or al-
ly completed in the United States cover the
owing areas of on-site wastewater treatment
disposal methods: construction methods, com-
ing toilets, water conservation, priority pollut-
, fate of toxins, fate of N and other inorganics,
age, pressure distribution systems, pressure
er design modifications, and H2O2 rejuvena-
. The United States Environmental Protection
ncy has established a national clearinghouse at
st Virginia University, Morgantown which col-
s and disseminates small community
tewater technology information. The Oregon
Site Experimental Systems Program has con-
ted an extensive study of the practical applica-
of sand filters, evapotranspiration and evapo-
spiration absorption systems, steep slope sys-
s, groundwater control systems, and several
er novel approaches to solve specific site con-
ints which preclude the use of conventional
ic tank adsorption systems. Some of the more
inent studies of this project which ended in
2 covered recirculating and intermittent sand
r systems, perimeter drain dewatering systems
vet soils, deep seepage trenches in soils with
v and very permeabilities, seepage trenches on
p slopes, disposal trenches in soil shallow to
thered and fractured bedrock, and pressure
ribution systems in soils with shallow ground-
er.
5-05222

OCEEDINGS OF THE 37TH INDUSTRIAL
STE CONFERENCE MAY 11, 12, AND 13,
2, PURDUE UNIV., WEST LAFAYETTE, IN-
ANA.
n Arbor Science Publishers, Ann Arbor, Michi-
, 1983. 952 p.

scriptors: *Industrial wastewater, *Conference,
astewater treatment, Chemical wastes, Food-
cessing wastes, Metal-finishing wastes, Textile
l wastes, Tannery wastes, Oil wastes, Explo-
es, Land disposal, Pharmaceutical wastes, Agri-
tural wastes, Pulp wastes, Paper wastes, Haz-
ous materials, Toxicity, Powerplants, Coal,
ke, Industrial wastes.

is proceedings volume contains 77 papers rele-
t to wastewater treatment and pollution con-
l. The papers are classified according to the
owing general categories: chemical wastes,
d wastes, metal wastes, textile wastes, tannery
stes, plating wastes, oil wastes, explosive wastes,
d disposal, pharmaceutical wastes, agricultural
stes, paper wastes, hazardous and toxic wastes,
l, coke and power plant wastes, refinery wastes,
s and regulations, physical/biological systems,
scellaneous wastes.
5-05224

CT/WET AIR REGENERATION OF AN OR-
NIC CHEMICAL WASTE,
npro, Inc., Rothschild, WI.
R. Rollins, C. E. Ellis, and C. L. Berndt.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 1-12. 11 Fig, 6 Tab, 14 Ref.

Descriptors: *Organic wastes, *Activated sludge process, Chlorinated hydrocarbons, Chemical wastes, Biological oxygen demand, Chemical oxygen demand, Organic carbon.

Pilot studies, to demonstrate application of PACT and wet air regeneration (WAR) to the treatment of an organic chemical waste, are described. The pilot study spanned 5 months of onsite pilot-plant operations, using 4 continuous-flow pilot plants. Three of the pilot plants were PACT systems; one was operated in an activated sludge mode without secondary solids handling. During the 5-month study period, each pilot unit treated nearly 21,000 liters of wastewater. The PACT process provided better removals of COD, TOC, BOD sub 5, color, chlorinated hydrocarbons and phenol than did activated sludge. Over the range of mixed liquor volatile carbon concentrations of 0-13 g/l the best PACT/WAR performance was observed at the highest carbon concentrations and at the lowest X/m values. Chlorinated hydrocarbon removals by the PACT/WAR process were excellent at all times. Influent concentrations ranging 5-100 mg/l had little effect on chlorinated hydrocarbon removal. Oxidation of chlorinated hydrocarbons during the WAR of the spent carbon was confirmed. PACT/WAR performance at 6-7 C aeration temperature remained stable and was superior to activated sludge at 22-29 C. Removals of BOD sub 5, COD and TOC in the low-temperature PACT/WAR pilot plant were greater than 98% of the influent concentration.
W85-05225

WASTEWATER TREATMENT OF A PHTHALATE PLASTICIZER, ETHANOLAMINE AND MORPHOLINE MANUFACTURING PLANT: A CASE STUDY,
National Environmental Engineering Research Inst., Nagpur (India). Industrial Wastes Div.
P. V. R. Subrahmanyam, S. N. Khadakker, T. Chakrabarti, and B. B. Sundaresan.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 13-20. 2 Fig, 5 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, Wastewater facilities, Biochemical oxygen demand, Chemical wastes, Organic wastes.

In-plant surveys were undertaken of biological treatability of combined wastewater from a factory manufacturing phthalate plasticizers, ethanolamines and morpholine. Data were presented on wastewater volume, BOD and COD loads discharged per 1000 kg of the different products made. Organics in morpholine wastewater exerted COD, but not BOD. The combined wastewater exerted an average BOD sub 5 of 1420 mg/l with a BOD load of 110 kg/l day. Whenever morpholine wastewater formed a part of the combined wastewater, the BOD-to-COD ratio was low. Plasticizer and morpholine sections produce sludge and slurry that are to be segregated, concentrated and disposed by burning. Bench-scale activated sludge treatment studies of the combined wastewater indicated that the BOD could be reduced by 96% at a loading of 0.16 kg BOD/kg MLSS/day, and SRT of 18 days. The sludge synthesis and endogenous respiration coefficients a and b were 0.56 kg/kg BOD removed and 0.014/day, respectively. The treated effluent at 0.26 loading was nontoxic to Lebistes reticulatus for 120 hr. Based on the treatment flowsheet prepared by NEERI, a full-scale wastewater treatment plant has been constructed, the cost of which was about 1.2% of the total capital cost.
W85-05226

ROTATING BIOLOGICAL CONTRACTORS TREATING COMBINED DOMESTIC AND CHEESE-PROCESSING WASTEWATERS,
Kirkham, Michael and Associates, Omaha, NE.
M. J. Hammer.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 29-38. 8 Fig, 6 Tab.

Descriptors: *Food-processing wastes, *Biochemical oxygen demand, *Wastewater treatment, Shock loads, Biological wastewater treatment.

The two-stage RBC system processing combined domestic and cheese-manufacturing wastewater at New Man Grove, in east-central Nebraska, provides excellent treatment at the present hydraulic and organic loads that are approximately 93 and 25% of the design values, respectively. The effluent BOD was less than 11 mg/l and suspended solids concentration was less than 20 mg/l for 90% of the time. The system is able to process maximum probable shock loads from accidental spilling of whey without prolonged loss of treatment efficiency. The effect is deterioration of the effluent quality to an average BOD of approximately 60 mg/l for 2 days. However, with only one shock load per week, resulting from the worst anticipated nonrepetitive spillage of whey, the effluent quality is expected to meet the specified average monthly BOD and suspended soilds limits of 30 mg/l and the maximum average weekly concentrations of 45 mg/l. The current arrangement of dividing the biological disks equally between the first and second stages does not provide optimum use of the contractor surface area. Based on curves drawn from the plant evaluations, the allowable BOD load on the rotating biological contractor system could be increased about 50% for an effluent quality of 30 mg/l BOD by providing 75% of the disk area in the first stage and only 25% in the second stage.
W85-05227

ANAEROBIC TREATMENT KEY TO POLLUTION CONTROL AND SOLIDS DISPOSAL WITH ENERGY RECOVERY FOR A FOOD PROCESSOR,
ADI Ltd., Fredericton (New Brunswick).
R. C. Landine, A. A. Cocci, T. Viraraghavan, and G. J. Brown.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 47-50. 1 Ref.

Descriptors: *Food-processing wastes, *Solid waste disposal, Manure, Chemical oxygen demand, Biochemical oxygen demand, Volatile solids, Potatos, Feedlot wastes.

A large potato processing plant needed to install secondary treatment. The company was also having difficulties in disposing of a large quantity of filter cake, other potato waste solids and manure from its feedlot where cattle were being fed screenings and some other potato wastes. The proposed waste treatment facilities entail continued trucking of screenings solids to the company's feedlot to form part of the feed ration for the cattle. The feed truck could carry manure supernatant (only) on its return trip for treatment in the bulk volume fermenter (BVF) system. This liquid manure stream would no longer present a pollution threat to the nearby stream, but will enhance biogas generation and receive a high degree of treatment prior to discharge into a large river. The biogas can be recovered and supplied to the process boilers where it displaces approximately 20,000 liter/day of imported oil when operating under design loading conditions. This design requires a very large load (80,000 kg/day) of chemical oxygen demand (COD), requiring secondary treatment; however, no difficulty was foreseen in metting effluent limits. The waste treatment facilities involve two-stage anaerobic treatment followed by single-stage aerobic treatment. The basic design data are: flow, 8000 metric ton/day; COD, 80 metric ton/day; biochemical oxygen demand (BOD), 40 metric ton/day; SS, 40 metric ton/day; and volatile suspended solids (VSS), 35 metric ton/day.
W85-05229

WATER USAGE AND WASTEWATER STUDY FOR A SPECIALTY FOOD PROCESSING COMPANY,
Van Kirk Engineers, Los Altos, CA.
F. N. Van Kirk.

In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 51-60. 2 Fig, 11 Tab.

Descriptors: *Wastewater treatment, *Food-processing wastes, Organic carbon, Suspended solids, Biochemical oxygen demand, Oil, Grease.

The water usage associated with the processing and packing of various specialty food items and the pollutional load per product resulting from these operations were determined. All of the water used for cleanup in the process room flows to the industrial waste sump. Although a good effort is made to keep fruit and vegetables from entering the sump, considerable amounts reach the sump. Other water uses include compressor cooling water, boiler makeup, water used for brines and vinegar, and domestic and irrigation uses. A tabulation of the average total amount of water used indicated that the greatest amount was used for cleanup (average approximately 37,500 gallons per day). The next largest usage was for leaching at approximately 23,000 gallons per day. The third largest usage was on the retail and food service lines. The usage per operation (boot tank, product washer, Solbern filler) on each of these lines was fairly constant, ranging 9200-9800 gallons per day. Samples of wastewater discharged to the sewer as well as samples of process wastewater were collected and analyzed for TOC, TKN and SS because they are the constituents, plus flow, on which the city is bases its sewer use charges for critical industrial users and canneries. TOC and related BOD concentrations were quite high, typical of food processing waste. TKN was low as was the O and G content. SS was low considering the amount of solids flowing to the industrial waste sump, indicating that the screen at the industrial waste sump is removing the solids.
W85-05230

SPRAY IRRIGATION OF CITRUS WASTE,
Bio Engineering Sciences, Inc., Orlando, FL.
C. W. Sheffield, and M. D. Sims.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 61-69. 3 Fig, 2 Tab.

Descriptors: *Citrus fruits, *Wastes, *Spray irrigation, Biological oxygen demand, Suspended solids, Hydraulic loading, Surface drainage, Hydraulic models, Groundwater.

The problems associated with spray irrigation of citrus waste are reviewed. The typical waste loads from a single-strength citrus plant include: 5-100 gallons per box processed; 100-1000 lb/day BOD combined flow, no treatment; 100-400 lb/day BOD wash water only; 60-200 mg/l suspended solids, combined flow, no treatment; and 1000-2000 mg/l total solids, combined flow, no treatment. The typical waste loads from citrus concentrating plants include: 200,000-5,000,000 gal/day volume of waste; 20-500 gallons of water per box processed; less than 100 mg/l BOD in weak water (cooling water); less than 3000 mg/l BOD strong waste, no treatment; less than 100 mg/l weak waste suspended solids; less than 300 mg/l strong waste suspended solids; less than 100 mg/l weak waste total solids; 400-4000 mg/l strong waste total solids; and pH 4-11. The characteristics of citrus wastes tends to compound the normally difficult problem of analyzing the hydrogeology of a site and determining allowable hydraulic loading rates and impact on groundwater levels and movement. The hydraulic model must be adjusted to account for soil clogging and the varying strength and physical properties of the effluent. The design of most systems will benefit by providing a minimum of 2 separate application areas such that the surface sludge layer can be allowed to dry and oxidize or be scraped and disced to restore infiltration rates on an alternating basis. Temporary storage basins should be provided to direct flows during high-rainfall periods such that excess surface runoff will not occur. Perimeter swales or berms should be provided to prevent runoff as surface clogging occurs.
W85-05231

EFFECT OF HEIGHT ON THE PERFORMANCE OF ANAEROBIC DOWNFLOW STATIONARY FIXED-FILM REACTORS TREATING BEAN BLANCHING WASTE,
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
K. J. Kennedy, and L. Van den Berg.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 71-76. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Food-processing wastes, *Wastewater treatment, Anaerobic bacteria, Methane bacteria, Downflow stationary fixed film reactors.

Downflow stationary fixed-film (DSFF) reactors are capable of high loading rates and high rates of methane production utilizing a variety of wastes and operating conditions. Successful operation of DSFF reactors is based on the immobilization of bacteria, especially the slowly growing methanogens, on a support medium in order to minimize the washout of these bacteria with the effluent. Results obtained over a period of 1.5 years with reactors of the same cross section but of different height are presented. Performance of DSFF reactors during startup and steady-state conditions was affected more by the support surface area-to-volume ratio than reactor height. In order to enhance mixing, DSFF reactors have a liquid volume above and below the packing material. It may be preferable that large reactors be scaled up vertically rather than horizontally so as to maximize the surface area-to-volume ratio.
W85-05232

STEEL WELDING WIRE MANUFACTURER MEETS STRINGENT EFFLUENT AND SLUDGE DISPOSAL CRITERIA,
Reece Engineering, Inc., Clarksville, TN.
R. S. Reece.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 77-83. 6 Fig, 3 Tab.

Descriptors: *Metals, *Sludge disposal, *Effluents, Industrial wastewater, Iron, Copper, Water conservation, Steel, Welding wire.

A steel welding wire manufacturer was able to meet stringent effluent and solid waste disposal requirements by taking a step-by-step approach. After a waste characterization and treatability study was performed, a plan of action was developed which included a water conservation program and phased construction to determine optimum design parameters. The final treatment facility reduced iron and copper concentration in a 65 gal/min rinse water stream to below 5 and 1 mg/l respectively, and neutralized approximately 30,000 gal/month of spent hydrochloric acid and copper plating solutions. Sludges were dewatered to a 50% solids content. Treated rinse water is recycled back to the cleaning and plating process. The combination of water conservation, cooling water recycle and rinse water recycle reduced water consumption by 75%.
W85-05233

METAL INHIBITION OF NITRIFICATION,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang, and B. Sheikhdeslami.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 85-93. 7 Fig, 4 Tab, 12 Ref.

Descriptors: *Nitrification, *Inhibition, Heavy metals, Ammonia, Nitrates, Nickel, Chromium, Zinc.

The rate constants of both ammonia oxidation and nitrate formation under various influences of chromium, nickel and zinc are used for evaluating the relative inhibition by the metals. Of the 3 metals investigated, nickel is the most toxic to both ammonia oxidation and nitrate formation, followed by zinc and chromium. Of these 2 steps of nitrification, the former step is more susceptible to inhibition, thus representing the weak link in the nitrification chain. The Hunter-Downs plot was used t characterize the type of metal inhibition on nitrif cation. The inhibition is neither competitive n noncompetitive.
W85-05234

GRAVITY FILTRATION FOR REDUCTION O SUSPENDED METALS IN A LIME PRECIP TATION TREATMENT SYSTEM,
General Motors Corp., Lockport, NY. Harriso Radiator Div.
R. D. Knapp, and E. G. Paulson.
In: Proceedings, 37th Industrial Waste Conferenc West Lafayette, IN, May 11-13, 1982. Purdu Univ., 1983. p 95-104. 5 Fig, 6 Tab.

Descriptors: *Gravity filters, *Suspended solid *Metals, Backwash, Heavy metals, Clarifie wastewater, Lime, Chromium.

A case history of an installation where filtratio was used to upgrade the clarified effluent of heavy metal removal treatment plant is presente The Harrison Radiator Division of General Moto Corporation primarily manufactures automotiv radiators and air conditioners at the facility locate in Lockport, NY, approximately 15 miles north Buffalo. Typical manufacturing operations inclu metal formation, assembly, degreasing, washin chromium conversion coating, and painting. T primary design factors, based on pilot-plant wor included filtration by gravity through unstratifie media, simultaneous air-water backwash witho media loss, no support gravel, and a maximu driving force of 10 ft of water head. The gravi filter system has demonstrated its ability to redu heavy metal concentrations to low levels that co sistently meet permit limits. The simultaneous a and water backwash has prevented agglomeratio of the medium, and the special backwash troug baffle design has prevented medium loss. Calciu carbonate deposition has occurred on the filt medium and can result in operational difficultie The effects of this deposition can be controlled a studies are underway to determine the most co effective way to accomplish this. Much of t success of this system can be credited to adaptab ity built into the design, particularly in the areas standby units, control systems, and the mediu transport system.
W85-05235

HANDLING OF ALUMINUM FORMIN WASTEWATER,
Sverdrup and Parcel and Associates, Inc., S Louis, MO.
J. C. Carlton, G. R. Aronberg, D. R. Washington J. K. Goodwin, and E. P. Hall.
In: Proceedings, 37th Industrial Waste Conferenc West Lafayette, IN, May 11-13, 1982. Purdu Univ., 1983. p 105-117. 13 Fig, 8 Tab.

Descriptors: *Wastewater treatment, *Filtratio *Cooling towers, *Effluents, *Aluminum, Su pended solids, Copper, Zinc, Chromium.

The production processes used in the aluminu forming and can manufacturing industries produ a significant volume of wastewater containing o and metals. The methods including settling a filtration, cooling towers, and countercurrent rin ing, are used to reduce the amount of wastewa produced. The discharged wastewaters are treat in a variety of ways, including chemical precipit tion of metals, pH adjustment, gravity oil-wat separation, chemical emulsion breaking, and filtr tion. The treatment processes used depend on t type, volume and characteristics of the wastewat streams and the disposal of the treated effluen The effluent discharged from a well-operate treatment facility directly to a receiving strea may contain less than 0.2 mg/l Al, 0.61 mg/l C 0.4 mg/l Zn, Cr 0.47 mg/l, 10 mg/l oil and grea and 10 mg/l suspended solids.
W85-05236

ALUM PRODUCTION FROM ALUMINU ETCHING WASTES,

e (Malcolm), Inc., Newport News, VA.
. Cornwell.
roceedings, 37th Industrial Waste Conference,
Lafayette, IN, May 11-13, 1982. Purdue
., 1983. p 119-126. 4 Fig, 6 Tab.

riptors: *Metal-finishing wastes, *Alum,
minum, Metals, Feasibility studies, Aluminum
te.

aluminum finishing industry typically pro-
s 3 waste streams: the concentrated spent
ng solution, the rinse water, and a concentrat-
ent acid solution. A number of processes exist
ecovering materials from either the etching
ion or from a sulfuric acid electrolyte solu-
One integrated process has been developed to
ver products from a controlled mix of the 2
es. The existing processes include: Bayer proc-
nutual neutralization, calcium aluminate, zeo-
evaporation-crystallization, ion exchange, and
m aluminate-aluminate sulfate. These all uti-
he spent etch and/or acid solution to produce
sable or marketable product. All but the inte-
d process produce significant waste materials
iring disposal. They all require the relatively
nsive step of dewatering the aluminum hy-
ide. A process was adapted which was devel-
for use in the water industry in an attempt to
uce a marketable aluminum sulfate solution
e producing a minimum of waste material and
nating or reducing the need for a sludge
atering step. The principle of the liquid ion
ange procedure used on aluminum hydroxide
extract the aluminum from the solid precipi-
by direct contact with a solvent. The solvent
ists of 3 components: the extractant is the
l compound in the solvent responsible for
tive extraction of the aluminum. A modifier is
to improve extractant solubility in the sol-
The diluent is the organic liquid into which
xtractant and modifier are dissolved. A feasi-
study concluded that such a procedure was
ble.
-05237

ATMENT FOR REMOVAL OF HEAVY
TAL AND OIL FROM A PISTON RING
NUFACTURING WASTE,
k and Veatch, Kansas City, MO.
Carter, and M. S. Jones.
Proceedings, 37th Industrial Waste Conference,
t Lafayette, IN, May 11-13, 1982. Purdue
., 1983. p 127-138. 8 Fig, 16 Tab.

criptors: *Metal-finishing wastes, *Wastewater
ment, *Heavy metals, *Oil, Sludge, Chromi-
Barium, Lead, Zinc, Acids, Suspended solids.

sey Corporation, at Sullivan, Missouri, manu-
ures cast iron and steel piston rings. About
000 gallons per day of waste is produced con-
ng oil, chromium, lead, barium, zinc, suspend-
olids, acids and alkalies. Separate treatment is
ided for the chrome-containing wastes and for
oil-lead containing wastes. All wastewater is
ed in a lagoon system prior to final discharge
tributary of Wenzel Creek. In 1980, the Mis-
i Water Pollution Board recommended that
use of the lagoon be discontinued because of
re to comply with its National Pollutant Dis-
ge Elimination System permit. Black and
tch conducted studies to define Ramsey's
te treatment problems and recommended treat-
t modifications to ensure meeting the dis-
ge permit. A three-cell basin system was rec-
mended for the treatment of Ramsey's Sullivan
t wastewater. The retention time in the hold-
basin is the same as that in the lagoon system.
re were difficulties in meeting the effluent
nit requirements for barium, oil, lead and sus-
ded solids. With the improved removal of oil in
plant, the effluent oil concentrations are below
nit requirements. The barium treatment com-
nd is not used. This eliminates barium in the
ted effluent. The sludge, containing metals and
e oil, is removed in the first cell of the pro-
ed basin system to prevent wind currents from
ing up settled sludge and producing high efflu-
concentrations.
5-05238

CASE HISTORY: PRETREATMENT OF TEXTILE WASTEWATER,
Weston (Roy F.), Inc., West Chester, PA.
R. Junkins.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 139-146. 5 Fig, 5 Tab.

Descriptors: *Textile mill wastes, *Pretreatment of water, *Bleaching wastes, Biochemical oxygen demand, Chemical oxygen demand, Oil, Suspended solids, Chromium.

A case study concerning pretreatment of bleachery wastes is presented. Investigative results of a biological approach to wastewater treatment are presented and shown to be effective. The analytical determinations performed included wastewater flow, biochemical oxygen demand (BOD), chemical oxygen demand (COD), oil, total dissolved solids (TDS), suspended solids (SS), pH, ammonia nitrogen, total phosphorus, phenol, sulfide and total chromium. The following sources were identified as major contributors of wastewater from the bleachery: bleaching operations (including scour tank, bleachers and washers); boiler blowdown; ion exchange units (including process water conditions units and boiler feedwater conditioning units); and sanitary system. It is emphasized that due to the variability of textile wastewater characteristics, treatability studies need to be conducted on a case-by-case basis in order to identify and confirm the required design parameters.
W85-05239

TEXTILE DYEHOUSE WASTEWATER TREATMENT: A CASE HISTORY,
Gilbert Associates, Inc., Reading, PA.
C. R. Kertell, and G. F. Hill.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 147-156. 8 Fig, 4 Tab.

Descriptors: *Textile mill wastes, *Wastewater treatment, *Dye industrial wastes, Biochemical oxygen demand, Suspended solids, Color, Alum, Effluents.

An industrial wastewater treatment system has operated successfully at Penn Dye and Finishing Company, Pine Grove, Schuylkill County, Pennsylvania since September 1980. Effluent samples are collected and analyzed on a regular basis in accordance with permit requirements. With only minor exceptions, effluent discharges have complied with all permit limits. Alum can be used to remove residual biochemical oxygen demand (BOD), suspended solids and color from biologically treated textile dyehouse wastewater. The treated effluent has potential for in-plant reuse. Several factors contributed toward producing a successful industrial waste treatment program at Penn Dye and extend beyond the basic system design function, including: an extensive program of preliminary studies which preceded the detailed design of the system and which established reliable design data; obtaining permits as an integral part of the system design, rather than as an isolated act; use of only proven, reliable unit operations and processes in the treatment system design; and commitment of company management and engineering personnel to conduct a successful waste treatment program. Continuing operations and maintenance are critical to any wastewater treatment system, and their importance cannot be minimized.
W85-05240

ENERGY AND MATERIALS RECOVERY OPTIONS FOR THE TEXTILE INDUSTRY,
Argonne National Lab., IL. Energy and Environmental Systems Div.
E. Kremer, B. Broomfield, and L. Fradkin.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 157-161. 4 Fig, 15 Ref.

Descriptors: *Textile mill wastes, *Wastewater treatment, *Dye industrial wastes, Sludge, Anaerobic bacteria, Effluents, Heavy metals.

Nearly half of the textile mills in the United States, excluding mills with low water use, indirectly discharge their wastewater without further treatment; as a result, the organic constituents of these streams pose significant problems for publicly owned treatment works and aquatic life. Those facilities that provide treatment generally use some form of the activated sludge process. On a wet weight basis, the textile industry is second only to the electroplating industry in its production of sludge. The organics discharged consist primarily of sizes, dyes and detergents. Treatment of these constituents provides the basic treatment of any plant's scheme. Size represent the single largest group of chemicals used in the industry. Starch has been the traditional sizing material used, but mills have been increasing the use of synthetic sizes polyvinyl alcohol (PVA) and sodium carboxymethylcellulose (CMC) as a replacement for starch for use on synthetic and synthetic blend materials. The synthetic detergents are divided into hard anionic, soft anionic, nonionic and cationic. The hard anionic types are not as readily biodegraded as the soft anionic types. Facultative anaerobic bacteria, which were able to degrade azo dyes, can be isolated from draining ditches at dyestuff factories. Most of the priority pollutants contained in textile industry effluents are aromatics, halogenated hydrocarbons and heavy metals. The optimal situations for chemcial recovery is the use of RO/UF for a specific process. In the manner, chemicals are recovered in their least contaminated form best suited for reuse.
W85-05241

TREATMENT OF METAL PLATING WASTEWATER WITH A DISPOSABLE ION EXCHANGE MATERIAL,
Indiana State Board of Health, Indianapolis. Div. of Water Pollution Control.
V. Keramida, and J. E. Etzel.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 181-188. 10 Fig, 3 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Heavy metals, Copper, Nickel, Zinc, Metal plating, Vermiculite.

Multivalent heavy metal ions were removed from simulated acid bath plating liquid wastes by passing the wastes through an unexpanded vermiculite cation exchange bed. The particular vermiculite material used had a particle size in the range of 0.0067-0.0234 in and a CEC of 676-86 meq/100 g of material. The CEC of the vermiculite varied depending on the particular multivalent metal ion present (copper, nickel or zinc), being lowest for zinc and highest for nickel. The vermiculite also functioned effectively to remove mixtures of the three heavy metal ions from waste streams.
W85-05243

MORE ECONOMICAL TREATMENT OF CHROMIUM-BEARING WASTES,
Espey, Huston and Associates, Inc., Austin, TX.
C. R. Taylor, Jr., and S. R. Qasim.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 189-196. 10 Fig, 6 Ref.

Descriptors: *Metal-finishing wastes, *Chromium, Oxygen, Wastewater treatment.

An experimental program was conducted to quantify the stoichometry of the chromium reduction reaction. The objectives were to quantify the oxygen reacting with reducing agent and to show how the stoichometry of the chromium reduction reaction can be proven if the oxygen reactions are considered. A process was designed to treat chrome bearing wastes more economically. Industries that plate metals with chromiun are concerned with the treatment and disposal of very dilute chromium concentrations from rinse baths. Great excesses of reducing agent are consumed by the dissolved oxygen contained in the chromium waste solution. The most common method of pretreatment of chromium containing waste is the reduction of hexavalent chromium to trivalent chrome using sulfur dioxide or one of its salts. A reactor was designed to allow complete oxygen

removal before addition of chemical, for chromium reduction, and to maintain the anoxic condition throughout the experiment. The presence of dissolved and atmospheric oxygen had a significant effect on the amount of reducing agent required to reduce hexavalent chromium to trivalent chrome. Chromium reduction is run at pH 2.0 and the reaction time is relatively fast (10 to 60 minutes) so that atomospheric oxygen does not consume extreme excesses of reducing agent. With the elimination of atmospheric oxygen as an interference, the reduction reaction is accomplished with an equal amount of reducing agent at greater reduction times.
W85-05244

OIL WASTE TREATMENT AND RECLAMATION IN THE AUTOMOTIVE INDUSTRY,
Chrysler Corp., Kokomo, IN. Transmission Plant.
B. D. Harlow, J. W. Hubbell, and T. M. Doran.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 197-202. 2 Fig, 3 Tab.

Descriptors: *Oil wastes, *Reclamation, Industrial wastewater, Aluminum, Emulsions, Wastewater treatment.

Industrial waste treatment can be a costly component of a manufacturing operation. The Chrysler Corporation manufactures die cast aluminum transmission housings and manifolds at the casting plant and assembles the transmissions at the transmission plant in Kokomo, Indiana. The industrial waste treatment plant is required to reduce the concentration of Freon-extractable compounds to less than 50 mg/l prior to discharge to Kokomo's sanitary sewer. In 1978 a program was developed to investigate an emulsion breaker/alum treatment system and to improve the processing capability for both wastewater and oil. The waste is pumped to one of 4 batch treatment tanks and a tank is added to increase detention time. Insoluble oils separate by gravity in the batch treatment tanks and are skimmed to a new oil/water separation tank. Oil skimming is accomplished by pumping treated effluent to the lower portion of the batch tank. After skimming the free oil, pH is adjusted to 6-7 and chemicals are added using a new chemical transport system which provides for the addition of 5 chemicals (sulfuric acid, caustic, alum, emulsion breaker and polymer). The more effective chemical application and treatment system and the increase in treatment time have resulted in a batch treatment tank effluent that is suitable for direct discharge to the sanitary sewer. In 1981 a comparison of treatment plant total operation and maintenance costs and the return on oil reclaimed at the facility shows a net profit for the treatment plant.
W85-05245

WASTE TREATMENT IN AN AUTOMOTIVE COMPONENT COMPLEX,
Gilbert/Commonwealth, Inc., Jackson, MI.
S. P. Gambhir, and R. Johnston.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 203-206. 1 Tab.

Descriptors: *Wastewater management, *Metal-finishing wastes, Oil, Sludge, Cleanup.

A case history of wastewater management in a metal working plant is described. The manufacturing operations of the Saginaw Steering Gear Division of General Motors Corporation consists of cold heading, grinding, machining, metal coating, and heat treating. The manufacturing operations are located adjacent to Wheeler National Wildlife Management Area. Wastewater from the site originates from cleanup and blowdown that occurs due to various plant operations. These operations consist of several phosphating lines which discharge rinse water and other wastes; many parts washers; waste coolants that occur from filtration systems; dumping of contaminated filtration systems and wash water from miscellaneous cleanup operations. Wastewater from the manufacturing plant is conveyed by a gravity sewer to a deep sump. The wastewater is lifted to a distribution channel which feeds 2 API separators. In the treatment cycle, a measured amount of diluted emulsion breaker (a cationic polymer) is added to the waste to destabilize the oil-in-water emulsion. The split oil coagulates, flocculates and floats to the surface of the batch tank. The treated waste is discharged from the bottom of the batch tanks to the suction of 2 centrifugal pumps located in a pump house. The split oil sludge is pumped to a tank farm. The sludge and skim oil are hauled away by outside firms. The skimmed oil is shipped to an oil reclaimer where it is cleaned and necessary additives are added to meet various oil specifications. Since startup the plant has consistently met the limitations imposed by state and federal regulations.
W85-05246

NEW METHOD FOR OIL TANKER BALLAST WATER DEOILING,
Ecodyne Corp., Union, NJ. Graver Water Div.
R. T. O'Connell.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 207-212. 4 Fig, 2 Tab, 3 Ref.

Descriptors: *Oil tankers, *Oil wastes, *Ballast, Coalescence, Deoiling, Ion exchange, Oil skimmers.

The contamination of the oceans by oil is a problem of vast magnitude. Elf Aquitaine, a French petroleum company, has applied a new oil removal technique to the treatment of oil tanker ballast water. The technique used synthetic ion exchange resin as a coalescing medium. It is applied as a polishing unit for the effluent of API separators or storage tanks equipped with skimmers. Commercial installations exist at Brest Harbor, France where the Brest facility is for repairing oil tankers and Bayonne Harbor, France where the Bayonne facility is operated by a reginal port authority. The Elf coalescing process offers a unique method of polishing ballast water, and other oil wastewaters. One of the benefits realized is the elimination of chemical feeds (acid, alum, polymer, etc.), while still achieving low effluent oil concentrations. Once the oleophilic groups are affixed to the resin beads, they remain stable over a wide range of pH (2-12) and temperature (up to 250 F). The bond between the oleophilic group and the resin is also not affected by organic solvents sometimes used in tank cleaning.
W85-05247

MUNITIONS MANUFACTURING WASTEWATER TREATMENT: A GRASS-ROOTS FACILITY CASE HISTORY,
Engineering-Science, Inc., Atlanta, GA.
R. A. Mannebach, M. R. Hockenbury, and W. M. Reilly.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 213-222. 4 Fig, 5 Tab.

Descriptors: *Wastewater treatment, *Explosives, Zinc, Heavy metals, Influent streams.

A comprehensive conservative approach to a unique wastewater treatment problem is discussed. The design provides a technically feasible and flexible system capable of meeting the client's operational requirements and stringent effluent limits. The Industrial Wastewater Treatment facility design features include the following: efficient treatment facility design for 4 distinct production operating conditions (round-the-clock, one-shift-per-day, no production but with equipment maintenance, and total plant shutdown); capability to handle 8 different sources of wastewater, consisting of 4 continuous wastestreams and 4 batch wastestreams; zinc chloride precipitation for complexed ferrocyanide and ferricyanide treatment; carbon adsorption for ABS treatment a three-stage pH adjustment, precipitation and removal system for heavy metal treatment; a sulfide polishing system for residual heavy metal removal; filtration for residual heavy metal hydroxide removal; and a unique flow scheme which utilizes parallel pretreatment systems designed to treat selected contaminants in the 8 influent waste streams, followed by a combination treatment system designed primarily for heavy metal removal.
W85-05248

LAND TREATMENT OF WASTE AS AN I DUSTRIAL SITING ADVANTAGE,
Law Engineering Testing Co., Marietta, GA.
G. L. Taylor, and L. A. Neal.
In: Proceedings, 37th Industrial Waste Conferen West Lafayette, IN, May 11-13, 1982. Purd Univ., 1983. p 233-238. 2 Tab.

Descriptors: *Land use, *Industrial wastes, *S selection, Hazardous materials, Electroplati Crop production, Groundwater.

Industrial siting has been limited to sites wit pumping distance of an adequate waste treatm facility, or a river capable of assimilating the wa ouput from an onsite system. Land treatment industrial wastes uses a vegetation-soil system both renovate the waste and to serve as the u mate receiver of the waste. If land treatment feasible at a site, the need for sewers is eliminat There are 4 basic waste application techniqu rapid infiltration, overland flow, spray irrigati and soil incorporation. The limitations of la treatment include the availability of the land. If potential industrial site is land locked, and land not available, conventional methods of treatm have to be utilized. Each land treatment site has be analyzed as a unique set of conditions. A la treatment system cannot be designed for one and that design transferred to another site. Ma of the hazardous wastes are treated effectively land treatment. Three categories of crops are u ally grown on a land treatment system: agronon or row crops, forage crops and grasses, and fore ed systems. Construction involves basically 3 co ponents: storage basin, pumping to move wastes, and distribution system. A case history presented of an electroplating manufacturer an nondischarge waste treatment system. The ambi ground water quality of the site is within curr drinking water standards. The buffer zones arou the site are planted to trees and shrubs to provid multistoried canopy to prevent drift of spray dr lets and to provide a visual barrier.
W85-05249

ASSESSMENT OF FLUID CONTROL LIN INSTALLATION PROCEDURES,
Southwest Research Inst., San Antonio, TX.
D. W. Schultz, and M. P. Miklas, Jr.
In: Proceedings, 37th Industrial Waste Conferen West Lafayette, IN, May 11-13, 1982. Purd Univ., 1983. p 239-251. 8 Tab, 5 Ref.

Descriptors: *Linings, *Clays, *Landfills, *Co paction, *Asphaltic concrete.

Field observations at 21 liner construction si indicate installers generally comply to a la degree with industry recommendations regard subgrade preparation and liner placement pro dures. Clay liners are often utilized for fluid poundments or landfills when a relatively hig fluid permeability can be tolerated. The most portant parameters for the recompaction of off clay for use as a liner are: compaction energy lift height. Asphaltic concrete used of liner sho contain a higher percentage of mineral filler asphalt than standard paving asphaltic concr For proper placement of asphaltic concrete lin subgrades must be smooth and flat. Polyme membrane liners are utilized to seal fluid impou ments and landfills. The liner must be secured the top of any slope. Proper sealing around penetrations must be accomplished. Both excess precipitation and cool temperatures can advers affect the quality of a given liner installati Sprayed on liners are formed in the field by spr ing a liquid onto a supporting surface. The types sprayed on liners include: urethane modified phalt, emulsified asphalt, latex rubber compou and air blown asphalts. Soil sealants reduce permeability of soil through a variety of mec nisms, including ion exchange and porosity red tion. The manufacturers of polymer modified b tonite soil sealants recommend dry blending w the soil for construction of a soil liner.
W85-05250

ATER AND WASTEWATER SURVEY FOR HE BRAZILIAN MERCK, SHARP AND OHME CHEMICAL AND PHARMACEUTI-AL PLANT,
lgon Corp., Pittsburgh, PA.
G. Rabosky, and W. G. Schuliger.
: Proceedings, 37th Industrial Waste Conference, est Lafayette, IN, May 11-13, 1982. Purdue niv., 1983. p 259-270. 3 Fig, 5 Tab.

escriptors: Wastewater treatment, *Chemical astewater, *Pharmaceutical wastewater, Water eatment, Sao Paulo, Brazil.

water and wastewater survey conducted at erck, Sharp and Dohme's industrial and pharma-utical facility in Sousas, Brazil, near Campinas in e state of Sao Paulo is presented. The facility oduces chemicals, agricultural veterinary prod-ts and pharmaceuticals. The plant's water supply the Atibaia River. The intake pumps transfer nal water to the flocculation basin, where lime d alum are added for pH control and coagula-n. Clarified water is chlorinated in a wet well d pumped to filters for additional removal of spended solids. The plant's water balance shows at untreated intake flows range 160-370 gpm, th an average flow of about 255 gpm. Storm-ater and industrial wastes are discharged into 2 en concrete ditches. Sanitary wastes are collect-and discharge into the municipal sanitary sewer. ne existing wastewater treatment plant consists of 8000 gallon wooden neutralization tank where id and lime and added on a batch basis. A oposed wastewater treatment process consists of ualization, neutralization, primary settling, idge concentration and carbon adsorption. Vari-ons in water demand should be controlled by stalling start-stop controls on the pump; flow version valve on the pump discharge in order to rect the excess flow to the river; or manual pass pipe and valve on the flocculator feed in der to divert the excess water to the river. occulation and sedimentation can be improved maintaining pH as near to 7.0 as possible. Co-ulation/flocculation of river water can be im-oved by using polyelectrolytes in combination th the present treatment scheme. The current utralization practices of wastewater are inad-uate.
85-05251

UAL NONSTEADY-STATE EVALUATION OF TATIC AERATORS TREATING PHARMA-EUTICAL WASTE,
anhattan Coll., Bronx, NY. Dept. of Environ-ental Engineering and Science.
A. Mueller, R. Donahue, and R. Sullivan.
: Proceedings, 37th Industrial Waste Conference, est Lafayette, IN, May 11-13, 1982. Purdue niv., 1983. p 271-283. 7 Fig, 5 Tab, 6 Ref.

escriptors: *Activated sludge process, *Aerators, Pharmaceutical wastes, Sludge, Wastewater treat-ent, Aeration.

bench scale activated sludge design study was nducted at the Merck and Co., Inc. Stonewall ant in Elkton, Virginia, from January 10, 1980 rough May 30, 1980. The purpose was to define e design criteria for a new activated sludge stem to replace an existing activated sludge stem and rock biofilters. The dual nonsteady ate technique requires 2 consecutive nonsteady ate aeration tests to be conducted at different gas ows in an aeration tank having a constant oxygen otake rate. Clean water static aerator testing was nducted using the nonsteady state reaeration test rocedure. The clean water data shows more scat-r than expected at the higher gas flows and a latively low correlation coefficient compared to e process values; however, reasonable agreement the factory test data is observed. Temperature oes not appear to markedly affect clean water alues. The excellent agreement of the calculated d measured oxygen saturation values indicates e validity of the dual nonsteady state testing chnique for K sub L a measurement in complete-mixed aeration tanks under process conditions. he process water results show a tendency for pha to vary with airflow. Future testing is planned to define the effects of wastewater on oxygen transfer of fine bubble aerators.
W85-05252

RECOVERY OF PROTEIN FROM SLAUGHTERHOUSE EFFLUENTS BY DOUBLE ADJUSTMENT OF PH,
Meat Industry Research Inst. of New Zealand, Hamilton.
R. N. Cooper, J. M. Russell, and J. L. Adam.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 285-293. 7 Fig, 5 Tab, 24 Ref.

Descriptors: *Meat processing industry, *Nitrogen compounds, *Blood, *Phosphorus removal, Biological oxygen demand, Chemical oxygen demand.

The effluent from a slaughterhouse characteristically contains high concentrations of fat and organic nitrogen. Primary treatment removes only 20 per cent of the organic nitrogen. Further treatment can be effected only by biological or chemical methods. The mechanisms of double pH adjustment are described. The procedure includes an evaluation of the initial and final pH values, the influence of neutralizing agent, and the influence of superphosphate. The results indicate that for a double pH adjustment process to be effective, the effluent must be initially acidified to pH 3 and that it is the blood component that dictates values between 4 and 6 the tetramer splits into 2 dimer units. This reaction is reversible on neutralization. Between pH 3 and 4 the reversibility of this reaction decreases, becoming irreversible at pH 3 and the dimer units split into monomer globin chains. Globin shows minimum solubility between pH 6.5 and 7.0. Below pH 7, both sodium hydroxide and calcium hydroxide had similar effects for neutralizing hemoglobin solutions; above pH 7, the rate of solubilization is greater with sodium hydroxide than with calcium hydroxide. A modification of the process, adding superphosphate in the acidification stage and then neutralizing to pH 9 with lime, slightly improves effluent quality, probably due to entrapment of colloidal material in the precipitated hydroxyapatite. In a model plant using the modified process, BOD, COD, organic nitrogen and inorganic P removals of 76, 81, 63, and 90%, respectively, were achieved.
W85-05253

ANAEROBIC FLUIDIZED BED WHEY TREATMENT,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
P. H. Boening, and V. F. Larsen.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 295-304. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Food processing industry, *Anaerobic digestion, *Fluidized bed process, *Chemical oxygen demand, Nutrient requirements, Microorganisms, Organic loading, Milk, Dairy industry, Whey, Waste treatment.

Anaerobic treatment of moderate strength lactic casein whey permeate (2000-7000 mg/l COD) is possible in fluidized bed reactors. Removal efficiencies up to 90 per cent were obtained at organic removal rates of 7.7 kg COD/cu m-day and efficiencies of 70 per cent were obtained at organic removal rates of 19.5 kg COD/cu m-day, both at 35 C. A removal rate of 310 kg COD/cu m-day at 50 per cent removal efficiency was obtained at 15 C. Nutrient requirements were much lower than for CSTR systems, no supplemental nitrogen or phosphorus was required for treatment. Removal efficiency decreased with increased organic loading rates, but removal rates per unit mass of microorganisms increased with increased organic loading rates. Microorganism concentration increased with decreased temperature compensation in part for the decrease in reaction rates at the lower temperture. Microorganism concentration was not limited by organic loading rate and may not have reached steady state levels. The most effective kinetic model was dependent on the influent substrate concentration.
W85-05254

FIVE-DAY BIOCHEMICAL OXYGEN DEMAND REMOVAL FROM RENDERING PLANT WASTEWATER,
Woodard and Curran, Gorham, ME.
K. R. Marston, and E. E. Woodard.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 305-310. 6 Fig, 4 Tab.

Descriptors: *Activated sludge process, *Dissolved air flotation, *Meat processing industry, Biochemical oxygen demand, Sludge, Wastewater treatment, Rendering plant.

A bench-scale pilot study showed that the dissolved air flotation (DAF) effluent from Pine State By-Products was amenable to treatment using the activated sludge process. A prototype activated sludge system was designed to provide the maximum amount of treatment with minimum of area and capital costs by utilizing a high MLSS concentration and F/M. The prototype system has performed very well under varying conditions. Waste activated sludge, along with sludge from the DAF system, is recycled to the plant for processing into high protein feed supplement. This eliminates the need for offsite sludge disposal. Based on an average influent BOD to DAF system of 65,000 mg/l, the treatment system (DAF followed by activated sludge) provides over 99 per cent BOD removal. The treatment system has been performing so well that a license has been granted for recommencement of overboard discharge of treated effluent, eliminating sewer use charges.
W85-05255

TREATABILITY OF DAIRY WASTEWATER,
Alexandria Univ. (Egypt). Higher Inst. of Public Health.
A. Hamza.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 311-319. 8 Fig, 4 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Dairy industry, *Activated sludge process, Effluents, Sludge, Biological oxygen demand, Organic carbon, Reverse osmosis, Milk, Cheese, Yogurt.

A field study is reported which sampled and characterized process effluents from Misr Dairy Company and proposed in-plant control measures and treatment alternatives are given. The plant produces pasteurized milk, yogurt and various kinds of cheese. Process effluents amount of 0.8 million cu m annually. The raw combined effluent from Misr Dairy plant was preaerated for 12 hours before feeding to the activated sludge unit at predetermined flowrates to obtain hydraulic detention times between 12 and 36 hours in the aeration tank. Advanced treatment of dairy waste, conducted at Hokkaido University in Japan consisted of treatment of dairy wastewater in reverse osmosis unit and multiple treatment using coagulation, adsorption and reverse osmosis. Preventive measures suggested for Misr Dairy Plant are: segregation of whey wastes and their possible use as an ingredient in animal feed; installation of drip shields on all fillers; use of automated valves with special seals to minimize leakage; better control of production to minimize losses in receiving, transfer and packaging areas; application of multiple reuse for cleaning compounds in the CIP system; and use of cooling water in closed cycle. The treatment efficiency of the activated sludge system decreased appreciably when influent BOD increased beyond 2000 mg/l. Extended aeration for 30 to 36 hours was necessary to attain adequate removals of the organic pollutants. The need for coagulation-adsorption pretreatment before feeding the effluent to the reverse osmosis system was demonstrated. Multiple treatment by coagulation, adsorption and reverse osmosis achieved reduction of TOC up to 97.5%.
W85-05256

FERMENTATION PROCESS FOR DILUTE FOOD AND DAIRY WASTES,
Abcor, Inc., Wilmington, MA.
V. Singh, C. C. Hsu, D. C. Chen, and C. H. Tzeng.

In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 321-327. 6 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Dairy industry, Effluents, Biological oxygen demand, Fermentation, Alcohols, Reverse osmosis, Food-processing wastes, Grain milling, Potatos, Sugar beets, Whey, Milk.

Many food and dairy operations produce large quantities of high strength waste effluents that constitute a major disposal problem. Many of these streams are dilute (4-5 per cent total solids), yet have a BOD in the range of 20,000-50,000 mg/l. The high BOD levels are chiefly due to sugars and starchy material in the wastewater. Many of the waste effluents are well defined, sanitary, contain fermentable carbohydrates and nutrients, and are available year round at fairly constant rates. One of the products that can be made from waste carbohydrates is ethanol by fermentation. The Abcor process converts lactose to ethyl alcohol. The dilute permeate from ultrafiltration operation is concentrated by reverse osmosis 3.5 times and then fed to the fermentation unit. During fermentation, the lactose in the permeate is converted to ethanol; some of the lactose is also converted to carbon dioxide and yeast cells. The dilute alcohol broth (9 per cent by volume) is fed to a distillation unit where the alcohol is concentrated. Final product concentration depends on the application: from 95 per cent ethanol to 99.5 per cent purity. The Abcor fermentation process is a continuous operation; concentrated permeate is constantly fed to the fermentors and product constantly withdrawn. The process, although developed specifically for the fermentation of cheese whey permeates, can be used for treating a variety of dilute food and dairy wastes, such as grain milling water, potato and sugar beet process effluents, and milk, acid whey and delactosed whey ultrafiltrates.
W85-05257

SLUDGE RECYCLING FOR METHANE FERMENTATION PROCESSING OF SWINE WASTEWATER,
Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
P. Y. Yang, and Y. T. Wong.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 329-337. 13 Fig, 4 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Methane bacteria, Fermentation, Sludge, Meat processing industry, Anaerobic digestion, Hogs.

Anaerobic fermentation of swine wastewater with recycling digested sludge provides an improved and stable process. The maximum gas yield and gas production rates are 1.05 liter of gas produced (67.5 per cent methane gas) and 2.72 liter of gas produced per liter of reactor liquid volume per day, respectively. The rate equations for estimation of TVS content in the effluent and gas production rate have been developed and tested for its predictability. Improvement of settling of anaerobically digested sludge can be achieved by using 50 C of instant heat treatment. Such heat treated settled sludge can be used for sludge recycling in an anaerobic fermentation process. The recommended design and operational critera for anaerobic fermentation of swine wastewater are summarized as follows: temperature, 30 C; ratio of flowrate of recycled sludge to influent flowrate, 0.25-0.30; critical swine wastewater hydraulic retention time, 6.5 days when alpha equals 0.25, c equals 2.0; feeding frequency, 3 times a week; TVS loading rate, below 4.0 gram per liter of liquid volume per day; degasification temperature of digested sludge, 50 C; and settling time for heated sludge recycling, 5 hours.
W85-05258

WASTEWATER TREATMENT AT A SWEDISH CARDBOARD FACTORY: POSSIBLE COST SAVINGS,
Svenska Traeforskningsinstitutet, Stockholm.
G. Fladda, E. Kubulnicks, B. Boman, J. Norman, and L. Ruus.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 339-352. 11 Fig, 3 Tab, 3 Ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Pulp and paper industry, *Cost analysis, Sludge, Automation, Cardboard.

The wastewater treatment system at a Swedish cardboard factory (production, 400 ton/day) was investigated to study the behavior of the treatment system and evaluate possible cost savings. The wastewater treatment plant consists of primary sedimentation, trickling filter, 2 activated sludge units in series, chemical treatment, clarification and microstrainers. For sludge treatment there are 2 thickeners and a belt press for sludge dewatering. Cost savings could be achieved in the following way: reduction of fiber losses from the cardboard factory; automatic control of the oxygen concentration in the aeration basins; automatic control of the addition of chemicals for flocculation; reduced addition of nutrients (N and P); and improved regulation of the pumps at the wastewater treatment plant. The most important cost saving was a reduction of the fiber losses from the factory, and this could be achieved by installation of an automatic control system. Significant energy savings were also obtained by such simple measures as a better regulation of the pumps in the main sump at the treatment plant. According to the calculations made the possible annual energy savings amounted to 5800 MW-hr and the annual cost savings to $981,900. Considerable cost savings can be obtained at unchanged or even improved treatment efficiency.
W85-05259

TREATMENT SYSTEM FOR CONTROL OF RADIOACTIVE WASTEWATER GENERATED DURING CLEANUP OF THE CANONSBURG, PENNSYLVANIA, SITE OF THE URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM,
Weston (Roy F.), Inc., West Chester, PA.
J. W. Hammond, and A. L. Lenthe.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 387-396. 2 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Uranium, *Radioactive waste disposal, Radioactivity, Groundwater, Sedimentation, Filters, Suspended solids, Radon, Radium, Thorium.

The Canonsburg site (Canon Industrial Park) is located in southwestern Pennsylvania, in northern Washington County. Radiological surveys determined that significant amounts of contaminated material remain on the site and the radiation levels measured in the buildings, soils and groundwater exceeded the proposed DOE guidelines for remedial action. Radium-bearing residues are present in soil beneath and adjacent to many of the buildings, as well as in the top few feet of soil over much of the area. Radon, radon-daughter products, and 230Th levels in building air are also above guidelines. The groundwater in area A is above the maximum permissible concentrations. Area B is above guidelines for radioactivity, although with lower contamination levels than Area A. Area C, a former lagoon area, was used as a depository for liquid wastes during uranium and radium recovery operations. The remedial action scenario is modular in approach, allowing various parts of the plan to be deleted if possible, based on the results of additional field studies. During the implementation of the decontamination program wastewaters will be generated that must be treated to remove radioactive species prior to discharge to Chartiers Creek. The wastewater treatment strategy includes a sedimentation basin for collecting runoff and other wastewaters generated at a rate in excess of the capacity of the treatment facility, followed by multimedia pressure filters to control suspended material, and followed by cation/anion exchange beds to control dissolved species. The design capacity of the treatment facilty is 100 gpm; the estimated construction cost is $760,000.
W85-05262

CONTROLLING RESIDUAL POLYCHLO NATED BIPHENYLS IN WASTEWA TREATMENT THROUGH CONVENTIO MEANS,
Aluminum Co. of America, Lafayette, IN.
L. L. Fox, and N. J. Merrick.
In: Proceedings, 37th Industrial Waste Confere West Lafayette, IN, May 11-13, 1982. Pu Univ., 1983. p 413-423. 2 Fig, 7 Tab, 12

Descriptors: *Physicochemical treatment, *E sions, *Wastewater treatment, *Polychlorinate phenyls, Clarifiers, Sludge, Filters, Esters, P phates.

Polychlorinated biphenyls (PCB) were used a Aluminum Company of America (Alcoa) La ette Works primarily in fire-resistant hydra fluids called phosphate esters. Through leak hydraulic systems and careless handling practi PCB's found their way into the trenches and in trial sewer systems on the plant site. The treatr plant consists of a physical-chemical clarifier c bined with a conventional primary clarifier, t ling filter and final clarifier. The industrial w stream consists largely of an oil-in-water emul From the industrial wet well, the waste strea pumped into a holding tank, then through a ve which operates a lime feeder and polymer pu and then the waste enters the industrial rea clarifier. A valve is used to blowdown clar sludge into a common sludge pit, which also ceives anaerobic digester sludge. The clarifier is equipped with a skimming device that re skimmed material to the industrial wet well. L and at times a polyelectrolyte are added as a co tioning agent to the industrial and digested slu in the sludge pit. The sludge is dewatered ov coil spring vacuum filter. The dewatered solids hauled to a chemically secure landfill. The ma ty of the 93.6 per cent PCB reduction during 12-week special sampling program was achie by physical-chemical removal in the indus clarifier. All efforts are being directed toward o mizing the waste treatment operation thro managing of the industrial influent flows and el nating treatment plant upsets. This is accomplis by constant monitoring of the plant processes.
W85-05263

EVALUATION OF ION EXCHANGE TE NOLOGY FOR TOXIC AND NONCONV TIONAL POLLUTANT REDUCTION BLEACH PLANT,
Jordan (Edward C.) Co., Inc., Portland, ME.
J. H. Fitch, Jr.
In: Proceedings, 37th Industrial Waste Confere West Lafayette, IN, May 11-13, 1982. Pur Univ., 1983. p 425-433. 3 Fig, 7 Tab.

Descriptors: *Ion exchange, *Color remo *Pulp and paper industry, *Wastewater, Efflue Bleaching wastes, Chemical oxygen dem Phenols, Chlorinated hydrocarbons, Metals, W treatment.

The wastes resulting from bleach plant opera in the pulp, paper and paperboard industry cha teristically contribute color, chemical oxy demand (COD) and toxicity to the effluent wa treams discharged. Three ion exchange de schemes have been developed for treating ble plant effluents: the Dow process, the Rohm Haas process, and the Billerud nonpolluting ble plant concept. The Billerud system is a pate ion exchange technology instituted at the Bille Uddeholm AB mill in Skoghall, Sweden. A scale batch ion exchange system was installe allow the plant to meet its color limitation addition to reducing color discharges by appr mately 90 per cent, the system removed o pollutants including chlorinated phenols (95-99 cent), chlorinated guaiacols (80-90 per cent), COD (70 per cent). Both the batch and pilot p systems were sampled to assess actual opera parameters, removal efficienies, and associ problems and costs. The first ion exchange col appears to remove a constant portion of the after approximately half the sample time while removal efficiency of the second column con ently decreases throughout the cycle. Any m

val probably resulted from the metals binding sulfhydryl groups, amide chelation, or elec-tic attraction to negatively charged macro-cules. Though some inorganic chloride is re-d initially, the removal rate rapidly decreases low level; most chlorides pass through the n. Excessive amounts of pollutants passed gh the system when the contact time on the columns was extended.
05264

ORITY POLLUTANT REMOVAL BY ACTI-ED SLUDGE TREATMENT: MONITOR-PHENOLS FROM DYE AND PIGMENT TE,
nnati Univ., OH. Dept. of Civil and Environ-al Engineering.
ckabaugh, and M. Lambert.
roceedings, 37th Industrial Waste Conference, Lafayette, IN, May 11-13, 1982. Purdue ., 1983. p 435-443. 5 Fig, 6 Tab, 6 Ref.

riptors: *Ion exchange, *Color removal, *Ac-ed sludge, *Pigments, *Phenols, Dyes, Dye stry wastes, Chlorinated hydrocarbons, ls.

monitoring of the removal of pollutants from strial waste streams is studied, and an analyti-service for an activated carbon-activated ge system used to treat a dye and pigment e is provided. The experimental analysis plan pecific organics was to identify by GC/MS pounds of significantly high level of concen-on to monitor by flame ionization detection/ chromatography analysis through the biologi-reatment process from influent to secondary ent. Routine monitoring for trace constituents ents some special problems. Available method-y cannot be expected to perform equally well ll kinds of samples. The limitations of methods be clearly identified whenever possible, in r to evaluate the usefulness of the data pro-d. Even though low recoveries and high vari-ty were found, the data are still valuable in treatment trends can still be seen. This study ts out the need for further method develop-t in the analyses of individual phenols in com-matrices.
5-05265

XILIARY DEMINERALIZATION SYSTEM R LIQUID RADIOACTIVE WASTE,
n Shan Nuclear Power Station (Taiwan).
H. Lin, and C. R. Witt.
Proceedings, 37th Industrial Waste Conference, t Lafayette, IN, May 11-13, 1982. Purdue v., 1983. p 445-449. 4 Fig, 1 Tab.

criptors: *Radioactive wastes, *Demineraliza-, *Nuclear powerplants, Ion exchange, Sus-ded solids, Waste treatment.

ncern over the effluents from nuclear power nts has led to increased efforts to achieve zero ase to the environment. A major source of ase from a plant is through its liquid radwaste em. A system was recently installed to aug-nt the liquid radwaste system. This has dramati-y reduced its radioactive activity releases to the ironment via the liquid effluent pathway. This em that Chin Shan installed is called the auxil-demineralization system (ADS). The equip-nt drain processing system collects, samples and ts high purity, low conductivity waste. The ste collector filter receives effluent from either waste collector or the waste surge pump. It oves suspended solids and passes the effluents the waste demineralizer. The waste demine-r is a mixed-bed ion-exchange type, that further oves impurities from the waste stream. Liquid waste is pumped from either the waste collector k or the waste surge tank using the ADS pump ough the ADS to either waste sample tank. In alternate mode, liquid radwaste is pumped from ner the waste collector tank using the lector pump or the waste surge tank using the ste surge pump, through the waste collector er, and even through the ADS to either waste mple tank. With the waste sample tank recircu-e mode, liquid radwaste is pumped from either waste sample tank using that tank's waste sample pump, through the ADS, and returned either to the same waste sample tank or to the opposite one. With the recirculate mode, liquid radwaste is internally recirculated through the ADS using the ADS pump.
W85-05266

CARBON TREATMENT OF PESTICIDE WASTEWATERS IN LIGHT OF BEST AVAILABLE TECHNOLOGY EFFLUENT LIMITATION GUIDELINES,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
K. N. Wood, O. R. Hunt, and J. J. Anderson.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 451-463. 9 Fig, 6 Tab, 32 Ref.

Descriptors: *Wastewater treatment, *Pesticides, *Agricultural chemicals, *Activated carbon, Cost analysis, Load distribution, Hydrogen ion concentration, Effluents.

A two phase program was undertaken with static isotherm tests with synthetic solutions of active ingredients in distilled water, followed by dynamic column studies with actual manufacturing process waste streams to: ascertain the efficacy of activated carbon in removing Du Pont agrichemical compounds to low levels in the aqueous phase and evaluate the cost-effectiveness of carbon treatment relative to alternate pesticide removal methods. The static isotherm test results demonstrated that activated carbon can reduce the concentration of Du Pont agrichemical compounds to low levels, but that adsorption characteristics are variable between compounds. Batch test results with synthetic solutions give overly optimistic predictions of adsorption capacities using the Freundlich isotherm equation. Dynamic column studies with actual process waste samples are required to accurately predict the effectiveness of activated carbon and to develop information for comparison with other treatment methods. Surface loading rate or linear velocity, pH and pesticide concentration were the variables identified as being significant factors in determining carbon adsorption. The presence of other pesticides in a multicomponent waste did not affect the behavior of one pesticide in the dynamic testing mode when compared to results obtained with it as the only pesticide in the waste. The adsorptivity of other organic contaminants in the manufacturing waste streams could be characterized as poor in relation to that of the active ingredient (i.e., the pesticide is preferentially adsorbed.) Cost-effectiveness was clear for only 2 of the 8 products.
W85-05267

STEAM STRIPPING OF COAL LIQUEFACTION WASTE FOR AMMONIA AND SULFIDE REMOVAL,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
K.-C. Tsai, M. A. Kamer, and J. H. Gray.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 465-473. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Mine wastes, *Coal, *Liquid wastes, *Ammonia, *Sulfides, Hydrogen ion concentration, Activated sludge process, Steam stripping.

Ammonia-nitrogen and sulfide are the two most important pollutants contained in coal liquefaction waste. If not removed, these two pollutants will present a great deal of nuisance to the environment. The feasibility of removing both ammonia-nitrogen and sulfide from coal liquefaction sour water in a laboratory stripping column at one single pH was examined. The steam stripping experiment was conducted by using a distillation apparatus commonly used in solvent recovery operations. A total of 14 steam stripping experiments were run at various pH to determine whether or not both ammonia-nitrogen and sulfide can be reduced to desired low levels at one single initial pH in one stripping column. The analytical results for the sour water reveal that both ammonia-nitrogen and total sulfide extraordinarily high with 9200 mg/l NH3-N and 9500 mg/l total sulfide. These high levels of ammonia-nitrogen are toxic to activated sludge microorganisms. At an initial pH of 9.25 both ammonia-nitrogen and sulfide could be reduced to very low levels. At a high temperature of 95 C in the stripping column, effective stripping of sulfide can be accomplished even at an alkaline pH of 9.75. Total elimination of sulfide was observed at a pH of 9.20. Recovery of ammonia-nitrogen from distillate for reuse is very promising because of the high NH3-N concentration obtained. The average NH3-N concentration in the first 50 ml distillate collected was 152,000 mg/l.
W85-05268

OPERATING EXPERIENCE WITH AN INTEGRATED POWER PLANT WASTEWATER TREATMENT SYSTEM,
Sargent and Lundy, Chicago, IL.
R. Chiesa, and P. D. Schumacher.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 475-487. 9 Fig, 6 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Powerplants, Coal, Chemical wastes, Oil, Iron, Copper, Grease.

The design and operation of an integrated wastewater treatment system (WWTS) used to treat the chemical wastes from a coal fired power plant are described. An integrated WWTS treating metal cleaning wastes, low volume wastes, and material storage runoff from WEPCo's new coal fired power plant has successfully been meeting its NPDES effluent limitations for almost two years with no major operational problems. The WWTS has demonstrated the flexibility to treat a variety of chemical wastes generated by the power plant (metal cleaning wastes such as oil, grease, iron, and copper). No major problems are expected in the operation of the WWTS when Unit 2 comes on line. Minor problems have occurred, but these have been corrected. The operators have increased their proficiency in operating the WWTS. The success of the integrated WWTS at the Pleasant Prairie Power Plant has demonstrated that the concept of an integrated WWTS can be used to design a cost effective WWTS which complies with the EPA effluent limits. Feedback from this project and from other operating WWTS has resulted in the incorporation of refinements in more recent designs of integrated WWTS.
W85-05269

TREATABILITY OF A COAL GASIFICATION WASTEWATER USING THE POWDERED ACTIVATED CARBON/ACTIVATED SLUDGE PROCESS,
O'Brien and Gere Engineers, Inc., White Plains, NY.
J. Janeczek, Jr., and J. C. Lamb, III.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 497-505. 9 Fig, 4 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Coal gasification, *Activated carbon, *Activated sludge process, Organic carbon, Chemical oxygen demand, Phenols.

To evaluate the effects of using powdered activated carbon and activated sludge (PAC/AS) in treating a coal gasification wastewater, six 2.3-liter bench-scale reactors were operated in parallel. Five of them received carbon dosages ranging between 250 and 5000 mg/l and the sixth, which served as a control, received no carbon. The reactors were operated for 142 days and reasonable stable operation was attained about day 110. Only results of analyses performed during the last 32 days of operation are presented. Results from all analyses were encouraging for using the powdered activated carbon-activated sludge process to treat coal gasification wastewaters. The addition of PAC to the activated sludge process increased color removal. The PAC/AS process exhibited better removals of total organic carbon (TOC), chemical oxygen demand (COD), and phenol, than did activated sludge treatment alone. The addition

of PAC to activated sludge increased the amount of biomass in the reactors, as determined by respiration rate analyses. The additon of PAC to activated sludge increased the amount of live biomass in the reactors, as determined by the ATP analyses.
W85-05270

BENZOL PLANT WASTEWATER TREATMENT IN A PACKED-BED REACTOR,
Duncan, Lagnese and Associates, Inc., Pittsburgh, PA.
M. Olthof, and J. Oleszkiewicz.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 519-525. 9 Fig, 18 Ref.

Descriptors: *Wastewater treatment, *Organic wastes, Packed beds, Chemical oxygen demand, Organic carbon, Benzol, Phenols.

The results of a treatability study of wastewaters originating from a benzol plant in an upflow biotower (UBT) are presented. The wastewater constituents are the same as for coke oven wastewater, except that most of the constituents are present in somewhat lower concentrations. The results show that the organics present in this wastewater are very well biodegradable and that it is possible to treat this wastewater biologically to a very high extent. The UBT proved to be an efficient reactor for biological degradation of benzol wastewater. Organic loadings as high as 300 lb COD/1000 cu ft-day resulted in 70 per cent or higher chemical oxygen demand (COD) removal. The percentage removal of CN and SCN was about 60-70 per cent at the loading at which the reactor was operated. Phenol is virtually completely oxidized as long as the percentage COD or SOC removal was above 50%. This does not necessarily mean that the phenol is completely oxidized but at least the ring is broken and the resulting organic does not register as phenol.
W85-05271

TREATMENT OF COKE PLANT WASTEWATER IN THE COUPLED PREDENITRIFICATION-NITRIFICATION FLUIDIZED BED PROCESS,
Canviro Consultants Ltd., Kitchener (Ontario).
S. G. Nutt, H. Melcer, I. J. Marvan, and P. M. Sutton.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 527-536. 4 Fig, 7 Tab, 10 Fig.

Descriptors: *Wastewater treatment, *Coke plant, Nitrification, Denitrification, Fluidized bed process, Hydrogen ion concentration, Retention time, Cost analysis, Organic wastes.

Liquid effluents generated from by-product coking operations are complex, containing high concentrations of phenolic compounds, thiocyanate, free and complex cyanide, ammonia, and a variety of trace organic contaminants that have been shown to produce adverse long term environmental impacts. Bench scale biological treatability studies conducted at Environment Canada's Wastewater Technology Centre (WTC) in Burlington, Ontario, have demonstrated that coke oven wastewaters can be nitrified and denitrified in single sludge suspended growth systems operated in a predenitrification mode. The fluidized bed process is a modification of more conventional fixed film processes, such as the trickling filter, in which wastewater is passed upward through a bed of granular support medium, typically sand, at a sufficient velocity to expand or fluidize the media. The pilot plant feed consisted of effluent from fixed and free leg ammonia stills at the by product coke plant of Dofasco Inc. in Hamilton, Ontario. Lime was utilized for pH adjustment in the fixed leg of the still. The results indicate that, under constant feed conditions, the coupled fluidized bed process was capable of maintaining a consistently high quality effluent at a total system hydraulic retention time (HRT) of approximately 17 hr. Effluent NH3-N concentrations of less than 2 mg/l were attained at a nitrification reactor HRT of 14 hours compared to a retention time of up to 48 hr required in a suspended growth nitrification reactor treating similar wastewaters. Removal of conventional carbonaceous contaminants (FOC) was consistently high. The estimated installed cost is $2,357,000; operating costs are estimated at $150,900.
W85-05272

OXIDATION OF ORGANIC COMPOUNDS IN SOLVENT-REFINED COAL II WASTEWATER VIA ULTRAVIOLET IRRADIATION,
Brown and Caldwell, Emeryville, CA.
J. C. Hein, K. E. Hartz, P. Bulson, and D. L. Johnstone.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 537-550. 15 Fig, 6 Tab, 12 Ref.

Descriptors: *Organic wastes, *Ultraviolet radiation, *Carcinogens, *Toxins, *Wastewater treatment, *Coal gasification, Liquefaction, Chemical oxygen demand, Organic carbon, Solvent refining, Coal.

Wastewaters containing a wide range of organic compounds are treated through biological decomposition. However, coal conversion wastewaters (gasification, liquefaction, synfuels) contain relatively large concentrations of certain groups of organic compounds that are not amenable to biological decomposition. Chemically they are aromatic amines, oxygen and sulfur heterocyclics, and polycyclic aromatic hydrocarbons. These compounds are of intense environmental concern because of their ability as bioaccumulators, as well as being toxins and carcinogens. To effectively remove these refractory compounds, their chemical structures must be altered to a more biodegradable structure. Observation and gas chromatographic analyses indicated that the UV treatment significantly changed the chemical character of the wastewater. The standard analytical methods for total organic carbon (TOC) and chemical oxygen demand (COD) indicated only minor differences. It appears the TOC instrument used in this research and the standard COD method have serious limitations when evaluating wastewaters containing relatively large concentrations of refractory compounds. Gas chromatographic analyses indicated that the photochemical reaction produced by the UV reactor preferentiallly attacked the base neutral compounds in the wastewater. The activated sludge in the UV bio unit exhibited a more uniform floc with better settling characteristics. Suspended solids in the bio unit effluents were reduced from 160 mg/l (mean) in the control effluent to 40 mg/l (mean) in the UV effluent. There was a decrease in the toxicity of the wastewater.
W85-05273

TOXICITY OF WET LIMESTONE SCRUBBER SLUDGES, ASH POND SLUDGES AND EFFLUENT WASTES FROM A COMBUSTION PROCESS,
Tennessee Technological Univ., Cookeville
E. L. Morgan, T. C. Yehl, and R. C. Young.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 551-557. 7 Tab, 11 Ref.

Descriptors: *Coal combustion wastes, *Toxicity, Sludges, Fish, Sedimentation, Metals, Biological oxygen demand, Aquatic insects, Fly ash.

Treatment of coal combustion wastes by primary settling of solids effectively displaced the hazard of this complex waste discharge from the pelagic biota to the benthic biota. The highly regarded single species bioassay test may have provided an inaccurate assessment in this case study. Site specific single species toxicity tests were executed with water fleas and fathead minnows. Laboratory multispecies tests combining the burrowing mayfly, isopod, and water flea were performed to assess the potential toxicity of solid and liquid wastes. Physical and chemical data were collected onsite while the limestone scrubber system was in operation. The coal combustion waste has low BOD values. The effluent had increased levels compared to river water of cadmium, copper, arsenic and selenium during metal uptake tests with fathead minnow. Uptake and clearance of metals by fathead minnows indicated that most metals di not accumulate in fish tissue after 30 days of exp sure to levels significantly higher than backgrou values in effluent or river water. Zinc concentrate in tissues by a factor of about 8 in effluent, and di not undergo clearance of accumulated zinc whe subsequently exposed to river water for up to 5 days. Site specific 28 day water flea reproducti tests in effluent dilutions revealed that effluer concentrations alter the day of first brood an reduce the number of broods per female. Inform tion concerning mortality and emergence of bu rowing mayfly nymphs and botton dwelling iso pods following a 6 day laboratory exposure in plied increased mortality.
W85-05274

BIODEGRADATION OF SULFOLANE IN RE FINERY WASTEWATER,
Shell Development Co., Houston, TX.
C. C. Chou, and R. A. Swatloski.
In: Proceedings, 37th Industrial Waste Conferenc West Lafayette, IN, May 11-13, 1982. Purdu Univ., 1983. p 559-566. 4 Fig, 7 Tab, 2 Ref.

Descriptors: *Oil refineries, *Activated sludg process, *Sulfur compounds, *Industrial waste Biodegration, Chemical industry, Hydrogen io concentration, Sludge, Sulfolane.

Sulfolane (thiocyclopentane-1,1-dioxide) is an im portant process chemical for the petroleum an chemical industries. The biodegradability of sulfo lane in 2 bench scale suspended growth system was assessed. The bench CMAS system was em ployed to simulate wastewater treatment oper ations. The pH was maintained at 7.0 plus or minu 0.2 with pH controller, and sodium hydroxide wa used to neutralize the acid generated from sulfo lane oxidation. Sulfolane did not affect the OUR o the nonacclimated activated sludge; it did enhanc the uptake rate after a short term acclimation. Th OUR doubled in the presence of only 1-2 mg/ sulfolane; however, the rate was not higher with 2 40 mg/l. During some batch degradation an oxygen uptake tests, it was observed that there wa a significant decrease of pH accompanying sulfo lane disappearance. Since the acclimated cultur showed a substantial increase in OUR with n butanol or butyric acid, it is conceivable that sulfo lane may be converted to a 4-carbon intermediat and sulfate (or sulfite) after initial ring cleavage The sludge volume index (SVI) ranged from 70 t 117 ml/g TSS. The interfacial settling velocity (ISV) increased from an initial 9.0 ft/hr withou sulfolane, to 16-20 ft/hr after sulfolane addition For nonacclimated activated sludge sulfolane shock loading had no effect on its settleability. Th addition of sulfolane (up to 80 mg/l) to refinery wastewater does not affect the general perform ance of the treatment processes studied.
W85-05275

IMPROVING EFFLUENT QUALITY OF PE TROCHEMICAL WASTEWATERS WITH MUTANT BACTERIAL CULTURES,
Sybron Corp., Birmingham, NJ.
J. A. Christiansen, and P. W. Spraker.
In: Proceedings, 37th Industrial Waste Conference West Lafayette, IN, May 11-13, 1982 Purdue Univ., 1983. p 567-576. 11 Fig, 6 Tab, 9 Ref

Descriptors: *Wastewater treatment, *Industria wastes, *Oil refineries, Effluents, Sludge, Biologi cal treatment, Activated sludge process, Nitrifica tion, Organic carbon.

The petroleum industry has made significant ex penditures in equipment, chemicals and operating expertise to produce high quality effluents. Bichem mutant bacteria are developed through simple in situ genetic engineering. Nitrification is often re quired due to stream standards. Toxicity to nitri fiers occurred under several circumstances. Case studies of 4 refineries are presented. One refinery experienced periodic problems with its sour water stripper. Bichem 1008SF was added to the aeration lagoon. At the same time, Bichem 1010N culture containing organisms that oxidize ammonia to ni trite and nitrate, was added to the activated sludge

tem. Another refinery system used a 2 stage ivated sludge system. Problems arose when a s of MLSS occurred in the second stage at the ne time as high oil and grease rendered first ge mixed liquor ineffective in reducing TOC. A eeding of Bichem 1003FG, in combination with hem 1004TX, combined with complete elimina- n of sludge wasting during the recovery process ulted in a decrease in MLSS oil. A refinery ated in the East, experiencing problems because the cold, seeded the activated sludge system h Bichem 1004TX and 1008SF to dissipate the ite frothy foam. Another refinery in the East, h problems because of the cold, added Sybron tant bacterial cultures for 14 days and showed a rked decreased in effluent suspended solids and increase in the number of stalked ciliates. A uston area refinery has an activated sludge atment process with 10-hr detention time. Com- te nitrification was achieved in the fifth week of trial, after a bioaugmentation program was gun.
85-05276

OMPARISON OF ACTIVATED SLUDGE RE- ONSE TO QUANTITATIVE, HYDRAULIC ND COMBINED SHOCK FOR THE SAME CREASES IN MASS LOADING,
elaware Univ., Newark. Dept. of Civil Engineer- g.
S. Manickan, and A. F. Gaudy, Jr.
Proceedings, 37th Industrial Waste Conference, est Lafayette, IN, May 11-13, 1982. Purdue iv., 1983. p 601-618. 11 Fig, 4 Tab, 30 Ref.

escriptors: *Physicochemical treatment, *Acti- ted sludge, Shock loads, Effluents, Chemical ygen demand, Clarifiers, Suspended solids, Ki- tics.

ock loads of different types, hydraulic, quantita- e, or combinations thereof, did not produce uivalent disruptions of effluent quality for equal creases in mass organic loading rate. Based on luent concentrations, a purely hydraulic and a draulic-quantitative shock at the same mass ading resulted in equal increases in total effluent OD, but the increase was due primarily to sus- nded solids in the hydraulic shock and to soluble OD in the combined shock. Predictive kinetic uations based on mass balance for the reactor do t adequately predict the disruption in either lids concentration or soluble substrate. The clari- r can function as a bioreactor when it receives etabolizable soluble substrate during a transient hich disrupts substrate removal in the aerator. It ay not be possible to develop kinetic equations hich incorporate all the variables that affect the sponse of a heterogeneous biomass to a severe ock load. The most logical approach to improve- ent of the present equations may lie in attempts predict the direction and magnitude of changes the biological constants brought about by vari- us types of shock loads.
785-05278

REDICTIVE MODEL FOR TREATMENT OF HENOLIC WASTES BY ACTIVATED LUDGE,
elaware Univ., Newark. Dept. of Civil Engineer- g.
. Rozich, A. F. Gaudy, Jr., and P. D'Adamo.
n: Proceedings, 37th Industrial Waste Conference, Vest Lafayette, IN, May 11-13, 1982. Purdue niv., 1983. p 619-639. 8 Fig, 9 Tab, 25 Ref.

Descriptors: *Industrial wastes, *Phenols, Activat- d sludge, Kinetic model, Biomass, Chemical xygen demand, Waste treatment.

A kinetic model for activated sludge treating inhib- ory wastes has been devised and tested experi- ientally using phenol as inhibitory carbon source. The model employs the Haldane equation as the unctional relationship between specific growth ate, mu, and exogenous substrate concentration, S, nd utilizes control of recycle sludge concentra- on, XR, as a major selectable engineering control arameter of net specific growth rate. Predictions f process performance were made utilizing the odel equations and the 5 biokinetic constants determined from the pilot plant data and from separate batch growth experiments. The model adequately predicted reactor biomass concentration, waste sludge production and effluent COD concentrations. However, the model predicted specific phenol concentrations in the reactor effluent significantly higher than the observed experimental values. Since several researchers have stated that predictive equations for the treatment of phenol can be based on the hyperbolic, Monod function for noninhibitory wastes, prediction of S, Se and Xw were made using model equations employing the Monod equation as well as those incorporating the Haldane equation. For the range of net growth rates, the two types of equations predicted essentially the same results. The use of a Monod function in the mass balance equations gives both the design engineer and the operator distorted view of the true operating range of the system and does not alter one to the existence of a critical operating point for an activated sludge process treating inhibitory carbon sources.
W85-05279

PREDICTING TREATABILITY OF MULTIPLE ORGANIC PRIORITY POLLUTANT WASTEWATERS FROM SINGLE-POLLUTANT TREATABILITY STUDIES,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
D. F. Kincannon, A. Weinert, R. Padorr, and E. L. Stover.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 641-650. 6 Tab, 11 Ref.

Descriptors: *Organic wastes, *Prediction, *Kinetics, Biodegradation, Phenols, Nitrogen compounds, Halogenated hydrocarbons, Hydrocarbons, Waste treatment.

The possibility of predicting biokinetic constants for system containing several priority pollutants by using data obtained from systems containing a single priority pollutant is examined. Averaging of biokinetic constants was not satisfactory. A weighted average based on the relative concentrations of priority pollutants was not satisfactory in predicting the biokinetic constants in the combined systems. It appears that the biokinetic constants are the result of many factors and a better understanding of these factors must be developed before adequate prediction of biokinetic constants can be made. It can be predicted that nitrogen compounds, phenols, oxygenated compounds, polynuclear aromatics and phthalates will be removed by biological degradation. Aromatics will be removed by both biological degradation and stripping. Halogenated hydrocarbons present a special problem. Some are removed by stripping; others are removed by combined biodegradation and stripping. Biodegradability and stripping constants could be developed for each priority pollutant and used very successfully in predicting the effluent concentrations for the pollutants when combined with other priority pollutants or when the influent concentrations varied. It is possible to develop structure/activity correlations for predicting the fate of priority pollutants.
W85-05280

APPLICATION OF ANAEROBIC PACKED-BED REACTORS TO INDUSTRIAL WASTEWATER TREATMENT,
Newcastle upon Tyne Univ. (England).
G. K. Anderson, T. Donnelly, and K. J. McKeown.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 651-660. 2 Fig, 6 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Organic wastes, *Industrial wastewater, Anaerobic digestion, Methane, Packed beds, Food processing wastes, Ethanol, Molasses, Edible oils.

The treatment of organic wastewaters by anaerobic packed bed reactors offers advantages over other types of anaerobic treatment systems. The production of methane from wastewater is an obvious attraction since it can be shown that for every kg COD utilized about 0.35 cu m methane could be produced. Other aspects which are attractive to industrialists are: low sludge production; ability of biomass to lie dormant for several months and then be fully operational; capability of operation on a stop/start basis; no environmental nuisance; low nutrient requirement; high organic throughput; automatic biological overload control facility; measurable and identifiable intermediate products; and a technology similar to that which exists in the food and beverage industry. Developments by Biomass International have evolved a comparatively low cost but effective method of designing and operating an anaerobic packed bed reactor (APBR). Two units are now in operation. The units consist of an upflow, packed bed reactor using a specially developed medium. The basis of each system is that low grade heat wasted from the factory is used for maintaining the reactor temperature at 35 C while the methane produced during digestion is used by the industries concerned as a high grade source of energy. The units treat: wastewater from a confectionery factory; wastewater from a molasses distillery ethanol plant; and wastewater from edible oil production.
W85-05281

MEMBRANE-ENHANCED ANAEROBIC DIGESTERS,
Abcor, Inc., Wilmington, MA.
W. T. Choate, D. Houldsworth, and G. A. Butler.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 661-666. 5 Fig.

Descriptors: *Membrane processes, *Food processing wastes, *Wastewater treatment, *Industrial wastewater, *Anaerobic digestion, Organic wastes, Retention time, Biomass, Chemical oxygen demand, Flour, Wheat.

Anaerobic processing is a simple and energy efficient means of treating and stabilizing many high strength organic wastes. The variable most significant in controlling anaerobic process performance and stability is the solids retention time (SRT). Most of the anaerobic process design improvements have concerned themselves with retaining suspended biomass and organic solids to increase the SRT relative to hydraulic retention time (HRT). The operation of a commercial anaerobic reactor that was retrofitted with ultrafiltration for solids and dissolved solids retention and expands on the potential use of membranes in the anaerobic field is presented. The Tenstar Products Ltd. factory processes 400-450 ton/week of wheat flour. The wastewater stream has a pH of 3.2-3.4 and 1.4% total solids, of which only 0.2% is suspended. The waste stream's COD averages 17,000 mg/l. A commercial scale tubular ultrafiltration plant was designed to operate on the effluent of one compartment within the main tank. This ultrafiltration plant was designed to increase the SRT while the HRT would remain at 4.5 days. The gas production from this plant is approximately 1000 cu m/day, approximately half of which is methane. A seasonal effect appears in the digester/ultrafilter system when the oil level in the flour feedstock for the factory increases. Normal cleaning of the ultrafiltration plant is by means of caustic soda and hypochlorite and has been performed on the average of once per month. Ultrafiltration has improved Temstar's existing digester operation.
W85-05282

DORR-OLIVER'S FIXED-FILM, SUSPENDED-GROWTH ANAEROBIC SYSTEMS FOR INDUSTRIAL WASTEWATER TREATMENT AND ENERGY RECOVERY,
Dorr-Oliver, Inc., Stamford, CT.
P. M. Sutton, A. Li, R. R. Evans, and S. R. Korchin.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 667-675. 5 Fig, 3 Tab, 10 Ref.

Descriptors: *Food processing wastes, *Dairy industry, *Wastewater treatment, *Industrial wastewater, Anaerobic digestion, Chemical oxygen demand, Retention time, Biological oxygen

demand, Hydrogen ion concentration, Grain processing.

Dorr-Oliver's fixed-film and suspended-growth anaerobic systems are discussed and a report on pilot-plant and full-scale application of the systems of treatment of wastewater from the grain process and dairy industries is presented. The Anitron system configuration is an adaptation of the fixed-film biological reactor. The characteristics of an anaerobic process favor application of fixed-film reactors, and particularly the Anitron system, over most suspended growth alternatives in the treatment of soluble high-strength (COD approximately 3000-15,000 mg/l) organic wastewaters. The slow growth rate of the methane bacteria necessitates maintenance of reactor solids retention (SRT) generally in excess of 10-15 days. Dorr-Oliver's patented Membrane Anaerobic Reactor System is an adaptation of the suspended-growth anaerobic process in which ultrafiltration is employed as the solid-liquid separation step. A soy processing company, in cooperation with Dorr-Oliver, conducted an Anitron system pilot-plant study involving operation of a single-stage fluidized bed reactor. The full scale plant consists of four 6.1-m (20-ft) diameter by 12.5 m (41-ft) high reactors with a design capability of removing 8165 kg BOD/day (19,000 lb/day). The pH of the reactors is controlled between 6.8 and 7.2 by use of a chemical feed system for automatic pH monitoring and caustic addition. The system is capable of reaching a volumetric loading rate of 16 kg COD/cu m-day in less than 1.5 months from initial startup. The system is capable of achieving in excess of 95% BOD removal and can be economically operated.
W85-05283

TREATMENT OF DYE AND PIGMENT PROCESSING WASTEWATER BY THE ACTIVATED SLUDGE PROCESS,
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
G. M. Shaul, M. W. Barnett, and K. A. Dostal.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 677-689. 5 Fig, 7 Tab, 18 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Dye industry Wastes, Pigments, Activated carbon, Retention time, Chemical oxygen demand, Activated sludge process, Gas chromatography.

In this ongoing treatability study, a dye and pigment processing wastewater was treated using powdered activated carbon (PAC) addition to both plug flow and complete mix pilot activated sludge systems which were operated at one solids retention time (SRT) (7-10 days) and 3 different PAC dosages. Addition of PAC to experimental units at a dosage greater than 1000 mg/l resulted in complete color removal, COD removals of approximately 96%, acute toxicity reduction, enhanced sludge settleability and increased system stability in both complete mix and plug flow units. Only slight differences in organics and color removal were observed between the PAC doses of 1000 and 1800 mg/l. It was also observed that PAC addition was not able to reduce influent TOC to less than approximately 80 mg/l SOC in the effluent. The complexity of the wastewater and the characteristics of PAC/activated sludge process (ASP) systems resulted in significant operational and analytical problems. High total suspended solids in the reactor created problems with obtaining representative samples and in analysis of these samples. The execution of the methods requires a more concentrated effort to provide meaningful data. No single gas chromatography methodology exists for such diverse wastewater.
W85-05284

OPTIMIZATION OF SECONDARY COOLING WATER FILTRATION IN A CONTINUOUS STAINLESS STEEL CASTING PROCESS,
Pennsylvania State Univ., University Park.
S. D. Roser, D. A. Long, and J. A. Vaughn.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 691-707. 22 Fig, 2 Tab, 4 Ref.

Descriptors: *Steel industry, *Wastewater treatment, *Industrial wastewater, Cooling water, Filtration, Effluents, Filtration, Suspended solids, Steel, Stainless steel, Casting.

Carpenter Technology Corporation of Reading, PA, operates a stainless steel continuous casting machine. The continuous casting of steel is a metallurgical process in which molten steel is converted into semifinished shapes which then are reheated and converted by reduction mills into finished products. A pilot plant unit was installed to determine an optimum combination of hydraulic loading rate and media. The control pilot sand filter exhibited equal or better effluent quality compared to that from the full scale filters. The dual medium pilot filter produced an effluent quality inferior to that of the single medium pilot filter at all hydraulic loading rates where turbidity was used as a measure of effluent quality. If minimum effluent turbidity is desired, there is no advantages in using dual medium filters over the existing single medium sand filters for this particular application. If the effluent quality obtained from both filters during the study would meet process requirements, then dual medium filtration would offer the advantage of longer filter runs. The percentage of influent turbidity removed by the single medium sand filters increased as the influent turbidity increased. The pilot unit produced similar quality effluent in terms of suspended solids when loaded with both media I and II at all filtration rates investigated. The quality of effluent was statistically the same at filtration rates of 15 and 10 gpm/sq ft and th effluent quality was best at a filtration rate of 5 gpm/sq ft for medium I. The quality of effluent decreased with increasing filtration rate for medium II.
W85-05285

OPTIMIZATION AND CONTROL OF THE ACTIVATED SLUDGE TREATMENT PROCESS BY QUASICONTINUOUS OPERATION: CONCEPT, STRATEGY AND RESULTS,
Karlsruhe Univ. (Germany, F.R.).
R. Staud, P. A. Wilderer, and L. Hartmann.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., MA, 1983. p 709-718. 15 Fig, 1 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, Aeration, Biological oxygen demand, Pollumat method.

To achieve a decrease of the amplitude of the diurnal and weekly oscillations of the food-to-microorganism (F:M) ratio, it is suggested that the number of aeration tanks to be kept in service be varied. Tanks which are actually not needed, and which, therefore, are brought out of service for an intermediate period of time are kept under anoxic conditions, thereby conserving the metabolic capacity of the biocommunity, and saving energy. The accomplishment of this treatment method calls for an appropriate analytical method to monitor the influent substrate concentration, i.e., the concentration of organic material which actually is converted by the activated sludge microbes present. The plateau-BOD is suggested as a reasonable parameter. A technique is described (Pollumat method) which was developed to measure the plateau-BOD within a time period of less than 60 minutes. This method needs still operator assistance, however. To lessen the dependence on actual analysis an empirically determined standard graph was developed based on the typical progress of the plateau-BOD values during a week. This standard graph proved to be applicable. Full-scale experiments were conducted at the Schwetzingen wastewater treatment plant to check the feasibility of the methods. The treatment process was controlled without any major problem. The energy demand for aeration was decreased to about 50%; the process efficiency was hardly changed; sludge bulking problems were decreased. Based on a comparison of this method with the sequencing batch reactor technology advantages.
W85-05286

ANAEROBIC TREATMENT OF THERMAL SLUDGE CONDITIONING LIQUOR WITH FIXED-FILM AND SUSPENDED-GROWT PROCESSES,
Environmental Protection Service, Burlingt (Ontario). Waste Water Technology Centre.
E. R. Hall, and M. Jovanovic.
In: Proceedings, 37th Industrial Waste Conferen West Lafayette, IN, May 11-13, 1982. Purd Univ., 1983. p 719-728. 10 Fig, 5 Tab, 14 R

Descriptors: *Wastewater treatment, *Anaero digestion, *Sludge, Methane, Chemical oxyg demand, Effluents, Biomass.

Pilot-scale high-rate anaerobic methane react demonstrated 50-76% COD removal at volumet organic loadings of up to 33 kg COD/ cu m-d during the treatment of thermal sludge conditi ing supernatant. Although the shortest start times and highest volumetric removal rates w achieved with fixed-film processes, the maxim removal rates observed in 2 of the reactors w reduced significantly by the low voidage supp media used. In addition, the high liquid recy rates required to maintain expansion in the flu ized bed resulted in lowered biomass accumulat and reduced COD removal efficiencies. The slud blanket system seeded with digester sludge was successful in treating thermal conditioning liq at loadings comparable to the fixed-film reacto The poor settling characteristics of the UASB b mass produced with this waste contributed to quent solids loss in the reactor effluent. Efflu and biogas quality were influenced by the mode operation, the operational maturity of the anae bic system, and to a lesser extent by the reac configuration.
W85-05287

RESPONSE OF METHANE FERMENTATI TO CONTINUOUS ADDITION OF SELECT INDUSTRIAL TOXICANTS,
Drexel Univ., Philadelphia, PA.
G. F. Parkin, and S. W. Miller.
In: Proceedings, 37th Industrial Waste Conferen West Lafayette, IN, May 11-13, 1982. p 729-74 Fig, 6 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Fermen tion, *Methane, *Retention time, Ammo Copper, Nickel, Chloroform, Acclimation, Ind trial wastes.

The magnitude of the effect of solids retention ti (SRT) on response patterns is dependent on t cant type, concentration, and temperature. T effect appears to be a complex interaction of age, biomass concentration, and toxicant conc tration. In general, the longer SRT (25 and days, compared with 15 days) gave the least sev responses. The preferred temperature for toleran toxicant exposure varies with the nature of inhibitor; the temperature most often resulting the least severe responses was 35 C. Signific acclimation to ammonia-nitrogen, copper, nick chloroform, formaldehyde and hydrazine was p sible through continuous addition of these mat als. The magnitude of the lethal dose was a fu tion of SRT, temperature, and initial toxicant c centration. For experimental conditions test conditions yielding the best potential for acclim tion were 25 or 35 C and 50-day SRT for amm nia-nitrogen, 25 C 50-day SRT of 35 D and 25- or 50-day SRT for copper, 25 C and 50-day SR or 35 C and 25 day SRT for nickel, 25-day SRT 25 or 35 C for chloroform, 35 C and 50-day SR for formaldehyde, and 35 C and 25-day SRT hydrazine.
W85-05288

IRON OXIDATION IN INDUSTRIAL WAS STREAMS,
Duncan, Lagnese and Associates, Inc., Pittsbur PA.
W. R. Kelly, and M. Olthof.
In: Proceedings, 37th Industrial Waste Conferen West Lafayette, IN, May 11-13, 1982 Pur Univ., 1983. p 745-751. 8 Fig, 2 Tab, 7 Ref.

scriptors: *Wastewater treatment, *Industrial stewater, *Oxygen transfer, *Iron, Hydrogen concentration, Oxidation.

e oxidation rate of iron for industrial stewaters is, in most cases, only of academic erest. For practical purposes the rate limiting p is the oxygen transfer when the pH is con-lled at levels above 8.0. The reaction rate for n oxidation is only of importance in natural ters where the iron concentration is relatively v. The use of sodium carbonate as a neutraliza-n agent can have an adverse effect on the rate of n oxidation when compared with hydroxide utralization agents. It is recommended to verify t the reaction from ferrous to ferric iron is not versely affected by some interferences present in e wastewater. Therefore, on each waste stream ygen uptake rates should be performed. Howev-in most cases the effect will likely be minimal as as sizing the aeration basin is concerned. The ximum iron oxidation rate that can be obtained rough aeration in a tank is about 100 mg/l-min sed on the limits of oxygen transfer equipment. 85-05289

HERMOPHILIC TREATMENT OF A HIGH-OCHEMICAL OXYGEN DEMAND ASTEWATER: LABORATORY, PILOT-LANT AND DESIGN,
aho Univ., Moscow. Dept. of Chemical Engi-ering.
. L. Jackson.
: Proceedings, 37th Industrial Waste Conference, est Lafayette, IN, May 11-13, 1982. Purdue niv., 1983. p 753-763. 7 Fig, 14 Ref.

escriptors: *Pulp and paper industry, Vastewater treatment, Biochemical oxygen mand, Thermophilic bacteria, Suspended solids, ffluents, Fermentation.

n industrial plant employing corrugated boxes in recycle operation to produce a liner for reuse oduces an effluent at elevated temperatures and latively high BOD concentrations. The existence colloidal materials in the original wastewater d laboratory effluent led to the operation of a nall pilot unit to assess flocculation and solids paration behavior. An extensive laboratory study as conducted in a 10-liter fermenter at 53 C ithout solids recycle for which the cell residence ne (CRT) is equal to the hydraulic residence time IRT). The wastewater was received at intervals ver a period of a year and varied in composition om 2130 to 2300 mg/l of BOD for 7 barrels with gher values for 2 others. The high concentrations suspended solids at long CRT showed a consist-nt performance. A study was conducted employ-g direct input of wastewater from the discharge ne of the box recycle plant. The purpose was to imulate operation with recycle of cell solids and ith input of fiber solids, and to evaluate solids occulation and separation by flotation. The pilot nit consisted of a 200-gal stainless steel reactor ith a settling clarifier for returning some of the ell solids. The BOD removal percentages approx-nate those for the laboratory study. For medium ell residence times at least 85-90% BOD reduc-ons can be expected. The flotation and settling sts indicated that good solids separation by flota-on is attainable even at fairly substantial suspend-d solids concentration.
V85-05290

IR STRIPPING OF TRACE VOLATILE OR-GANICS FROM WASTEWATER,
Camp, Dresser and McKee, Inc., Boston, MA.
. Pekin, and A. Moore.
n: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Jniv., 1983. p 765-771. 3 Fig, 4 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Organic vastes, Air stripping, Methylene chloride, (1,1,1)-Trichloroethane, Trichloroethane, (1,2)-Dichloro-propane.

Data from pilot plant studies that were completed o demonstrate the effectiveness of using air strip-ping for removal of certain trace volatile organics are presented. The efficiency of air stripping of organics can be predicted once the Henry's law constant (H) and the air-to-water ratio in the stripping process are known. One factor that influences the design of an air stripping system is the rate of transfer of the volatile organics from the water to air. Henry's law only describes the equilibrium distribution of a volatile organic between the liquid and the gas phase, not the length of time it will take to reach this distribution. The pilot plant was constructed so that it can be operated either as a diffused air or packed tower system. Removal efficiencies predicted by Henry's law constants and air-to-water flow ratios for the parameters of interest were verified in general by the pilot air stripping experiments. However, theoretial efficiencies should be used only as an indication of potential process feasibility, because there is not sufficient field data to establish a mathematical relationship between the theoretical and actual removals. Feasibility of air stripping was verified for the purposes of the project.
W85-05291

VARIABILITY ANALYSIS DURING BIOLOGICAL TREATABILITY OF COMPLEX INDUSTRIAL WASTEWATER FOR DESIGN,
Oklahoma State Univ., Stillwater.
E. L. Stover, D. E. McCartney, F. Dehkordi, and D. F. Kincannon.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 773-783. 7 Fig, 4 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Activated sludge process, Variability, Gas chromatography, Kinetics, Retention time.

Bench-scale, continuous-flow, complete-mix activated sludge reactors were used to treat a synthetic wastewater containing chemicals normally present in chemical, plastics, petrochemical and petroleum industry wastewaters. The influent wastewaster flowrates were regulated to provide hydraulic retention times of 8 hours in the activated sludge reactors. The influent air and offgas were measured and controlled with air flow meters. The offgas was pulled by vacuum pumps through purge traps containing 6 inches of Tenax and 4 inches of silica gel for gas chromatograph analysis. A minimum of 3 individual activated sludge systems were acclimated to each synthetic wastewater. The variability analysis approach presented indicated that Kd was a true biokinetic constant, mu(max) was also treated as a true biokinetic constant, and since mu(max) equals K times Yt, and Yt was found to be a variable biokinetic coefficient, mu (max) and K could not both be treated as constants. If Yt equals mu (max)/K varies, mu (max), K, or both must vary. If both mu (max) and K vary, the prediction of these coefficients becomes more difficult. The decision to make mu (max) a biokinetic constant and K a variable biokinetic coefficient depending on the variable biokinetic coefficient Yt simplifies the prediction of mu (max) and K.
W85-05292

DESIGN-ORIENTED REVERSE OSMOSIS MODEL,
Toledo Univ., OH.
J. F. Metzger, and D. Angelbeck.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 785-794. 2 Tab, 9 Ref.

Descriptors: *Reverse osmosis, *Design standards, Industrial wastewater, Model, Membrane processes, Fluctuations.

A model describing the reverse osmosis process is presented and tested against reverse osmosis data contained in the literature. The mass flux of a chemical species across a given surface area of membrane may be attributed, as in Fick's law, to a permeability coefficient of that species and a concentration gradient. Likewise, water or solvent flux through the membrane may be related to a pressure gradient across the membrane and a water permeation coefficient. If the solute flux is divided by the solvent flux, a dimensionless mass ratio of the solute to solvent leaving the membrane surface is obtained at any increment of time. To evaluate the model's ability to predict the performance of actual reverse osmosis systems, certain data for presently operating systems was input into the model. The model's output was then compared with the corresponding measured conditions of the operating system being considered. A comparison of the predicted and observed pressure values show that, with some exception, a maximum and minimum pressure discrepancy of plus or minus 10% generally exists with respect to observed operational pressures. These discrepancies should be acceptable for most design purposes, especially for conceptual designs where discrepancies approaching 50% are not uncommon. An industrial waste is a candidate for treatment by reverse osmosis with a membrane of unknown properties.
W85-05293

REMOVAL PATHWAYS AND FATE OF ORGANIC PRIORITY POLLUTANTS IN TREATMENT SYSTEMS: CHEMICAL CONSIDERATIONS,
Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards.
M. P. Strier, and J. E. Gallup.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 813-823. 5 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Activated sludge process, *Organic wastes, Adsorption, Chemical reactions, Air stripping, Biochemical oxidation, Polychlorinated biphenyls, Chlorinated hydrocarbons, Phenols, Biodegradation, Phthalate esters.

The physical and chemical properties of organic pollutants coupled with the chemical nature of their water matrix govern their behavior and fate during treatment of primary effluent by activated sludge. There are basically 4 removal pathways possible during activated sludge treatment with only one most likely predominating for any one pollutant at any one point in time. These removal pathways consist of adsorption, air-stripping, biochemical oxidation and chemical reaction. Adsorption and air-stripping are nondestructive; biochemical oxidation and chemical reaction are destructive. Generally, larger, unreactive, polarizable and insoluble molecules are the most adsorptive, i.e., PCB, PNA (PAH) and phthalate esters. Smaller, volatile and less soluble molecules are most air-strippable, i.e., halogenated methane (fluorinated or chlorinated). Reactive aromatics of intermediate solubility, provided they possess no more than one substituted chloro- or nitro-group (applies strictly to priority pollutants) are highly biodegraded. Phenol is a good example. Certain compounds are so highly chemically reactive that they will chemically degrade or transform instantaneously prior to biodegradation. Certain substituted phenolics are examples. Adsorptive and chemical reaction pathways appear to be the most rapidly occurring and dominating processes, when conditions are most favorable for them. Air-stripping is next and finally biochemical oxidation is the slowest and least dominating of the four removal pathways. Compound solubility in water is a governing factor in establishing its removal pathway from water.
W85-05294

TREATMENT OF CORK-STOPPER MANUFACTURING WASTES,
Newcastle upon Tyne Univ. (England). Public Health Engineering Div.
G. K. Anderson, C. Y. Cheng, and A. C. Pinto.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 825-831. 2 Fig, 2 Tab, 2 Ref.

Descriptors: *Cork industry, *Wastewater treatment, *Industrial wastes, Effluents, Sludge, Acids, Dyes, Aeration, Biological treatment, Cork stoppers.

A comprehensive but preliminary investigation into the treatment and disposal of wastewaters from the cork-stopper production industry is presented. Due to the nature of the manufacturing

operations, a large proportion of the wastewater consists of the discharge of spent processing fluids which will normally be only once per week. Two schemes have been suggested and are being considered for further investigation at a pilot scale. In both schemes, boiling tank effluent, oxalic acid and dyeing solution, and chlorinated lime slurry would go to their own equalization tank. In one scheme, nutrients would be added to the boiling tank effluent for biological treatment, to sludge or batch coagulation, to sludge or flow equalization, through pH adjustment, and then to the rivers. Oxalic acid and dyeing solution and chlorinated lime slurry would go from their own equalization tanks to the neutralization and then to either biological treatment or batch coagulation and then, ultimately, to the river. In the other scheme, the boiling tank effluent would go from the equalization tank to the batch coagulation and then to either sludge or supernatant storage, batch neutralization, and either sludge or sewer. Oxalic acid and dyeing solution and chlorinated lime slurry would go directly to batch coagulation and then to either sludge or sewer. A pilot scale biodisc has been constructed and installed on site and is being used to confirm laboratory data and to derive full scale design data. The extended aeration unit pilot plant is being designed and constructed to operate alongside the biodisc. A technician training scheme is being developed to improve wastewater technology in Portugal.
W85-05295

TREATMENT OF SPENT DETERGENT SOLUTION CONTAINING MONOETHANOLAMINE,
Western Electric Co., Inc., New York.
E. T.-Y. Lee, and T. A. Hunter.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 833-839. 1 Fig, 5 Ref.

Descriptors: *Wastewater treatment, *Detergents, *Activated sludge process, Aeration, Waste disposal.

Discharge of aqueous detergent cleaning waste containing about 40 lb MEA/day into an activated sludge extended aeration sewage plant treating 200,000 gal/day caused significant plant upsets and the discharge had to be discontinued. Detergent waste containing MEA interferes with conventional metal hydroxide precipitation process by forming soluble metal complexes. Treating MEA waste with hypochlorite in the presence of soluble calcium is feasible. This is verified by a nearly complete reduction of the waste's complexing ability after hypochlorite treatment. More analytical work is needed before and after the hypochlorite treatment to verify the completeness of the reactions and to determine the final products and their oxygen demand and toxicity. While the use of aqueous detergent cleaners and other water soluble solutions in manufacturing processes provide certain advantages over the replaced solvent operations, the availability of their disposal alternatives and associated costs, whether it is a discharge into a municipal sewer system or an onsite treatment approach, should be investigated before switching from solvent to aqueous type operation. For industrial users who have to discharge directly into waterway, the disposal alternatives are further limited. Due to the wide variety of organic chemicals used in aqueous solutions, a chemical/physical treatment process may prove to be very complex and costly.
W85-05296

COMPUTER CONTROL OF A SMALL WASTEWATER TREATMENT PLANT,
Loftus (Peter F.) Corp., Chicago, IL.
R. Seksaria, D. B. Corkle, and R. E. Schwab.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 841-846. 4 Ref.

Descriptors: *Wastewater treatment, Oily water, Computers, Chromates, Cooling towers, Boiler water.

Computers provide exceptional controller versatility, replace conventional control room instrumentation and reduce operating costs through process optimization. How the computer was applied as a useful tool for operating 2 treatment systems is demonstrated and additional feature that a computer can provide are discussed. All oily wastewater from the manufacturing processes except for coolants is collected and pumped to the waste treatment facility. Free oil is skimmed from the plate separator and concentrated. Chromate containing wastewater from the cooling towers and heating plant waste containing boiler blowdown and softener regenerant flow through an equalization tank into a compartmentalized treatment tank where sulfuric acid, ferrous sulfate and caustic soda are added in succession. Because the treatment processes are fairly complex, requiring monitoring and controlling of many process variables, conventional control systems would have required approximately 65 current switches, 40 indicators, 75 alarms, 12 recorders, 20 controllers, 2 totalizers, 3 alternators and 15 relays for monitoring the process alone. A single computer replaced all of this conventional instrumentation. The computer also operates and monitors the status of approximately 40 pumps, 25 equipment drives, and 30 automatic valves, and performs other specialized functions. In the oily wastewater treatment system, the computer calculates the running times for the various chemical feed pumps depending on the chemical dosage rate and volume to be treated and operates them in sequence for the required amount of time.
W85-05297

ENHANCED BIOLOGICAL TREATMENT OF LEACHATES FROM INDUSTRIAL LANDFILLS,
Notre Dame Univ., IN.
R. L. Irvine, S. A. Sojka, and J. F. Colaruotolo.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 861-870. 4 fig, 9 Tab, 3 Ref.

Descriptors: *Leachates, *Landfills, Industrial wastewater, Biological treatment, Effluents, Cost analysis, Activated carbon, Organic carbon.

The technical steps take by Occidental Chemical Corporation to treat the leachate collected at the Hyde Park Landfill site are presented. The site consists of a tile leachate collection system, an improved clay cap and treatment of leachate by activated carbon. The present treatment of Hyde Park leachate by conventional carbon technology, although producing a suitable quality effluent, is unacceptable from an economic and technical reason. Two sets of biological studies were conducted. The first set operated for approximately 50 days. Two reactors were maintained with both reactors receiving nonsterile raw waste feed (NSRWF) but with one reactor having Hooker organism HCV (2,6 DCT), referred to as SS3, added on every fifth day. SS3 and similar organisms may be of value in future treatment operations, but will require additional research before benefits can be expected from their use. The major conclusion that can be drawn from this study is that Hyde Park leachate is easily treated biologically in a sequencing batch reactor (SBR). Because of the turbid nature of the effluent, any full scale application of the SBR should include a filter or some other similar solids separation device. Further TOC removal from the filtered SBR effluent can be accomplished readily in the existing (or expanded) activated carbon facilities if future effluent limitations demand more extensive treatment. The use of biological waste treatment in the SBR is expected to result in a substantial savings in cost.
W85-05299

LAND TREATMENT OF MUNICIPAL WASTEWATER: SELECTED EXAMPLES IN THE UNITED STATES,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
F. M. D'Itri, H. Bouwer, Y. A. Demirjian, T. P. Smith, and W. G. Leseman.
In: Symposium on the Treatment and Reuse of Industrial and Municipal Wastewater, March 24, 1982, Mexico City (Mexico). 34 p, 5 Fig, 12 Tab, 27 Ref.

Descriptors: *Spray irrigation, *Land disposa *Wastewater disposal, *Wastewater irrigatio *Wastewater renovation, *Wastewater manag ment, *Biological treatment, Recycling, Municip wastes, Wastewater treatment, Phosphorus, Nitr gen, Infiltration.

Four wastewater land disposal programs in t United States that have been successfully operati for several years in the disposal of municip wastewater are described. The Flushing Meadov project of Phoenix, Arizonia examined the renov tion of wastewater by groundwater recharg through rapid infiltration basins in the Salt Riv bed 2.4 km downstream from the 91st Aven Sewage Treatment project. The project ran fro 1967 to 1978. The renovated wastewater contain acceptable levels of N, P, BOD, and heavy meta and showed effective removal of fecal coliform and viruses. The 23rd Avenue project initiated 1974 in the City of Phoenix in response to th favorable results of the Flushing Meadows proje tested the effects of increased levels of algae in th sewage effluent and increased hydraulic loading o the infiltration system. The project covered larger infiltration area and produced enough re ovated water for commercial reuse by an irrigatio district. The Tallahassee spray irrigation proje started in 1966 with the use of treated effluent fro the Tallahassee Southwest Wastewater Treatme Plant. In 1971, effluent overload from the La Bradford Plant was pumped to the Southwe plant for spray irrigation. Irrigated plots we seeded with Bermuda grass and rye grass to reduc N levels. The Mushegon County Wastewater Ma agement System No. 1 in Michigan is one of th few full scale spray irrigation land treatment faci ties in the United States. The wastewater is deli ered to sandy, unproductive land (4,455 ha) via s pumping stations. The combined wastewaters a treated biologically in three aerated lagoons.
W85-05324

CONCENTRATING WHEY BY HYPERFIL TRATION AT A SMALL CANADIAN CHEES PLANT.
Technology Development Report EPS 4-EP-83-
July 1983. 84 p, 44 Fig, 28 Tab, 12 Ref.

Descriptors: *Dairy industry, *Hyperfiltratio Wastewater treatment, Water pollution contro Pollution load, Whey, Cheese.

Whey from cheese making operations, if simpl discharged to the aquatic environment, exerts a extremely high pollution load. While large chees making plants have been able to incorporate var ous recovery, reuse, and treatment schemes, n cost effective method of handling whey has bee available to smaller operations. This report de scribes the application of a hyperfiltration syste for concentrating the solids in sweet whey at L Fromagerie d'Oka, Oka, Quebec, a cheese makin plant with a production of 4256 kg/d. Hyperfiltra tion offered the potential for recovery of a whe concentrate which could be used in the manufac ture of edible products, while also reducing th pollution load from the cheese plant. The results o a 592-day evaluation of the system showed tha whey could be concentrated from an initial 6.24% solids to 24.1% solids, with a high recovery o protein and minerals. At the same time, majo pollutant parameters in the raw whey were re duced by more than 95%. The payback period fo the hyperfiltration system was calculated at 1 months when savings in wastewater treatment an considered and the concentrated whey is give away free of charge. If the whey were to be sold the payback period would decrease proportionally with the amount of revenue recovered. The study recommends that hyperfiltration for whey concen tration be considered in any economic evaluation of pollution abatement/by-product recovery schemes for cheese making plants of similar size taking into account the site-specific characteristic of the operation.
W85-05331

OT SCALE INVESTIGATION OF COMPUT-ZED CONTROL OF THE ACTIVATED JDGE PROCESS,
ironmental Protection Service, Ottawa (Ontar-

. Stephenson, B. A. Monaghan, and L. Y. Yust.
ort SCAT-12, 1982. 118 p, 56 Fig, 28 Tab, 47

criptors: *Pilot plants, *Activated sludge proc-*Dissolved oxygen, Hydrogen ion concentra-, Suspended solids, *Organic carbon, *Sludge, ntact stabilization process, Temperature, Liquid v, Air flow, Modelling, Canada.

ilot plant evaluation of the feasibility of using ine instrumentation and an automated data ac-ition system to continuously monitor param-s within the activated sludge process is de-bed. Also investigated was the extent to which technologically and economically possible to an automated system to assist the plant opera-in controlling the activated sludge process. ruments selected for evaluation included sen-for dissolved oxygen, suspended solids, pH, perature, liquid flow, air flow, and total organ-carbon. Sensor precision and accuracy were ssed in comparison to standard reference tech-ues, and maintenance and calibration require-nts were determined. The pilot plant instrumen-on was interfaced with a minicomputer data uisition and control system which was provided h sufficient capacity and peripheral devices to mit activities such as modelling and data analy-

5-05333

GANIC CONTAMINANT BEHAVIOR RING RAPID INFILTRATION OF SEC-DARY WASTEWATER AT THE PHOENIX D AVENUE PROJECT,
nford Univ., CA. Dept. of Civil Engineering.
. Bouwer, M. Reinhard, and P. L. McCarty.
ricultural Research Service, Technical Report 264, March, 1982. 88 p, 8 Fig, 10 Tab, 39 Ref, ppend.

scriptors: *Wastewater treatment, Secondary stewater treatment, *Rapid infiltration, *Perco-on, *Chlorination, Wastewater, Secondary stewater, Infiltration, Aliphatic hydrocarbons, drocarbons, Benzenes, *Path of pollutants, Ari-a.

ganic trace contaminants were removed to vary-degrees during rapid infiltration of secondary ated wastewater for groundwater recharge at 23rd Avenue Rapid Infiltration Project in oenix, AZ. Samples of the wastewater applied the spreading basins and of renovated water en from monitoring wells were characterized specific organic pollutants using gas chroma-raphy/mass spectrometry. The study was divid-into two sampling periods of three months each. ring the first period, nonchlorinated secondary stewater was applied to the basins. During the ond period the system was operated with chlor-ted wastewater. Chlorination of the secondary stewater with 1.5 milligrams/l Cl had little ct on the organic compounds identified and ir concentrations in the secondary wastewater renovated water. Nonhalogenated aliphatic aromatic hydrocarbons and the priority pollut-s ethylbenzene, napthalene, phenanthrene, and thylphthalate were removed with high efficiecy ing soil percolation, but many of the com-nds could still be detected in the underlying undwater. Volatilization losses were important the low-molecular weight volatile compounds water moved across the basin. Biodegradation sorption processes appear to be responsible for decreased organic concentrations in the ren-ated water resulting from soil passage. Both obic and anaerobic processes were probably ive.
85-05335

OCESS DESIGN MANUAL FOR DEWATER-G MUNICIPAL WASTEWATER SLUDGES,
lp/Wesner/Culp, Santa Ana, CA.
C. Gumerman, and B. E. Burris.
Report EPA-625/1-82-014, October 1982. 207 p, 65 Fig, 41 Tab, 122 Ref, 3 Append.

Descriptors: *Sludge, *Municipal wastewater, *Dewatering, Cost analysis, Filters, Centrifugation, Vacuum filtration, Pressure filtration, Drying, Sludge lagoons.

A critical review of municipal wastewater sludge dewatering process technology is presented. Particular emphasis is given to the development of a procedure for the selection and design of a dewatering process. Included in the manual are discussions of sludge characteristics, dewatering processes, their performance capabilities and operational variables, chemical conditioning cost and energy considerations, and case study information. Dewatering processes discussed are basket centrifuge, low G and high G solid bowl centrifuges, belt filter presses, drying bed, sludge lagoon, and gravity/low pressure devices.
W85-05352

FIFTH ANNUAL MADISON CONFERENCE OF APPLIED RESEARCH AND PRACTICE ON MUNICIPAL AND INDUSTRIAL WASTE.
Wisconsin Univ.-Extension, Madison. Dept. of Engineering and Applied Science.
September 22-24, 1982. 651 p, 210 Fig, 121 Tab, 388 Ref. $25.00.

Descriptors: *Waste management, *Industrial wastes, *Municipal wastes, *Regulations, *Waste disposal, *Land disposal, *Waste recovery, *Solid waste disposal, *Symposiums, Wastewater management, Sanitary landfills, Landfills, Sludge disposal, Wastewater disposal, Water quality control, Recycling, Political aspects, Policy making, Solid wastes.

Promoting technology transfer and resolving the policy issues within the land disposal field remain challenges for professionals involved in municipal and industrial waste management. During the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, specialists in engineering, soils, geology, and related disciplines explored these challenges, reviewed the latest developments in land disposal, and provided insights on future directions. A future forum, eight technical sessions, and two field trips were features of the three-day conference. Four national figures addressed political concerns, regulatory controls, special problems facing solid waste managers, and land application programs for sludge. Technical sessions considered landfill design and operation, groundwater quality protection, management of municipal sludge, leachate, and chemical waste, and land application of industrial wastes. Tours included the Madison Municipal Sludge District Metrogro Program's facilities for the application of sludge on agricultural land and the City of Madison refuse derived fuel plant.
W85-05364

CASE STUDY OF LEACHATE AND GAS MANAGEMENT AT A SANITARY LANDFILL,
Reitz and Jens, Inc., St. Louis, MO.
D. E. Murray.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ.-Extension, Dept. of Engineering and Applied Science, Madison. p 31-35.

Descriptors: *Landfills, *Waste disposal, *Waste recovery, *Odor control, *Land disposal, *Leachate, *Waste management, Odors, Solid wastes, Solid waste disposal, Waste storage, Waste dumps, Wastewater treatment, Wastewater management.

A large sanitary landfill started over 15 years ago which receives over one million cu yards/yr has recently had problems with leachate collection and disposal and control of gas odors. It was decided to develop an onsite leachate treatment facility consisting of chemical and biological treatment units and settling lagoons. Effluent from the settling lagoons goes through a meter manhole into the Metropolitan Sewer District sewer. As the landfill needed to expand, a quarry pit was approved as an appropiate site for the expansion if a holding lagoon could be provided for the leachate accumulated in the bottom of the quarry pit. Leachate transferred to the holding lagoon would be treated by the landfill leachate treatment facility. The gas odor problem was controlled by application of daily cover over the active landfill area and application of a chemical to the leachate lake surface to retard evaporation. A gas burner unit was also built to collect and burnoff the landfill gases. The satisfactory performance of this unit has resulted in the development of a larger burner assembly for gas recovery.
W85-05365

CHOOSING SEWAGE ASH DISPOSAL SITES IN THE TWIN CITIES METROPOLITAN AREA,
Metropolitan Council, St. Paul, MN.
J. L. Frost, R. W. Thron, D. J. Knuth, and E. A. Hickok.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ.-Extension, Dept. of Engineering and Applied Science, Madison. p 59-78, 1 Fig, 4 Tab, 3 Ref.

Descriptors: *Landfill, *Sludge, *Minnesota, *Sludge disposal, *Site selection, *Environmental impact statement, *Urban areas, *Public participation, *Urban planning, Decision making, Land use, Land disposal, Solid wastes, Solid waste disposal, Environmental policy, Public policy, Public opinion, Minnesota, Social participation, Public relations, Public rights, Attitudes.

A sewage sludge ash siting process designed to be technically sound and to encourage public participation by stimulating controversy was tried in the Twin Cities Metropolitan Area of Minnesota. The Waste Management Act passed by the Minnesota legislature in 1980 called for public involvement throughout the siting process and directed the Metropolitan Council to guide the siting process. The Council recommended various criteria for public comment and then held a series of public meetings in the Twin Cities Area. This first round of public meetings was attended by only about 100 people. After the Council named 31 potential sites, the next round of meetings drew over 1,700 people. A comprehensive discussion regarding the criteria and related public concerns then took place prior to Council adoption of the criteria. The criteria delineating the optimum site conditions suitable for a sludge ash landfill took into consideration surface water, hydrogeology, surface geology, topography, environmentally sensitive areas, transportation, agriculture, aesthetics, land use, number of property owners, historical or archaeological importance and other factors in the Council Development Guide. Environment impact statements were prepared on six candidate sites and the final site was chosen in the summer of 1983.
W85-05366

DEVELOPMENT OF A SLUDGE/REFUSE CO-DISPOSAL PROGRAM,
Donohue and Associates, Inc., Sheboygan, WI.
For primary bibliographic entry see Field 5E.
W85-05367

LEACHATE DISPOSAL ALTERNATIVES IN A SOLE SOURCE AQUIFER ENVIRONMENT,
Dvirka and Bartillucci, Syosset, NY.
For primary bibliographic entry see Field 5E.
W85-05373

'CONTAINMENT' STRATEGIES TO MANAGE ABANDONED HAZARDOUS WASTE SITES IN A COST EFFECTIVE MANNER,
Weston Environmental Consultants-Designers, West Chester, PA.
For primary bibliographic entry see Field 5E.
W85-05375

FINDING AN ACCEPTABLE APPROACH FOR DISPOSAL OF COAL COMBUSTION RESIDUES IN CALIFORNIA,
Stanley Consultants, Inc., Muscatine, IA.
For primary bibliographic entry see Field 5E.
W85-05376

CASE STUDY OF DESIGN PROCEDURES FOR A LAND TREATMENT OF WASTEWATER SYSTEM, DALTON, GEORGIA,
Golder Associates, Atlanta, GA.
H. M. Gauntt, and G. D. Trott.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, Madison, p 611-621, 2 Fig, 5 Ref.

Descriptors: *Design criteria, *Wastewater management, *Land disposal, *Wastewater disposal, *Waste disposal, *Site selection, *Waste management, *On-site data collections, Soil properties, Water quality, Project planning, Soil chemistry, Percolation rate, Data collections, Hydrologic data collections, Georgia.

The geotechnical investigation conducted to select wastewater management alternatives, in particular, land treatment systems, for the city of Dalton, Georgia was based on guidelines published by the Georgia Environmental Protection Division. These guidelines called for the development of a soil series (type) map with confirmatory boring locations, verification of previously assumed percolation rates, determination of soil chemistry and groundwater flow regimen, and determination of existing groundwater quality to serve as background data for future monitoring programs. Evaluations of the ability of the soil to absorb wastewater were made from USDA Soil Conservation Service data, laboratory permeability tests and field double ring infiltrometer tests. The design team decided on an application rate of 0.16 inches/hr. The joint involvement of geotechnical and sanitary consultants with the regulatory agency proved invaluable in the design and approval processes. The results of all design studies and investigations for the Dalton, Georgia Land Treatment System were design parameters that adequately characterized the site.
W85-05393

PROCEEDINGS, 38TH INDUSTRIAL WASTE CONFERENCE.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
May 10-12, 1983. Butterworth Publishers, Boston, MA, 1984. 1000 p.

Descriptors: *Industrial wastewater, *Conferences, *Wastewater treatment, Chemical wastes, Food-processing wastes, Metal-finishing wastes, Textile mill wastes, Tannery wastes, Oil wastes, Pharmaceutical wastes, Agricultural wastes, Pulp wastes, Paper wastes, Hazardous materials, Toxicity, Powerplants, Coal, Coke, Industrial wastes.

This proceedings volume contains 74 papers relevant to wastewater treatment and pollution control. The papers are classified according to the following general categories: oil wastes, land disposal, paper wastes, agricultural wastes, animal wastes, pharmaceutical wastes, textile wastes, hazardous and toxic wastes, metal wastes, plating wastes, chemical wastes, coal, coke, and power plant wastes, physical/biological systems, food wastes, and miscellaneous.
W85-05396

EVOLUTION OF DESIGN OF FORD MOTOR COMPANY INDUSTRIAL WASTE TREATMENT FACILITIES,
Ford Motor Co., Dearborn, MI.
N. B. Silverson, D. L. Ruch, D. E. Kinnee, and F. L. McAuliffe.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA, 1983. p 13-22, 7 Fig, 3 tab.

Descriptors: *Oil wastes, *Paint wastes, *Heavy metals, *Wastewater treatment, *Metal finishing wastes, Sludge digestion, Sludge treatment, Emulsifiers, Clarifiers, Gravity filters, Separation techniques.

The design approaches taken at Ford in the treatment of oily, paint and heavy metal wastes are described. Oil-laden sludges are treated in a conventional ferric chloride facility with a 'Windsor process' modification. This process utilizes sulfuric acid for low acid digestion of the emulsifiers, calcium chloride and caustic for emulsion breaking and pH adjustment, resulting in the virtual elimination of sludges. Heavy metal/paint waste treatment facilities were first batch treatment tanks and settling lagoons, with the settling lagoons being replaced by clarifiers in later years to increase treatment efficiency and decrease the land area used. A further improvement in this direction is the replacement of clarifiers with parallel plate gravity separators. Care must be taken to properly weatherproof all facilities. A permanent staff should be used so that they will be able to diagnose and treat any emergencies in the system. Automation has so far been impractical due to excessive down time of the automated system requiring manual running of the treatment facility.
W85-05397

OILY WASTEWATER TREATMENT AND THE IMPACT OF HIGH WATER CONTENT SYNTHETIC FLUIDS AT FORD MOTOR COMPANY,
Ford Motor Co., Detroit, MI.
P. R. Lawrence.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA, 1983. p 29-34, 2 Fig, 1 Tab.

Descriptors: *Oil wastes, *High water content fluids, Biological oxygen demand, Chemical oxygen demand, Emulsifiers, Separation techniques, *Wastewater treatment, Biological wastewater treatment.

This paper reports the special attributes of 'synthetic' high water content fluids (HWCF) that replaced petroleum-oil based fluids used for machinery and/or hydraulic applications in Ford plants. HWCF are categorized as semisynthetic or synthetic. Semisynthetic HWCF typically contain from 3% to a maximum of 15% petroleum oil products. Because of the types and quantities of emulsifiers, surfactants and various other ingredients, semisynthetic fluids can be extremely difficult to separate from wastewater and can interfere with wastewater treatment operation. True synthetic coolants, which contain no petroleum oil, do not interfere with effective removal of free and/or emulsified oil that has entered the fluid in the manufacturing process. Because many of the synthetics are composed of polyglycols, alcoholamine salts and other water soluble organics, the COD and BOD of these HWCF are extremely high and must be lowered to meet permit levels. Ford has encouraged suppliers to formulate HWCF that would respond to Ford's conventional oil-water separation treatment techniques. Although biological treatment can eventually oxidize the water-soluble organics, biological treatment facilities cost over $2.5 million each and offer little improvement over the best HWCF fluids combined with the best conventional treatment.
W85-05398

CHEMICAL COAGULATION OF TAR SAND PROCESSING WASTEWATER,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
P. H. King, M. O. Akad, and W. F. McTiernan.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ , Butterworth Publishers, Boston, MA, 1983. p 35-40, 4 Fig, 7 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Oil wastes, Ferric chloride, Chemical coagulation, Suspended solids, Organic carbon, Sludge, Alum, Lime, Flocculation.

The use of chemical coagulants is a viable treatment of a representative steam-flooding tar sand processing wastewater. Alum, ferric chloride and lime were all effective in removing suspended solids, but the alum system produced a relatively high volume of sludge and the lime system required unusually long periods of time to stabilize the pH and resulted in a substantially poorer removal of soluble total organic carbon content. For these reasons ferric chloride was chosen for more extensive testing. The appropriate dose of ferric chloride is 300 to 450 mg/liter depending on the suspended solids concentration. The system is insensitive to pH in the 4.0 to 5.5 range and to variations in mixing and flocculation rates. Settling and polymers do not enhance either suspended solids or total organic carbon content removal, but do result in some improvements in sludge volume.
W85-05399

WASTEWATER TREATMENT BY OVERLAND FLOW,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
A. R. Abernathy.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA, 1983. p 47-55, 5 Fig, 6 Tab, 6 Ref.

Descriptors: *Municipal wastewater, *Wastewater treatment, *Overland flow, Biochemical oxygen demand, Suspended solids, Organic carbon, Phosphorus, Ammonia, Nitrate, Nitrogen compounds, Lagoons, Algae, Effluents, Construction costs, Operating costs.

An overland flow facility for treating municipal wastewater in a region of high rainfall, mild climate, and relatively low soil permeability is described. Overland flow was successful in treating comminuted raw wastewater and polishing lagoon effluent. Comminuted raw sewage was converted into an effluent, better than effluents from more traditional secondary treatment plants. Lagoon effluent treated by overland flow gave a final effluent approaching tertiary treatment quality except for the problem of algae cells produced in the lagoon. These algae moved down the plots with the runoff and increased the suspended solids concentration in the plot effluent. Costs for both construction and operation of the overland facility compare favorably with more traditional facilities if land cost is low, energy costs were low, and operating the system basically required keeping the pumps operating, mowing the grass and clearing an occasional plugged spray nozzle or gated pipe opening.
W85-05400

HYDRAULIC LOADING FOR LAND TREATMENT SITES UNDER NON-IDEAL CONDITIONS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
T. S. Steenhuis, R. C. Loehr, and C. Babajimopoulos.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA, 1983. p 57-65, 12 Fig, 17 Ref.

Descriptors: *Wastewater treatment, *Model studies, *Mathematical models, Model testing, Hydraulic loading, Land treatment, Computer models, Groundwater, Water table rise.

A methodology was developed that may assist in determining the proper hydraulic loading of land treatment systems for wastewater. The method is based on comparing the calculated rise of groundwater mound with surface elevation. Two methods, a finite difference technique and an analytical (or closed form) solution, were used to solve the partial differential equation for groundwater flow and to calculate the mounding. The closed form solution rapidly computes groundwater table elevations and uses a minimum of input data. Spatial variability of input data is not considered. This method is suited for initial screening of land treatment facilities of wastewater where accuracy of

diction is of little consequence as long as input ameters have a broad error margin. The finite ference technique is the method of choice for ailed design; it considers variability in site spe- c hydrological parameters. The method is much re computer time intensive than the closed form ution.
35-05401

VESTIGATION OF THE POTENTIAL OF AN IZYMATIC TREATMENT OF PULP AND IPER MILL EFFLUENT TO FACILITATE CCOLORIZATION BY LIME PRECIPITA- ON,
orth Carolina State Univ. at Raleigh. Dept. of ood and Paper Science.
C. Campbell, and T. W. Joyce.
Proceedings, 38th Industrial Waste Conference, est Lafayette, IN, May 10-12, 1983. Purdue iv., Butterworth Publishers, Boston, MA, 1983. 7-73, 8 Fig, 12 Ref.

escriptors: *Wastewater treatment, *Color re- val, *Pulp wastes, Laccase, Quinones, Lime ecipitation, Pulp and paper industry, Hydrogen roxide.

ce increasing the molecular weight of color olecules (quinones, quinonemethides and vinyl ups conjugated with an aromatic ring) by po- nerization increases the efficiency of their re- val by lime, this study sought to determine if ccase and hydrogen peroxide could increase the ectiveness of lime precipitation of color from veral pulp and paper mill effluent types. Pretreat- nts of three pulp and paper mill effluent types th the enzyme laccase prior to lime addition ve limited or no improvements in color removal iciency. Spiking biologically treated whole mill luents with phenolic compounds during pre- atment caused an improvement, but this increase as not substantial enough for industrial signifi- nce. An assay for laccase activity in these ef- nts at pH 5 with added syringaldazine as the bstrate indicated that laccase activity could be stained in the effluents. The inability of laccase produce the effects desired is probably attributa- e to insufficient phenolic hydroxyls in the ef- nents, or to the absence of phenolic compounds ving sufficient reactivity with the enzyme.
85-05402

NHANCED PRIMARY TREATMENT OF ULPING WASTEWATERS,
nvirotech Corp., Salt Lake City, UT. Eimco rocess Machinery Div.
W. Okey.
: Proceedings, 38th Industrial Waste Conference, est Lafayette, IN, May 10-12, 1983. Purdue niv., Butterworth Publishers, Boston, MA, 1983. 75-82, 5 Fig, 12 Ref.

escriptors: *Wastewater treatment, *Suspended lids. *Pulp wastes, Lignin, Chemical oxygen emand, Effluents, Biological wastewater treat- ent, Lime, Color removal, Calcium hydroxide.

problem frequently encountered when pulping astewater is treated biologically is an unusually gh effluent suspended solids level. An attempt as made to intercept the precursor of the lignin- ke particle, which is responsible for creating high ffluent suspended solids, through the combined se of lime, polymer and neutral calcium. The ature of the reaction when using neutral calcium n appears to be distinctly different from that seen ith lime. Less color (50%) is removed using eutral calcium, while massive lime treatment ommonly removes substantial quantities (80-90%) f color. The difference appears to be due partly to he actual quantity of calcium ion available in the ystem at elevated pH where lime is employed. he color removal reaction is at least in part due to dsorption onto solid phase Ca(OH)2.
85-05403

COLOR REMOVAL FROM SULFITE WASTES WITH CATIONIC SURFACANTS,
Tennessee Technological Univ., Cookeville. Dept. f Civil Engineering.
K. L. Roberts, and J. Gu Lin.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA, 1983. p 83-88, 4 Fig, 13 Ref.

Descriptors: *Wastewater treatment, *Color removal, *Cationic surfactants, *Pulp wastes, Sulfite wastes, Pulp and paper industry, Sludge, Lime, Alum, Coagulation, Chemical oxygen demand.

The objectives of this study were to determine whether or not a cationic surfacant would effectively remove color from a sulfite mill waste and to compare its efficiency with that of lime, alum, and lime-magnesium. Another objective was to compare the characteristics of the sludge produced by each coagulant. Cationic surfactants are superior to inorganic coagulants in removing color from sulfite waste. For example, Cetol removed 97% of the color at a dose of 1750 mg/l while lime removed only 70% at a dose of 60,000 mg/l. The inorganic coagulants removed more COD than the cationic surfacant. The cationic surfacant-color sludge thickened much more rapidly into a much smaller volume than any of the inorganic coagulant-color sludges. The dewatering characteristics of the sludges were similar. Considerable work, including a pilot scale study, will be required before a meaningful economic analysis of this technology can be completed. Cationic surfacants are relatively expensive compared to alum and lime but considerably less chemical is required. The degree of treatment is much higher, and the sludges produced are much easier to thicken. All of these considerations must be balanced in the final economic analysis.
W85-05404

TOTAL SYSTEMS APPROACH REDUCES MILL WASTEWATER TREATMENT COSTS,
Nalco Chemical Co., Oak Brook, IL.
D. H. Prah, and D. E. Grimestad.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 89-94, 4 Fig, 2 Tab, 1 Ref.

Descriptors: *Wastewater treatment, *Pulp wastes, Solids removal, Costs, Sludge Drying, Cost analysis.

The Total Systems Approach increased profits in one year for one paper mill. By reallocating the expenses (in essence, spending more for electrical power in aeration to maintain mixed liquor dissolved oxygen better) and being more conscious of control of the nutrient feed, savings were realized in sludge dewatering (polymer) and drying (natural gas). The energy recovered by firing these solids in the hog fuel boiler reduced the mill's purchases for electricity and coal, and the savings were realized directly. In other words, the waste treatment operation became part of the mill's utilities needed for production. Competitive evaluations of polymers from other suppliers demonstrated conclusively to this mill that savings achievable strictly on a cost-competitive basis would have amounted to no more than 10 to 15% based on the polymer costs alone. However, these savings would only have improved the costs of operation of this mill's wastewater treatment plant by 4 to 7% overall. It is claimed that by using NALCO Chemical Company as part of a service-intensive contract approach to the water treatment chemicals business, the customer actually achieved savings of 10.5%, while realizing a 16.5% net savings in polymer at the same time.
W85-05405

ANAEROBIC TREATMENT OF FUEL ALCOHOL WASTEWATER BY SUSPENDED GROWTH ACTIVATED SLUDGE,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover, G. Gomathinayagam, and R. Gonzalez.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 95-104, 9 Fig, 5 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, Sludge, Fuel alcohol, Methane, Cattle feed, Kinetics, Sludge utilization.

Anaerobic treatment of high strength fuel alcohol production wastewater was examined for methane production and the suitability of the resultant sludge for cattle feed with both batch and continuous flow methods. Both the kinetics of substrate removal and the quality of methane production were a function of the food/microorganisms (F/M) ratio. The protein and carbohydrate content of the anaerobic biological sludge makes it suitable for use as cattle feed when dried and mixed with stillage solids. The reaction kinetics of the batch and continuous systems appear different due to volatile acid accumulations in the batch systems above a certain F/M ratio.
W85-05406

CHEMISTRY AND APPLICATION OF OZONE AND ULTRAVIOLET LIGHT FOR WATER REUSE: PILOT PLANT DEMONSTRATION,
Westgate Research Corp., West Los Angeles, CA.
J. D. Zeff, and J. A. Harris.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 105-116, 3 Fig, 6 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, Pesticide removal, UV-ozonation treatment, Lime pretreatment, Hazardous materials, *Water reuse.

The objective of this study was to demonstrate on a small pilot plant of a typical industrial wastewater, the destruction of refractory and toxic organic residues by a UV-ozonation process. A standard Model P-602 (ULTROX) Pilot Plant was used. Lime pretreatment increased the efficiency of the UV-ozonation process. The ozone dose requirement is 4.1 mg O3/liter of effluent. An oxygen supply is more economical than air. The cost savings of this system compared to landfill disposal are significant and under certain conditions the payback of the equipment is less than seven months without including the value of the reusable water.
W85-05407

CASE HISTORIES: PRETREATMENT OF POULTRY PROCESSING WASTEWATER,
Georgia Dept. of Natural Resources, Atlanta. Environmental Protection Div.
K. Hopkins.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 117-131, 5 Fig, 17 Tab.

Descriptors: *Wastewater treatment, *Poultry wastes, Air flotation, Biological oxygen demand, Suspended solids, Biodegradation.

The pretreatment of wastewater at four poultry processing plants was examined. Raw and pretreated wastewater characteristics, the various treatment processes employed, chemicals used and the impact of this wastewater on the treatment plant were summarized. Poultry processing wastewater contains high organic matter, high suspended solids, floating materials, fat, oil, and grease; and is readily biodegradable. Poultry processing wastewater can be successfully treated by a dissolved air flotation system with the addition of coagulant and flocculant. Removal of BOD to 250 mg/liter TSS to 250 mg/liter, and oil and grease to < 100 mg/liter can be achieved. The pretreated poultry wastewater can then be readily treated by a biological process in a municipal wastewater treatment system.
W85-05408

TREATMENT OF BEEF SLAUGHTERING AND PROCESSING WASTEWATERS USING ROTATING BIOLOGICAL CONTACTORS,

Northeastern Univ., Boston, MA. Dept. of Civil Engineering.
F. C. Blanc, J. C. O'Shaughnessy, and S. H. Corr.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 133-140, 10 Fig, 1 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Slaughtering wastes, Biological treatment, Biological oxygen demand, Suspended solids, Aerobic treatment, Effluents, Kinetics, Waste load, Sludge.

A study was conducted to evaluate treatment kinetics, waste loading rates, removal efficiencies and sludge production rates associated with beef slaughtering wastewaters. The results indicate that rotating biological contactor units can be used to treat a combination beef slaughtering and process wastewater to achieve 65 to 70% BOD reduction. However: (1) severe foaming problems can arise; (2) further treatment will be required prior to discharge; (3) solids settling is poor; and (4) the volume-to-surface ratio of the reactor has little impact on treatment efficiencies. The expected salt concentration would have little, if any, effect on the treatment process. The study also indicates that anaerobic pretreatment could improve the treatability of the wastewaters. Aerobic treatment, without anaerobic pretreatment, would require extended aerobic polishing to obtain secondary treatment effluent standards.
W85-05409

INTEGRATING ANAEROBIC DIGESTION AND ALGAL-BIOMASS TREATMENT PROCESSES FOR SWINE WASTEWATER,
Hawaii Univ., Honolulu. Dept. of Agricultural Engineering.
P. Y. Yang, and S. Y. Nagano.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN. May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 141-161, 15 Fig, 11 Tab, 31 Ref.

Descriptors: *Wastewater treatment, *Swine wastewater, *Anaerobic digestion, Algal-biomass raceway, Methane production, Retention time, Hydraulic loading, Chemical oxygen demand, Sedimentation, Effluents, Biological oxygen demand, Oxidation ditches, Oxidation ponds.

A study was conducted to develop a set of full design and operational criteria for both anaerobic digestor and algal-biomass raceway treatment processes for swine wastewater in a tropical environment. Five different overall hydraulic retention times (HRT) and total volatile solids (TVS) loading rates were used to determine the critical loading rate for maximum gas production in the anaerobic digestion process. Maximum methane production is at approximately 3.0 g TVS/liter/day. The main objective of using an algal-biomass raceway system is to reduce the soluble COD and NH4-N concentration of anaerobically digested effluent by aerobic bacteria and microalgae. Care must be taken that overaeration does not decrease the pH and kill the algae. The raceway effluent after sedimentation can meet the IWDP standards for total BOD, suspended solids and NH4-N concentrations. The anaerobic digestor-algal-biomass system has some advantages over other systems. It has a much higher BOD loading rate compared to a faculative oxidation pond and it uses 1/10 the energy of an oxidation ditch. Selecting the proper option depends on the cost of land, energy and equipment.
W85-05410

PILOT PLANT TREATMENT OF SWINE WASTES BY THE DEEP SHAFT METHOD,
Tokyo Univ. of Agriculture (Japan). Dept. of Liberal Education.
K. Ishimaru, G. Oyama, A. Ushikubo, and F. M. D'Itri.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 163-71, 2 Fig, 4 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Swine wastewater, Deep shaft method, Biological oxygen demand, Chemical oxygen demand, Suspended solids, Nitrogen compounds, Activated sludge process, Organic loading, Retention time, Aeration, Ammonia.

The advantages of the deep shaft (tall cylinder) wastewater treatment method for swine wastes compared to the conventional activated sludge system are: much higher organic loading capacity, reduced retention time, and more efficient oxygen and energy utilization due to intimate contact between oxygen, substrate and organism. Because the system is compact, less land is required. Circulation velocities are directly related to the aeration depth, volume of pumped air, diameter of the user pipe, and water level in the shaft. Maximum oxygen dissolution efficiency was obtained at an aeration depth of 300 cm and a pumped air volume of 10 liter/min. Under these conditions, the maximum BOD loading rate was limited to 2.00 kg/cu m/day. At a loading rate of between 0.6 and 2.0 kg/cu m/day, the BOD, COD and suspended solids removal rates exceeded 85%, while the percent removal of ammonia and total Kjeldahl nitrogen ranged from 72 to 95%.
W85-05411

SINGLE STAGE NITRIFICATION ACTIVATED SLUDGE PILOT PLANT STUDY ON A BULK PHARMACEUTICAL MANUFACTURING WASTEWATER,
Merck and Co., Inc., Rahway, NJ.
R. T. Donahue.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 173-180, 1 Fig, 7 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Pharmaceutical wastes, Nitrification, Sludge drying, Sedimentation, Activated sludge process, Biological oxygen demand, Chlorination.

The pilot plant treatability data for sludge thickening and dewatering studies for a pharmaceutical manufacturing wastewater primarily during the first five month of operation are summarized. The plant consists of an equalization basin, neutralization, primary sedimentation, roughing biofilter and a single stage nitrification activated sludge system. The values of the BOD removal rate constant, K, determined for the pilot plant study did not demonstrate the expected relationship of between reaction rate and temperature. The pilot plant oxygen uptake rate data demonstrates a low net oxygen requirement for nitrification. The system operation was stable and efficient at F/M ratios of 0.19-0.30. A prolonged period of operation at an F/M ratio 0.15 led to an episode of filamentous bulking. Chlorination of the mixed liquor for eight days at dosages ranging from 3.0-7.5 lb. Cl2/1000 lb. MLVSS successfully controlled the bulking. Nitrification stopped during the chlorination period. At aeration basin temperatures > 38 C, BOD removal efficiency decreased and nitrification ceased. The oxygen uptake rate test was a good indicator of wastewater toxicity or inhibition of the microorganisms.
W85-05412

COMPARISON OF DOME AND STATIC AERATORS TREATING PHARMACEUTICAL WASTE,
Manhattan Coll., Bronx, NY. Dept. of Environmental Engineering and Science.
J. A. Mueller, R. T. Donahue, and R. Sullivan.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 181-192, 6 Fig, 6 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Pharmaceutical wastes, Oxygen diffusion, Aerators, Activated sludge process.

The design criteria for a new activated sludge system to replace an existing activated sludge system and rock biofilters for treating pharmaceutical wastes were defined. Kenics static aerators and Gray Fine/Air dome diffusers were evaluated. Excellent agreement was obtained between the calculated and measured oxygen saturation values for both dome and static aeration systems. This indicates the validity of KL a measurements obtained by the dual nonsteady state testing technique in a completely mixed aeration tank under process conditions. Process water results on both systems had a tendency for alpha and theta to vary with gas flow. Theta values in the range of 1.02-1.026 are representative of the design range for the dome systems and from 1.015 to 1.024 for the static aeration system. Theta values decrease with increasing gas flow. Alpha values for the static aeration system were somewhat higher than those in the dome aeration system varying from 0.64 to 0.75 in the design range versus 0.5 to 0.57 for the dome system. These values are specific for the high strength and high total dissolved solids Merck pharmaceutical wastewater. Efficiency of the dome diffuser system is the same as the static aeration system under process conditions at low air flows, and it increases as airflow increases. At the normal operating air flows, the dome diffuser system is 14% more efficient than the static aeration system. These results are specific for the Merck pharmaceutical wastewater.
W85-05413

TREATMENT OF WOOL SCOUR WASTEWATER: RECENT TRENDS IN NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
F. Wilson, and P. H. King.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 193-200, 5 Fig, 9 Tab, 10 Ref.

Descriptors: *Wastewater treatment, *Wool scouring, *Textile mill wastes, Aerobic treatment, Anaerobic digestion, Solvent extraction, Pentanol, Chemical oxygen demand, Activated sludge process, Effluents.

Present trends in New Zealand indicate that the preliminary treatment stage incorporated in the Wronz mini bowl scouring system could provide a useful starting point in the overall treatment of wool scour wastes. Anaerobic digestion of a cracked jet liquor appears to be favored over aerobic processes which suffer from efficiency reductions in the cold New Zealand winter. Further experiments are being conducted both with variations of the anaerobic filter and with upward flow sludge blanket digesters. Meanwhile the DSIR pentanol extraction process has been patented and prototype trials have been run in Dunedin in the last year. The effluent has proven acceptable for direct treatment in the local authority biological treatment plant.
W85-05414

BIOLOGICAL TREATABILITY STUDY OF WASTEWATER FROM A NYLON FIBERS AND PLASTICS FACILITY,
Rivanna Water and Sewer Authority, Charlottesville, VA.
G. A. Anderson, G. D. Boardman, and D. A. Wallis.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 201-210, 7 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Nitrogen removal, *Activated sludge process, Caprolactam, Nylon, Plastics, Textile mill wastes, Organic carbon, Hydrogen ion concentrations, Temperature effects, Evaporation.

The feasibility of reducing nitrogen levels in wastewater containing about 10,000 mg/liter caprolactam from a nylon fibers and plastics manufacturing plant was investigated. Activated sludge is an effective means of treating textile wastewaters which contain high levels of caprolactam. Although problems with evaporation somewhat confound the calculations, it is believed that organic carbon and total Kjeldahl nitrogen removals of up to 95 and 80%, respectively, were obtained. Tem-

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perature and pH were very important factors, and in no systems was nitrification apparent. In those reactors operated at sludge ages suitable for nitrification, it is believed that nitrification was inhibited by caprolactam, low dissolved oxygen levels, and/or high levels of ammonia.
W85-05415

STUDY ON REUSE OF WATER IN A WOOLEN MILL,
Tongji Univ., Shanghai (China). Dept. of Environmental Engineering.
H. Jiajun.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 211-219, 2 Fig, 5 Tab.

Descriptors: *Wastewater treatment, *Dye industry wastes, Water reuse, Color, Color removal, Cost analysis, Activated carbon, Effluents, Textile mill wastes, Coagulation, Adsorption.

This study reports the results of treating and/or recycling the wastewaters from dyestuffs which were either acidic mordant dyes, disperse dyes, sulfur dyes, neutral dyes, reactive dyes or direct dyes. After field experiments determined the design parameters, a biotower-flotation process was used. The effluent from this process has been meeting the criteria for discharge but has a distinct color that excludes the effluent from reuse. Subsequently a coagulation-adsorption process for decolorization was added so that the effluent could be recycled with insignificant modification of the existing facilities. This strategy makes it possible to refrain from discharge of colored wastewater and is economically feasible. The cost for reuse is 0.2 Yuan/cu m which includes the cost for wastewater treatment of 0.16 Yuan/cu m as opposed to the cost of tap water (0.12 Yuan/cu m). The key is the availability of waste activated carbon from a nearby pharmaceutical factory.
W85-05416

BIOLOGICAL TREATMENT OF CYANIDATION WASTEWATERS,
Homestake Mining Co., Lead, SD.
T. I. Mudder, and J. L. Whitlock.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 279-287, 1 Fig, 3 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Mine drainage, Cyanide, Thiocyanate, Gold, Silver, Ammonia, Nitrogen compounds, Construction costs, Operating costs, Biological treatment, Pilot plants, Toxic wastes.

Since 1977, personnel at Homestake Mining Company's Homestake Gold Mine in Lead, SD, have been engaged in research and development of a process to treat a maximum of 5.5 MGD (3600 gpm) of combined mine and tailings impoundment wastewaters containing free cyanide, complexed cyanides and thiocyanate. Various chemical and/or physical treatment processes were pilot plant tested, but construction of a full-size treatment based on these principles never materialized due to inadequate treatment performance, residual toxicological effects associated with the effluent, or prohibitive capital and/or operating costs. The bacterial seed was found in Homestake wastewaters. During the pilot plant evaluations the bacteria were gradually and specifically acclimated to the wastewater combination to be treated. The only chemical requirements were an inorganic carbon source to aid nitrification and phosphorus as a trace nutrient. The biological treatment processes removed thiocyanate, free and metal complexed cyanides, metals and ammonia through oxidation and adsorption. The products included the anions sulfate, nitrate and carbonate. The kinetics of thiocyanate, cyanide and ammonia oxidation were generally zero order down to levels of 1 mg/L for thiocyanate and cyanide, and 4-5 mg/L for ammonia.
W85-05417

ADAPTATION OF AN INDUSTRIAL ACTIVATED SLUDGE PROCESS TO THE REMOVAL OF CYANIDE,
Alabama Univ. in Birmingham. Dept. of Biology.
D. Harden, D. D. Jones, and J. J. Gauthier.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 289-298, 8 Fig, 6 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Cyanide, *Ammonia, Phenol, Thiocyanate, Biological treatment, Nitrification, Organic loading, Toxicity, Toxic wastes.

The object of this paper was to determine whether a mixed microbial population already adapted to the treatment of steam-stripped coke-plant wastewater could be further adapted to treat the higher concentrations of ammonia and cyanide found in non-distilled ammonia liquors. Treatment of relatively high concentrations of cyanide is possible at moderate organic loadings, after an extended period of adaptation. The nitrifiers did not appear to become significantly more tolerant to cyanide, but the action of cyanide degraders in a complex-mix process provided protection of the nitrifiers from the inhibitory effects of cyanide. Phenol and thiocyanate removal were unaffected by cyanide. The primary difficulty in treating high strength coke-plant wastewater appears to be the general toxicity that occurs at higher organic loadings which decreases the efficiency of all the microorganisms in the system.
W85-05418

MIXED CULTURE BIOLOGICAL ACTIVITY IN WATER CONTAINING VARIABLE LOW CONCENTRATIONS OF CYANIDE, PHENOL, AND BOD,
Yarmouk Univ., Irbid (Jordan). Dept. of Civil Engineering.
A. M. Shahlaham.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 311-322, 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Phenol, *Cyanide, Temperature effects, Mathematical models, Statistics, Biological oxygen demand, Biodegradation, Toxic wastes.

The biological degradation rate of easily degradable carbonaceous materials in waters containing phenol and cyanide was determined. Two complete-mix, continuous, mixed culture reactors were used; one was run at 9 C and the other at 24 C. In addition to temperature, the concentrations of glucose, phenol, cyanide, nitrogen and other trace chemicals remained constant in a pair of simultaneous experiments. The experiments were intentionally performed at very low concentrations of glucose, phenol and cyanide. In a complex solution of various chemicals such as glucose, phenol, and cyanide, the degradation rate of one chemical is dependent on the presence of other chemicals. Without the definitive knowledge of the interrelationships of these chemicals while being degraded in waters by biological mass, the biodegradation rates may be expressed as functions of chemical concentrations and temperature utilizing statistical methods.
W85-05419

WET OXIDATION OF PACT PROCESS CARBON LOADED WITH TOXIC COMPOUNDS,
Zimpro, Inc., Rothschild, WI.
T. L. Randall.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 323-338, 4 Fig, 15 Tab, 13 Ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Chlorinated hydrocarbons, Hydrocarbons, PACT process, Wet air regeneration, Domestic wastes, Priority pollutants, Phenols, Organic loading, Organic compounds, Nitrogen compounds, Activated carbon, Toxic wastes.

The results of laboratory studies of the destruction of priority pollutants such as cyanides and phenols, during wet air regeneration are reported as are the results of continuous flow PACT/Wet Air Regeneration system studies to observe removal of toxic organics. In the case of 2-chlorophenol, destruction of more than 98.4% was observed. The residual 2-chlorophenol was tightly bound to the carbon with only traces of it appearing in the liquid phase. No formation of priority pollutants during regeneration was observed and only low molecular weight oxygenated species were identified. Pilot plant PACT treatment studies on wastewater containing chlorinated aromatic hydrocarbons demonstrated excellent removal by PACT (92-100% for most pollutants) and ultimate destruction of these compounds during wet air carbon regeneration. Additional continuous pilot studies employing the PACT system with wet air regeneration have shown reduction of wastewater toxicity, resistance of the treatment system to shock organic loads such as phenol, and excellent removal of priority pollutants.
W85-05420

MERCURY REMOVAL FROM A CHLORAL-KALI PLANT IN EGYPT,
Alexandria Univ. (Egypt). Higher Inst. of Public Health.
A. Hamza, O. Elsebai, and H. Saleh.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 339-347, 4 Fig, 4 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Mercury, *Electrolysis, Effluents, Rechlorination, Clay adsorption, Activated sludge process, Fish, Contamination, Mortality, Toxic wastes.

Wastewater containing the electrolysis effluent from the Misr Chemical Company has a high mercury concentration (17.3 mg/L). The treatment train used in this study consisted of pH adjustment, clay adsorption, and an activated sludge biological system. Aeration and dechlorination may achieve 50% reduction in the mercury content. A local clay has satisfactory adsorption capacity compared to activated carbon. Clay adsorption reduced mercury concentration to about 1 mg/l. Further reduction in mercury was attained by biosorption using 20 mg/l PAC and an average detention time of 24 hr. Spontaneous death was observed when fish inhabited raw electrolysis wastewater due to its high chlorine content. Fish living in sublethal dilutions of the pretreated effluent showed progressive mercury accumulation in the gills and liver while the flesh contained relatively low mercury levels.
W85-05421

TREATMENT OF CYANIDE-CONTAINING WASTEWATERS BY THE COPPER-CATALYZED SO2/AIR OXIDATION PROCESS,
Canviro Consultants Ltd., Kitchener (Ontario).
S. G. Nutt, and S. A. Zaidi.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 357-368, 3 Fig, 6 Tab, 18 Ref.

Descriptors: *Wastewater treatment, *Cyanide, *Gold, *Metal-finishing wastes, Operating costs, Capital costs, Oxidation process, Catalysts, Sulfur dioxide/air oxidation, Toxic wastes.

The results of laboratory scale treatability studies of the INCO copper-catalyzed sulfur dioxide (SO)/air process for the treatment of barren bleed solutions from several Canadian gold mills and rinsewaters from several metal plating operations containing cyanides are reviewed. Conceptual process design details for full-scale SO/air oxidation systems applicable to these wastewaters are presented and capital and operating cost estimates for the process are developed. In the presence of adequate concentrations of dissolved copper, and SO/air oxidation process was capable of reducing cyanide concentrations from $>$ 1 g CN/L to $<$ 1 mg CN/L. The optimum copper concentration

was dependent on the composition of the untreated sample. Removal efficiencies exceeding 99% in terms of cyanide species and heavy metabls were achievable during treatment of gold mill barren bleed solutions and metal finishing rinsewaters. Removal of > 99.5% of iron present as iron cyanide complexes was attained in the presence of adequate concentrations of copper and zinc in the wastewater sample. Thiocyanate was virtually unaffected. The estimated total annual cost associated with the operation of an SO/air oxidation process at a model gold mill are $1.77 to $2.07 per kg CN removed. Chemical costs amount to approx $0.98 per kg CN removed. The estimated total annual costs for copper cyanide rinsewater treatment are approximately $26,050, equivalent to $11.95 per kg CN removed. Chemical costs amount to approximately $4.31 per kg CN removed.
W85-05422

CATALYTIC OXIDATION OF MUNITIONS WASTEWATER,
Pima County Dept. of Wastewater Management, Tucson, AZ.
C.-J. Kuo, and R. A. Sierka.
In: Proceedings 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 377-385, 13 Fig, 2 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Munitions wastewater, Organic compounds, Hydrogen ion concentration, Catalyts, Organic carbon.

The specific objectives of this study were as follows: (1) to quantify the effect of the Raney Nickel (Ra-Ni) Catalyst concentration on the kinetics of trinitrotoluene/cyclotrimethylenetrinitramine (TNT/RDX) destruction and (2) to quantify the effect of Ra-Ni concentration and initial solution pH on the rate and extent of TNT/RDX destruction when ozone is employed as the oxidant. For both the catalytic destruction process and the catalytic ozonation process; the initial rates of total organic carbon (TOC) and TNT destruction increased with increased concentrations of Ra-Ni. For experiments with the same concentration of Ra-Ni, the higher the ozone dose, the higher the rate of TOC destruction. However, the rate of TNT destruction was not improved, or it was adversely affected by the presence of ozone in the reactor. The rate of TOC destruction at the same ozone dose was enhanced when Ra-Ni was present in the reactor, especially at the high initial solution pH levels.
W85-05423

MICROBIAL RESPONSES TO ORGANIC SPECIES IN INDUSTRIAL LANDFILL LEACHATE,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
P. Corbo, and R. C. Ahler.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 387-393.

Descriptors: *Wastewater treatment, *Industrial waste, *Leachates, Activated sludge process, Landfills, Groundwater pollution, Runoff, Surface water, Organic carbon, Oil wastes, Lime.

The biological treatment of liquid residuals produced by water runoff due to rain, surface water and/or groundwater that has become contaminated as it passes from or through a landfill holding industrial wastes is described. Leachate used in this study was supplied by USEPA Oil and Hazardous Material Spill Branch. The bulk aqueous phase was separated from the bulk of oil phase by gravity separation and was further treated with lime at 6 gm/L. An activated sludge culture seed was obtained from the Somerset-Raritan Sewerage Authority. The leachate used in the study was not lethal to a mixed population of activated sludge organisms. Leachate organic components induced high respiratory activity that correlates with dissolved organic carbon (DOC) reductions. The organic species are available as a growth carbon source, and biodegradation does not require the presence of an easily degradable carbon source. An overall leachate DOC reduction of 80% (shake flask) and 65% (fermentor) have been observed. Absorption of DOC on cellular material did not appear to be taking place although a definite conclusion on this matter could not be drawn.
W85-05424

PILOT STUDY FOR THE REMOVAL OF PRIORITY POLLUTANTS BY THE PACT PROCESS,
Greeley and Hansen, Chicago, IL.
J. W. Cormack, D. Y. Hsu, and R. G. Simms.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 403-415, 4 Fig, 4 Tab, 17 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Activated sludge Process, Pollutants, Pretreatment of water, Organic compounds, Metals, Heavy metal, Trace metals, Cyanide, Inorganic compounds, Toxic wastes.

A pilot study of the PACT process for pretreatment of industrial waste discharged to the Kalamazoo treatment plant is reported. The PACT process apparently has higher tolerance limits for toxic substances than the activated sludge process. The treatment performance was not affected at the maximum concentrations used in running this pilot study. Among the 28 priority pollutants investigated were acrolein, phenol, tetrachloroethylene, toluene, arsenic, cadmium, cyanide, mercury. A large number of these pollutants as found in the raw wastewater in the Kalamazoo Wastewater Treatment Plant can be removed by the PACT process. The removal efficiency may range from > 54.2 to > 97.4% for the organic pollutants, and 9 to 82.9% for the inorganic pollutants.
W85-05425

REMOVAL OF METAL IONS FROM WASTEWATER BY ALGAE,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
F. J. Sloan, A. R. Abernathy, J. C. Jennett, and G. V. Goodman.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 423-429, 7 Fig, 2 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Cadmium, *Copper, *Lead, *Zinc, *Algae, Anabaena, Nostoc, Chlorella, Industrial wastewater.

Green algae and blue-green algae were tested for their ability to remove cadmium, copper, lead and zinc from solution. Approximately 50% of the ions were removed by the algae, although this was not reproducible with the zinc ion. Calculations for process design and algae mass for some industrial wastewater situations are given. The study confirms other reports that algae introduced to metals in solution are capable of removing them from solution.
W85-05426

COPPER RECOVERY FROM A BRASS BRIGHT DIPPING SOLUTION,
Modine Mfg. Co., Racine, WI.
J. C. Egide, and W. M. Robertson.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 431-438, 4 Fig, 4 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Copper, *Brass, Metal-finishing wastes, Operating costs, Economic evaluation.

An acid retardation system for the removal of copper metal and its subsequent recovery from a brass bright dipping solution has been developed and field proven by the Modine Manufacturing Company at its Trenton, Missouri facility. The system returns concentrated etchant chemicals back to the processing bath. Advantages of the system, in addition to the recovery of copper metal, include a reduction of overall cleaning line maintenance time, an improvement in process bath life, a reduction in wastewater treatment operations, and an overall stabilization of the cleaning line processes. The system has demonstrated a rapid payback and has readily justified the initial capital investment.
W85-05427

DISTRIBUTION OF CADMIUM AND NICKEL IN ACTIVATED SLUDGE SYSTEMS,
Illinois Inst. of Tech., Chicago. Dept. of Environmental Engineering.
P. S. Kodukula, and J. W. Patterson.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 439-448, 14 Fig, 29 Ref.

Descriptors: *Wastewater treatment, *Nickel, *Cadmium, *Hydrogen ion concentration, Activated sludge process, Adsorption, Suspended solids, Precipitation.

pH seems to be a master variable controlling adsorption of metals to activated sludge solids. Percent metal adsorption increased by > 70% over 1-2 units of pH change. In the case of cadmium, significant change in percent adsorption seems to occur between pH values of 5.0 and 7.0 whereas for nickel, the adsorption edge is shifted toward a higher pH with maximum change in percent removal being in the pH range of 6.0 to 8.0. At a pH of 8.0, removals of both cadmium and nickel were 90% while at pH 7.0 removal of cadmium remains about the same with that of nickel dropping down to 60%. For the highest removals to cadmium as well as nickel, a pH > 8.0 would be preferable. The effect of suspended solids on distribution of metals at a high pH (8.0) seems to be minimal but is quite significant at low pH. In the case of cadmium as well as nickel at a pH of above 8.0 is solid-bound metal was above 90%, irrespective of suspended solids concentrations tested. However, at pH levels below 7.0, influence of suspended solids on metal distribution is more pronounced. Thus a combination of low pH levels and low suspended solids concentrations yields adverse results when high removals of metals, particularly, nickel, are desired. The results of this study demonstrate that at the mixed liquor suspended solids concentrations and pH values, generally encountered in full-scale activated sludge plants, metals are removed primarily by sorption processes. Even at low pH levels, where adsorption diminishes, precipitation may not take place because of the simultaneous increase in the solubility limit of the system with a decrease of pH.
W85-05428

WASTEWATER TREATMENT FOR A SMALL CHROME PLATING SHOP: A CASE HISTORY,
J. G. Rabosky, and T. Altares.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 449-456, 2 Fig, 6 Tab.

Descriptors: *Wastewater treatment, *Metal-finishing wastes, Nickel, Copper, Heavy metals, Sludge, Chemical precipitation, Polyelectrolytes, Sulfuric acid.

A case history is presented of the design and operation of a wastewater treatment plant that dealt with the heavy metal, cyanide and phenol discharges from a small chrome plating shop. The raw wastewater was first analyzed and the flow-rate determined. Separate pits have been used to store the wastes from nickel/chrome vs copper plating operations separately; this procedure was maintained. For both wastewaters, sulfuric acid and polyelectrolyte were added, and the mix allowed to set for one hour. The metals precipitated after phase separation although the pH's were different in the two tanks. pH was then adjusted to 7.5-8.0 and the effluent was discharged. Sludge phases from both nickel/chrome and copper wastewater treatment were retained in a storage

tank for disposal by a contracted waste disposal service.
W85-05429

REMOVAL OF CHELATED NICKEL FROM WASTEWATERS,
Harza Engineering Co., Chicago, IL.
K. V. Mayenkar, and A. L. Lagvankar.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 457-472, 9 Fig, 8 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Nickel, Iron, Adsorption, Electric powerplants, Copper, Heavy metals.

The adsorption process was examined as a practical means of removing heavy metals, particularly nickel from boiler tube chemical cleaning wastewaters produced in steam-electric power plants. Bench scale studies of an iron filings treatment process, conclusions and recommendations are presented. For a give type of wastewater, dilution and filings/wastewater (F/W) ratio, quiescent and circulatory contact modes provided effective nickel removal. Wastewater filution considerably improved the rate of nickel removal for a given F/W ratio and contact mode. Higher ratios of iron filings contacted per unit volume of wastewater (F/W) removed larger amounts of nickel from the wastewater than for lower F/W ratios. The type of chelating agent present in the wastewater affects reaction rate. Higher wastewater temperatures may not improve the nickel removal rate. Under quiescent contact, an increase in bed surface area for a given F/W ratio improves the nickel removal rate. The overall metal removal rate in iron filings treatment are somewhat slow. However, the time of reaction should not rule out treatment by iron filings as a viable process for industries such as utilities where chemical cleaning wastewaters are generated only few times a year. This is especially true if the treatment results in a substantial cost savings.
W85-05430

TREATMENT OF ELECTROLESS COPPER PLATING WASTES,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
P. L. Bishop, and R. A. Breton.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 437-480, 5 Fig, 7 Ref.

Descriptors: *Wastewater treatment, *Copper, *Metal-finishing wastes, Mathematical models, Electrolysis, Hydrogen ion concentration.

The performance of a specific high-surface area electrolysis system treating dilute, chelated copper rinsewaters from the printed circuit board industry was studied in terms of copper removal efficiency. The use of high-cathodic surface electrolysis technology can effectively remove copper from dilute, chelated rinse waters, with copper removal efficiency of 80 to 85%. Influent pH had relatively little effect on chelated copper removal over the pH range of 3 to 11. Influent copper concentration and flow rate (superficial velocity) exerted the strongest influences on unit performance. Removal efficiency was independent of influent copper concentration above 50 milligrams/l, but removal efficiency decreased significantly below this concentration. Flow rate (superficial velocity) proved to be the best predictor of unit performance. Recirculation of recovery unit effluent had no effect on overall treatment efficiency. A mathematical model was tested for its validity using experimental data and may be used to estimate certain design parameters for similar electrolytic devises treating chelated rinse waters.
W85-05431

BIODEGRADATION OF CHEMICAL PLANT WASTEWATER CONTAINING DIMETHYLFORMAMIDE,
Black and Veatch, Kansas City, MO.
J. L. Carter, and D. A. Young.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 481-486, 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Chemical wastes, Dimethylformamide biological treatment, Organic compounds, Biodegradation.

The design of a biological system for the treatment of chemical plant wastewater containing dimethylformamide (DMF) is reported. The design and operation of this treatment plant were verified with a bench scale treatment plant. Operation at the design feed rate of 40 pounds DMF/day/1,000 cu ft was achieved with an effluent concentration of less than 10 mg/l for a three-month period. The pilot plant continues in operation, exploring different operating temperatures and feed rates. Effluent concentrations of less than 10 mg/l were achieved at feed rates as high as 90 pounds DMF/day/1,000 ct ft. Biological treatment of high strength DMF wastes has proven effective and practical.
W85-05432

CASE HISTORY: TREATMENT OF CHEMICAL PLANT WASTEWATER,
Weston Environmental Consultants-Designers, West Chester, PA.
R. Junkins.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 487-492, 4 Fig, 5 Tab.

Descriptors: *Wastewater treatment, *Chemical wastes, *Case studies, *Biological treatment, Biological oxygen demand, Chemical oxygen demand, Suspended solids, Pilot plants, Design criteria.

A case study concerning treatment of chemical plant wastewaters is presented. The raw wastewater was first analyzed and characterized. A biological approach to treatment was tested on a bench scale and the results used for the process design of a full scale plant. This biological approach has proven to be effective in operation as discharge limits for BOD, COD and suspended solids were consistently met or bettered. It is emphasized that due to the variability of chemical plant wastewater characteristics, treatability studies should be conducted on a case-by-case basis in order to identify and quantify the design parameters.
W85-05433

EVALUATION OF CHLOROFORM REMOVAL IN A BIOLOGICAL TREATMENT SYSTEM TO MEET BAT LIMITS,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
Y. Argaman, and J. H. Koon.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 493-507, 5 Fig, 9 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Chloroform, Biological treatment, Aeration, Mathematical model, Costs, Activated sludge process, Activated carbon, Capital costs, Operating costs, Effluents.

The cost and effectiveness of eight treatment options for chloroform removal are summarized. The costs are only those which would be incurred in removing chloroform. The installation of subsurface aeration would result in the savings of $154,000/yr in energy costs. However, it is estimated that the difference in total annual cost for this option compared to use of surface aeration would be very small. Effluent chloroform concentrations would be significantly higher using subsurface aeration compared to using surface aeration. Calculated effluent concentrations obtained using the (1) PACT process or (2) an activated carbon approach are low, but the cost of implementing these options is very high, ranging from approx $4,440,000-$6,620,000. The incremental chloroform removed for these processes is very small compared to the relatively great cost for implementing these process alternatives. The calculated effluent chloroform concentrations for four others lay between 30 and 50 micro-g/l, while the cost of implementation ranged from $240,000/yr to $1,130,000/yr.
W85-05434

EDS COAL LIQUEFACTION WASTEWATERS: ZERO-DISCHARGE TREATABILITY STUDIES,
Exxon Research and Engineering Co., Florham Park, NJ.
S. A. Kaczmarek, and F. L. Robertaccio.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 509-517, 5 Fig, 4 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Coal liquefaction, Biological treatment, Activated carbon, Activated sludge process, Cooling towers, Water reuse, Organic carbon, Organic acids, Phenols, Ammonia, Dissolved solids.

Research to verify the commercial readiness of a zero-discharge treatment scheme for wastewaters produced by the EDS coal liquefaction process is discussed. Each separate process selected for the treatment of EDS wastewater has been demonstrated. The overall process scheme is capable of removing the wastewater constituents that could jeopardize the water's use in cooling tower. The coal liquefaction process waters tested would normally be diluted by other less concentrated and historically-treatable wastewater streams onsite, allowing even more confidence in assuring proper functioning of each of the treatment steps. For example, ammonia is controlled by stripping, biological treatment and cation exchange. In a full-scale operation, a stripper could target its ammonia removal to a level consistent with the nutrient needs of biological treatment. This study demonstrated several advantages to using carbon in Powdered Activated Carbon Treatment (PACT) rather than relying solely on Granular Activated Carbon adsorption. The PACT effluent of this study had similar characteristics to the GAC discharge after 150 turnovers, and achieved that with more economical use of the activated carbon (ie, more total organic carbon removed per mass of activated carbon). Assuming that ammonia and acid gas stripping, plus solvent extraction of phenolic compounds, were prerequisites for successful wastewater treatment, organic acids appear to have the greatest impact on overall treatment train design. They affect sizing of organic carbon removal facilities (biological treatment and carbon adsorption), the ability of strippers to remove ammonia, and the dissolved solids content of the post-stripped waters. Thus, future data on EDS-like wastes should try to quantify the organic acid component more adequately if an overly conservative treatment train design is to be avoided.
W85-05435

BIOLOGICAL TREATABILITY OF UNDERGROUND COAL GASIFICATION WASTEWATER,
Texas Univ. at Austin. Dept. of Civil Engineering.
T. P. Caire, D. F. Lawler, and M. J. Humenick.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 519-527, 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Coal gasification, Biological treatment, Kinetics, Chemical oxygen demand, Ammonia, Thiocyanate, Nitrogen compounds, Sulfur compounds, Phenols, Organic compounds, Suspended solids.

Wastewaters generated by an underground gasification process in Hanna, Wyoming were studied to (1) evaluate the kinetic coefficients; (2) determine the removal efficiency of selected wastewater contaminants and (3) observe the dependence of removal efficiency on sludge age. The wastewater had to be diluted to 10% strength due to inhibitory chemicals; 10 mg/liter of phosphorous was added to the diluted wastewater for optimum efficiency.

COD removals of 90% were obtained. The best estimates of the yield (Y) and decay (Kd) coefficient values associated with activated sludge treatment of this wastewater at 10% strength are 0.35 mg VSS produced/mg COD removed and 0.075/day, resp. Simple phenolic compounds, which comprise 70% of the COD of this wastewater, are almost completely removed during biological treatment. Thiocyanate and ammonia also can be oxidized by this process.
W85-05436

BIOTOXICITY OF COAL LIQUEFACTION WASTE IN THE ACTIVATED SLUDGE PROCESS,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
K.-C. Tsai, M. Fleischman, N. S. Yee, and J. H. Gray.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 529-539, 4 Fig, 5 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Coal liquefaction, Biological treatment, Ammonia, Nitrogen compounds, Air stripping, Phenols, Sulfides, Chemical oxygen demand, Biological oxygen demand, Suspended solids, Hydrogen sulfide, Nitrification, Retention time, Aeration, Organic loading, Shock loads, Sludge volume index, Settling velocity, Effluents, Turbidity, Biomass.

It is possible to remove high levels of ammonia nitrogen from coal liquefaction wastewater by the activated sludge process with simultaneous high sulfide removal by air stripping. The factors to encourage nitrification include low ammonia loading (0.0106 g NH3-N/g MLSS/day), long hydraulic detention time (5 days), low organic loadings (0.163 g COD/g MLSS/day), long solids retention time (> than 60 days), gradual acclimation, and avoidance of shock ammonia loading. Ammonia nitrogen levels < 345 mg/l in the influent coal liquefaction wastewater or 0.0106 g NH3-N/g MLSS/day loading consistently produced effluent concentrations < 7.5 mg/liter. Above this influent concentration, the reactor's ammonia removal performance becomes unstable. Sulfides are removed from wastewater primarily by air stripping action in the aeration tank which has a pH of about 7. Air stripping of sulfide is highly efficient (> 99%) and its performance is independent of organic or ammonia loading to the tank. However, since H2S is released to the air, human exposure to the gas may pose a health risk. Chemical oxygen demand (COD) removal by the system was unaffected by changes in influent ammonia concentrations. Although BOD and phenol removals are susceptible to shock loading of ammonia nitrogen than is COD removal. Biotoxicity in the activated sludge reactor did not occur at phenol concentration as high as 1,800 mg/liter and phenol loading as high as 0.13 g phenol/g MLSS/day. The sludge settleability as measured by zone settling velocity (ZSV) and sludge volume index (SVI) improved during the six months of this study. Turbidity in the effluent increased as the levels of ammonia and sulfide in the influent increased. When the organic loading to the tank was doubled, the corresponding COD and BOD levels in the effluent also doubled. The biomass production declined significantly as the organic loading was doubled.
W85-05437

USE OF THE DOUBLE ALKALI FLUE GAS DESULFURIZATION PROCESS TO TREAT ELECTRIC UTILITY METAL CLEANING WASTES,
Donohue and Associates, Inc., Sheboygan, WI.
M. Crosser, and S. LaViolette.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 541-551, 13 Fig, 5 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Power plants, *Flue gas resulfurization, Bromate, Metals, Cadmium, Lead, Filter Cake, Boiler water, Arsenic, Organic compounds, Lime, Filtration, Land disposal, Arsenic, Chromium, Copper, Selenium.

The use of the flue gas desulfurization (FGD) process to treat wastewaters produced by removing scale from the boiler tubes and air heater of the Newton power station is reported. Ammoniated EDTA and ammoniacal bromate were chosen as the test cleaning solution as these are commonly used and are most difficult to treat by conventional methods. Ammoniated EDTA boiler cleaning wastewater cannot be used for slaking lime both because the EDTA solubilizes a substantial amount of calcium and because the slaking reaction is inhibited. Because ammoniacal bromate could potentially oxidize sulfite to sulfate and adversely effect the FGD buffer system, the slaking lime option was dropped. Washing filter cake with ammoniated EDTA or ammonia bromate is suitable at wash ratios of < 0.5 gm spent solution per gram cake moisture. As, Cd, Ba, Cr, Ag, Cu, Pb or Se are not increased in the filtrate returned to the process loop. Cake strength is maintained and the cake is not hazardous as defined by the RCFA. The metals in the cake can be isolated from the environment by proper landfilling. Disposal vs treating costs are compared.
W85-05438

UPGRADING THE PERFORMANCE OF A BLAST FURNACE SCRUBBER WATER CLARIFIER BY COAGULATION/FLOCCULATION OPTIMIZATION,
Dofasco, Inc., Hamilton (Ontario).
A. J. Palmer, and D. W. Averill.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 553-560, 4 Fig, 3 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Steel industry, *Flocculation, Suspended solids, Bench scale modelling, Optimization, Scale-up techniques, Clarifiers, Clarification, Model studies, Effluents.

Bench-scale modelling procedures, process optimization methodology and scale-up techniques in general are reviewed. The application of these techniques to solve the full-scale problem of the removal of particulates from a blast furnace scrubber water is outlined. Bench-scale optimization, using response surface methodology, was an effective technique for the improvement of process performance. An approximate comparison between a bench-scale model and full-scale hydraulic conditions resulted in a successful modification of the full-scale apparatus. In this case the lack of complete similarity between the two scales did not prevent attainment of the project goals. Inefficient flocculation was determined to be a major problem in the blast furnace clarifier system. This blast furnace clarifier is capable of providing an effluent containing a net suspended solids concentration of < 15 mg/liter. The process modification that increased flocculation substantially was successful in significantly reducing random and seasonal variation in clarifier performance.
W85-05439

BIOLOGICAL TREATMENT OF HIGH-STRENGTH COKE-PLANT WASTEWATER,
Alabama Univ. in Birmingham. Dept. of Biology.
D. D. Jones, J. L. Speake, J. White, and J. J. Gauthier.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 561-570, 13 Fig, 1 Tab, 10 Ref.

Descriptors: *Wastewater treatment, *Biological treatment, *Coke-plant wastewater, Ammonia, Organic carbon, Nitrification, Bacteria, Activated sludge process, Retention time, Effluent, Toxicity, Sludge volume index.

The objective of this project was to determine if a microbial population that had already been adapted to ammonia stripped coke-plant wastewater could be further acclimated to treat higher levels of ammonia and organic loading. Treatment of ammonia liquor (influent to the still) appears to be limited to a total organic carbon (TOC) of not more than 400 mg/liter at a hydraulic retention time of 42 hr. It is not clear whether the limitation is the inability of the microbes to degrade specific components of the influent load, thus increasing the toxicity, or the indirect consequence of filamentous growth that interferes with normal treatment plant operation. The increase in effluent TOC may have two different adverse effects: It may result in inhibition of the nitrifying bacteria, and it may create a selective environment for filamentous bacteria which may be less sensitive to the increased toxicity. It is concluded that high influent loadings of coke-plant wastewater may lead to the development of filamentous growth. Once established, such treatments as alkaline pHm exposure to hydrogen peroxide, and wasting at 4% or greater do not reduce the filament population. Operating at elevated temperature (42 C), effectively reduces the filamentous growth and improves settleability while maintaining good effluent quality. However, the long-term effects of operating at this temperature have not been determined.
W85-05440

CHEMICAL REACTOR DESIGN THEORY AND BIOLOGICAL TREATMENT OF INDUSTRIAL WASTES: IS THERE A GAP,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
A. W. Busch.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 571-577, 6 Fig, 21 Ref.

Descriptors: *Wastewater treatment, *Mathematical models, *Activated sludge process, Chemical reactions, Design criteria, Kinetics, Biomass, Biological treatment, Sedimentation.

Issues arising from the application of chemical reactor design theory for first order reactions to aerobic biological waste water treatment are addressed. The Monod kinetic model and/or its first order approximation are convenient descriptions of experimental data. However 'constants' of Ks and Um are highly system specific and thus are coefficients. Use of chemical reactor design theory for 'first-order' reactions is mathematically encouraged by the 'linear' relationship of the Monod model and/or its first order approximation. Biological continuous, stirred tank reactors (CSTRs) have the capacity to operate at the same overall average specific reaction rate as plug flow reactors (PFRs) and batch reactors (BRs). This can be shown conveniently by operating the CSTR at lower MSS concentrations. Thus, there is a 'gap' between chemical reactor design theory and biological waste water treatment. Maximum substrate removal rate cannot exceed loading rate. That is, loading rate is the limit on removal rate until maximum removal rates are achieved. Thus, an underloaded CSTR fulfills chemical reactor design theory by operating at a lower removal rate (read loading rate) than a batch or plug flow reactor. Reports of problems with settling properties of CSTR biomass are likely due to an underloaded process; i.e., too high MLSS. Biological CSTRs designed by chemical reactor therapy will have a greater treatment capacity than anticipated if oxygen transfer, nutrients, and final clarifiers are not limiting. Owners of treatment systems designed by chemical reactor theory are unlikely to complain if they find a higher capacity than anticipated and paid for. A rational basis for determining reactor performance is the Effluent Refractory Assessment test.
W85-05441

PILOT SCALE INVESTIGATIONS ON THE REMOVAL OF VOLATILE ORGANICS AND PHTHALATES FROM ELECTRONICS MANUFACTURING WASTEWATER,
Camp, Dresser and McKee, Inc., Boston, MA.
K. F. Whittaker, and A. T. Moore.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 579-589, 12 Fig, 7 Tab, 3 Ref.

Descriptors: *Wastewater treatment, Industrial wastewater, Activated carbon, Air stripping,

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Methylene chloride, Electronic equipment, Organic compounds, Phthalates, Adsorption, Economic aspects, Operating costs.

The capability of powdered activated carbon to remove toxic organic compounds from electronic component manufacturing wastewater was examined. Activated carbon is not well suited for the removal of methylene chloride from wastewater. Carbon's low adsorption capacity, and therefore, the need for frequent replacement to prevent compound desorption suggest that alternate means of treatment, such as air-stripping, would be far more suitable. Removal of other volatile organic compounds with activated carbon may be feasible due to demonstrably higher isotherm capacities. Since carbon requirements for full-scale column treatment are predictable from isotherm data, adsorbent requirements (and therefore approximate operating costs) should be predictable once influent concentrations and isotherm relationships are known. In treating electronic manufacturing wastewater, careful consideration should be given to the economic benefits of using a combination of air-stripping and activated carbon. Whereas the combined unit operations are effective in removing volatile organics, activated carbon alone will be successful in removing phthalate compounds. The high affinity of activated carbon for phthalates suggests that the concentration of these chemicals will not be a critical parameter in determining effective carbon adsorption life.
W85-05442

BATCH ADSORPTION OF ORGANIC POLLUTANTS FROM OXIDATION POND EFFLUENTS USING FLY ASHES,
Cleveland State Univ., OH. Dept. of Civil Engineering.
Y.-T. Hung.
International Journal of Environmental Studies, Vol. 21, No. 3/4, p 261-270, October, 1983. 4 Fig, 5 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Fly ash, *Adsorption, *Organic compounds, Oxidation ponds, Tertiary wastewater treatment, Volcanic ash.

The use of fly ash was evaluated in the tertiary treatment of wastewater to improve the oxidation pond effluent quality and to determine factors affecting the organic pollutant removal efficiency. The adsorbents selected for this study were three fly ashes obtained from power plants in North Dakota. A volcanic ash was also used for comparative purposes. Factors affecting organic removal efficiencies for oxidation pond effluent by fly and volcanic ashes were ash dosages, ash sizes, initial COD concentrations, and pretreatment condition of ashes. An increase in fly ash concentration caused a continual increase in organic removal efficiency until a fly ash concentration of 1000-2000 mg/l was attained, after which the removal efficiency remained fairly constant. The total organic carbon (TOC) removal efficiency varied from 30% to 58% at an ash concentration of 6000 mg/l. A decrease in fly ash sizes resulted in an increase in organic removal efficiency. A higher organic removal efficiency was observed at a lower initial pond effluent organic concentration. Washing of ashes by distilled water generally reduced the organic removal efficiency. Among the four ashes tested, volcanic ash D exhibited highest adsorption capacity due to its large surface area of 13,894 sq cm/cu cm. (Baker-IVI)
W85-05445

GROWTH STUDIES OF AZOLLA PINNATA BRR. IN A PERMANENT POND,
Indian Inst. of Tech., New Delhi. Centre for Rural Development and Appropriate Technology.
T. S. Kumar, P. Vasudevan, and S. V. Patwardhan.
International Journal of Environmental Studies, Vol. 21, No. 3/4, p 297-300, October, 1983. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Biological wastewater treatment, *Aquatic plants, *Biomass, Plant growth, Seasonal variation, India, Ponds.

Azolla growth was studied in a permanent pond in a village in India. The increase in biomass was determined every week by sampling Azolla pinnata from 20 x 20 cm quadrants from the pond. Depending on the season the samples consisted of mixed populations of Spirodela polyrhiza (duckweed) and A. pinnata. Over almost the entire year the water surface is covered with these two plants except when there is a shift from Azolla to to Spirodela. Growth is typically sigmoidal in nature. On the basis of weekly observations and the increment in terms of biomass, the doubling time is found to vary from 5.5 days to 13.5 days. Doubling time is lowest in October and November and increases with time. The observations indicate the suitability for integration of Azolla into various wastewater treatment systems. (Baker-IVI)
W85-05447

REMOVAL OF PHENOL USING WATER HYACINTH IN A CONTINUOUS UNIT,
Excel Industries Ltd., Bombay (India).
S. Vaidyanathan, K. M. Kavadia, M. G. Rao, S. Basu, and S. P. Mahajan.
International Journal of Environmental Studies, Vol. 21, No. 2, p 183-191, August, 1983. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Biological wastewater treatment, *Phenols, *Water hyacinth, Cost analysis, Industrial wastes, Wastewater treatment.

Experimental runs were performed on a continuous unit in an attempt to apply water hyacinth as a low cost treatment system for phenol removal from industrial wastewaters. Phenol in concentrations of 25, 75, 100, and 125 mg/l were added to an overhead tank, hyacinth and control tank. Detention times of 24 and 36 hrs were kept and flow rate adjusted knowing that the volume of hyacinth tank was 62 liters. The removal efficiencies were correlated with influencing parameters such as water hyacinth concentration, organic loading and hydraulic loading. The correlation offered a simple tool for the optional design of a water hyacinth system for phenol on an industrial scale. (Baker-IVI)
W85-05449

POLLUTING SEWERS BROUGHT UNDER CONTROL,
Marion County Health Dept., Indianapolis, IN. Bureau of Environmental Health.
For primary bibliographic entry see Field 5G.
W85-05470

WINTER WATER AND WASTEWATER OPERATIONS,
G. W. Szelc.
Public Works, Vol. 115, No. 8, p 62-64, August, 1984. 1 Fig.

Descriptors: *Water treatment facilities, *Wastewater facilities, *Cold weather operation, Ice formation, Water treatment, Settling basins, Freezing, Wastewater treatment, Intakes, Pipelines, Trickling filters.

A limited survey of select northern US water and wastewater facilities was made to examine winter problems and solutions. Some of the techniques will be of value to other operators and may be of particular help to those operating new treatment plants that have not yet gone through a winter season. A variety of problems surfaced with water treatment facilities. Freezing pipelines and ice formation in the various treatment basins were troublesome as were outdoor chemical feeding systems. Surface water intakes were plagued with ice formation and ice crystals blocking the intake screens. Ice formed around the drive columns of a circular sludge collector in an open settling basin. Ice movement in the settling basins caused some damage to concrete effluent flumes. Treatment equipment and processes for wastewater also face problems with winter cold and snow. Freezing pipelines, ice, problems with snow removal, a slow down in biological activity, and other factors all combined to tax the efforts of most operators. Trickling filters lost some of their efficiency in the colder climes and activated sludge might be the better choice. (Baker-IVI)
W85-05481

PRIMARY EFFLUENT FILTRATION. THE WARMINSTER EXPERIENCE,
Warminster Municipal Authority Wastewater Treatment Plant, PA.
S. Becker, and G. A. Garzonetti.
Public Works, Vol. 116, No. 2, p 54-56, February, 1985. 4 Fig.

Descriptors: *Wastewater treatment, *Primary effluent filtration, *Warminster, *Pennsylvania, Filtration, Trickling filters, Sand filters, Cost effectiveness.

Warminster is investigating a sand filter/trickling filter/sand filter scheme to increase plant capacity from the present 3 mgd to 7 mgd. The filtration of primary effluents has not been successful in the past because of high solids and grease content. With conventional filtration techniques, solids and grease clog the filter surfaces, resulting in very short filter runs and frequent backwashing. A cost effectiveness study indicated that expanding a trickling filter plant from 10 mgd to 20 mgd would be less expensive through increased trickling filters. Primary effluent filtration (PEF) and trickling filters were also shown to represent 15-20% less in operating costs than a conventional activated sludge system. Several benefits occur as a result of filtering primary clarified effluent ahead of secondary treatment. PEF allows the use of low cost trickling filters for secondary treatment instead of energy- and capital-intensive biological treatment with aeration. No matter which type of secondary treatment is used, PEF can allow significant plant expansions. Because waste activated sluge processes can be eliminated or avoided through the use of PEF, sludge handling costs can be significantly reduced. PEF substantially reduced humus generated in tricklng filters. The decrease in humus and increase in primary type solids improved the quality of digester supernatant, reducing its treatment needs. (Baker-IVI)
W85-05487

CROSSFLOW MEMBRANE TECHNOLOGY AND ITS APPLICATIONS,
Osmonics, Inc., Hopkins, MN.
D. J. Paulson, R. L. Wilson, and D. D. Spatz.
Food Technology, Vol. 38, No. 12, p 77-111, December, 1984. 13 Fig, 1 Tab, 21 Ref.

Descriptors: *Wastewater treatment, *Food processing wastes, *Filtration, *Membrane processes, Industrial wastes, Ultrafiltration, Microfiltration, Reverse osmosis.

Reverse osmosis, ultrafiltration (UF), microfiltration (MF), and particulate filtration are discussed with primary emphasis on the use of membranes in crossflow filtration. Crossflow membrane filtration is fundamentally different in design from other systems in that the influent stream is separated into two effluent streams, known as permeate and concentrate. The permeate is that fraction which has passed through the semipermeable membrane. The concentrate is that stream which has been enriched with the solutes of suspended solids which have not passed through the membrane. The membrane media is continuously self cleaned with solutes and solids swept away by the concentrate stream which is running parallel to the membrane. Required membrane characteristics are considered including pressure resistance, temperature resistance, pH resistance, and chemical compatibility. Membrane configuration for MF and UF are considered including tubular elements, hollow-fiber or capillary fiber, plate and frame element, and spiral wound element. Membrane configurations considered for RO include tubular, hollow fiber, plate and frame, and spiral wound. Crossflow filtration applications include desalination, and treatment of a variety of food processing waste streams. (Baker-IVI)
W85-05506

METABOLITES AND BIODEGRADATION PATHWAYS OF FATTY ALCOHOL ETHOXYLATES IN MICROBIAL BIOCENOSES OF SEWAGE TREATMENT PLANTS,
Henkel K.G.a.A., Duesseldorf (Germany, F.R.). Dept. of Ecology.
J. Steber, and P. Wierich.
Applied and Environmental Microbiology, Vol. 49, No. 3, p 530-537, March, 1985. 5 Fig, 5 Tab, 38 Ref.

Descriptors: *Wastewater treatment, *Biodegradation, *Fatty alcohol ethoxylates, Metabolites, Polyethylene glycol, Model studies, Isotopic tracers, Bacteria.

The characterization and identification of radiolabeled metabolites isolated from the effluent of a model sewage treatment plant are described. There is a faster degradation of the alkyl than the polyethylene glycol moiety and there are two distinct primary degradation mechanisms acting simultaneously in microbial biocenoses: intramolecular scission of the surfactant as well as oxidations of the alkyl chain. Characterization of the bulk of C-14 labeled metabolites as a homologous series of neutral and acidic polyglycol units and identification of several C2-fragments accounted for the depolymerization of the hydrophilic part of the surfactant by stepwise cleavage of ether-bound ethoxylate (EO) units. Hydrolytic as well as oxidative cleavage of C2-units is involved from additional degradation studies employing either neutral or carboxylated C-14 labeled polyethylene glycols as model metabolites. Most of the identified low-molecular-weight C-14 labeled acids suggest an ultimate degradation of EO monomers by the oxidative dicarbonic acid cycle or the glycerate pathways or both. In addition, the finding of considerable amounts of oxalic and formic acids allow consideration of an additional, mineralization route via glyoxylic, oxalic, and formic acids. The simultaneous action of different degradation mechanisms indicates the involvement of several distinct bacterial groups in the biodegradation of fatty alcohol ethoxylates under environmental conditions. (Baker-IVI)
W85-05510

EFFECT OF SEEDING DURING THERMOPHILIC COMPOSTING OF SEWAGE SLUDGE,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
K. Nakasaki, M. Sasaki, M. Shoda, and H. Kubota.
Applied and Environmental Microbiology, Vol. 49, No. 3, p 724-726, March, 1985. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Sludge composting, *Inoculation, *Wastewater treatment, Thermophilic composting, Biological treatment, Carbon dioxide, Composting, Thermophilic bacteria, Bacteria.

The effect of seeding on the thermophilic composting of sewage sludge was examined by measuring the changes in carbon dioxide revolution rates and microbial numbers. The starting materials for composting were prepared by mixing gamma-irradiated compost product or nonirradiated compost product as the seed with the raw sludge but at different ratios to retain similar physical and chemical properties. From the results it can be deduced that the rate of composting of sewage sludge is mainly controlled by the degradability of solid substrates and not by the kinds of microorganisms inhabiting the compost. The seeding of compost products at the start of sewage sludge composting, therefore, is unlikely to have any appreciable effects on the rate of composting or on the quality of the final product, although the degree of the contribution of thermophilic bacteria and thermophilic actinomycetes to the carbon dioxide evolution rate depends heavily on the amount of seed added. (Baker-IVI)
W85-05513

ASPECTS OF WATER AND SEWAGE TREATMENT IN AUSTRALIA,
Gutteridge, Haskins and Davey, Melbourne (Australia).
For primary bibliographic entry see Field 5F.
W85-05514

STABILITY AND SETTLING OF SUSPENDED SOLIDS IN SETTLING PONDS. PART II. DIFFUSION ANALYSIS OF INITIAL SETTLING OF SUSPENDED SOLIDS,
McGill Univ., Montreal (Quebec). Geotechnical Research Centre.
For primary bibliographic entry see Field 2J.
W85-05527

TEMPERATURE AND NUTRIENT EFFECTS ON THE ANAEROBIC EXPANDED BED TREATING A HIGH STRENGTH WASTE,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
C. R. Kelly, and M. S. Switzenbaum.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 591-601, 4 Fig, 4 Tab, 27 Ref.

Descriptors: *Wastewater treatment, *Temperature effects, *Nutrient requirements, Anaerobic digestion, Micronutrients, Iron, Cobalt, Nickel, Activated sludge process, Chemical oxygen demand, Effluents, Suspended solids.

The purpose of this study was to define accurately the effects of temperature and nutrients on the anaerobic film expanded bed (AFEB) process treating a high strength waste. The AFEB process is relatively temperature insensitive. Calculated activation energies were low and within a narrow range (1875-3099 cal/mole). These values are much lower than those reported for anaerobic slurry systems. Likewise, calculated Q10 values were low (1.11-1.19) and indicate that the AFEB process is even more temperature tolerant than the activated sludge process. The AFEB process is more restricted by diffusional limitations than by biochemical reaction rates. Q10 values were on the order of 1.2 which is even less than typical values reported for diffusion limited systems. The addition of iron, cobalt, and nickel greatly enhanced reactor performance. COD removal rates increased and volatile organic acids (VOA) dramatically decreased after addition of the above elements to the influent substrate. The higher COD removal rates and the lower levels of VOA indicate that the methanogenic bacteria were more affected by nutrient-limitation than were the nonmethanogenic bacteria. Micronutrients must not be overlooked and may not be a critical requirement for some industrial waste treatment applications.
W85-05547

DETERMINATION OF ALKALINITY REQUIREMENTS FOR THE ANAEROBIC TREATMENT PROCESS,
Dorr-Oliver, Inc., Stamford, CT.
A. Li, and P. M. Sutton.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 603-613, 4 Fig, 17 Tab, 18 Ref.

Descriptors: *Wastewater treatment, *Mathematical models, *Anaerobic, Bases, Digestion, Carbon dioxide, Volatile acids, Alkalinity, Hydrogen ion concentration, Bicarbonates, Pilot plants.

The purpose of this paper is to present a rational method for estimating the alkalinity requirements in the anaerobic wastewater treatment process. The demand for alkalinity is mainly for maintaining the CO2 equilibrium and for neutralizing the volatile acids. The calculation procedures are given and can be simplified by the construction of a PC02-BA-VA-PH diagram. A pilot plant demonstrated the usefulness of the model. A short discussion is included on the merits and disadvantages of some neutralizing compounds, such as NH3 and bicarbonate.
W85-05548

EFFECT OF INFLUENT CONCENTRATION ON THE STARTUP OF AN ANAEROBIC DOWNFLOW STATIONARY FIXED FILM (DSFF) REACTORS,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
K. J. Kennedy, and R. L. Droste.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 615-626, 12 Fig, 7 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, Chemical oxygen demand, Load distribution, Volatile acids, Biomass, Influent streams.

This study reports the effects of (1) two support materials (needle punched polyester material and red draintile clay); (2) support surface area to volume rate; and (3) influent substrate concentration on biofilm accumulation and reactor startup. The effective performance of the polyester and the draintile appeared to be a function of the ease with which bacteria become attached. Leaching of minerals out of the clay may be a factor. Needle punched polyester has the advantage of light weight and versatility. Red draintile clay, on the other hand, is almost universally available and cheap. Increased surface area to volume ratios resulted in increased space loading rates and COD removal. Startup of reactors with higher surface area to volume ratios required a longer period of time which appeared to be related to the higher dependence these reactors and on methanogenic biofilm accumulation. Total biomass and biofilm yields were higher and rates of biofilm accumulation faster for treatment of lower strength wastes. The biofilms that were developed had similar specific activities. This would indicate for biofilms up to 1.8 mm in thickness that diffusional resistances in the biofilm were minimal. It appears advantageous to start reactors with a weak waste that would result in greater biofilm accumulation and easier operational control. The study has also shown that space loads can be increased in DSFF reactors while volatile acid levels are maintained between 200-1500 mg/liter. This assumes that the wastes are well buffered and pH is maintained in an optimum range (above pH 6.8). These results differ from those reported for startup of sludge blanket reactors. For these reactors it is reported that volatile acid levels should be negligible before implementing increases in space loads.
W85-05549

DESIGN AND PERFORMANCE OF EGG-SHAPED DIGESTERS FOR COMBINED SLUDGE AND INDUSTRIAL WASTEWATER TREATMENT,
Schulze (Oswald) G.m.b.H. und Co. K.G., Gladbeck (Germany, F.R.)
H. Sixt, and P. A. Wilderer.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 627-636, 9 Fig, 5 Tab, 17 Ref.

Descriptors: *Wastewater treatment, *Sludge digestion, *Industrial wastewater, Sludge, Anaerobic digestion. Design criteria, Performance evaluation, Chemical wastewater, Cotreatment.

The potentials, requirements and benefits of cotreatment of wastewater sludge and highly polluted wastewater in egg-shaped digestors are discussed. This reactor shape provides structural as well as operational advantages. In particular, mixing of the reactor content can be accomplished most effectively, and the energy required to achieve uniform distribution of the reactants is relatively low. Effective mixing is a crucial factor as far as process stability is concerned. This is especially true when solid and liquid wastes are planned to be treated jointly. Local peak concentrations within the reactor can be effectively avoided. The applicability of co-treatment of industrial wastewater and municipal wastewater sludge depends on a number of factors besides perfect mixing. The wastewater to be treated must be low in volumetric quantity compared to the volumetric quantity of the sludge to be treated but rich in easily digestible substrates. The digester, on the other hand, must provide extra capacity. Chemostat conditions must be maintained. The situation in Lahr, Germany, is considered to be almost ideal to investigate the potentials of joint treatment of wastewater and sludge. The technique currently in use is described and preliminary findings are

summarized. The results warrant further investigations.
W85-05550

USE OF LONG SOLIDS RETENTION TIMES TO IMPROVE THE ACTIVATED SLUDGE BIODEGRADATION OF A COMPLEX WASTE,
South Dakota School of Mines and Technology, Rapid City.
K. Hagelstein, and R. R. Dague.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 637-642, 5 Fig, 3 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Retention time, *Activated sludge process, Biological treatment, Pyrolysis waste, Organic carbon, Suspended solids, Biological oxygen demand, Effluents, Toxicity, Daphnia, Monitoring, Biodegradation.

Sludge retention times (SRTs) > 10 days produced effluents with reduced total organic carbon (TOC), biological oxygen demand (BOD), and suspended solid (SS) after activated sludge processing of this complex waste. The advantage of long retention times is the higher concentration of biological solids which is responsible for either higher assimilative or adsorptive removal of the organics. Practically, larger activated sludge units may have to be designed to apply this treatment enhancement. Daphnia magna toxicity tests with 100% effluent from the pyrolysis waste activated sludge units supported the conclusion that long sludge ages (20 and 40 day SRTs) provided more efficient treatment and greatly reduced the toxicity of the complex waste than did the 10 day SRT system. The long SRT activated sludge systems adequately eliminated the toxicity of the pyrolysis waste from a LC50 equaling 0.33% to 100% survival of daphnids in 100% effluent. Therefore, the toxicity testing of an effluent rather than an individual chemical, was successfully applied as a monitoring method to be compared to standard efficiency measurements.
W85-05551

APPLICATION OF CARRIER/ACTIVATED SLUDGE PROCESS FOR TREATMENT OF PHENOLIC WASTEWATER,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
Y. Lu, and J. J. Ganczarczyk.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 643-657, 7 Fig, 8 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, Phenols, Biological treatment, Activated carbon, Coke, Sludge volume index, Biomass, Effluents, Clarifiers, Organic compounds, Substrates.

A hybrid biological process based on the use of suspended carrier particles for biological growth is shown to be a viable modification of activated sludge treatment. It is superior to the activated sludge process operating without a carrier addition as it allows for maintaining a higher biomass concentration in aeration tanks, helps control sludge volume index, and improves substrate removal rates. Two different types of carrier particles were investigated: activated carbon and coke. They differed substantially in their sorption capacity, but this did not affect the process performance under its equilibrium conditions. However, under fluctuating loading conditions, the activated carbon system proved to be much superior in maintaining a stable operation and continuously high effluent quality, apparently due to its higher sorption capacity. The studied process differs from the powdered activated carbon (PAC) activated sludge by an application of larger size carrier particles which can be regenerated by an in-the-system or separate aerobic digestion process, and then recycled back to the treatment reactor. Use of these carrier particles should not create any problems in installations equipped with integrated clarifiers. For those with separate clarifiers, a proper selection of recirculation pumps is required.
W85-05552

ACTIVATED SLUDGE WITH POWDERED ACTIVATED CARBON TREATMENT OF A DYES AND PIGMENTS PROCESSING WASTEWATER,
Industrial Environmental Research Lab.-Cincinnati, OH.
G. M. Shaul, M. W. Barnett, T. W. Neiheisel, and K. A. Dostal.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 659-671, 4 Fig, 7 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Dye industry wastes, *Pigments, *Activated sludge process, *Biological treatment, Activated carbon, Biological oxygen demand, Chemical oxygen demand, Organic carbon, Color removal, Toxicity, Effluent, Suspended solids, Lead, Chromium, Metals, Clarifiers.

This study was designed to evaluate the treatability of a dyes and pigments processing wastewater using an activated sludge (AS) process both with and without the addition of powdered activated carbon (PAC). The activated sludge process removed 50 to 98% of the toxicity as measured by three test organisms, and the addition of powdered carbon increased the removal of toxicity in all cases. The activated sludge process (no PAC) reduced the BOD by 97 to 98% (based upon total influent and soluble effluent) at solids retention times ranging from 4 to 16 days. The AS process reduced the COD and TOC (based upon soluble effluent) by 57 to 75% and 56 to 64% resp. The AS process removed very little of the color, from 0 to 34%. Addition of powdered activated carbon to the activated sludge process increased the removals of BOD, COD, TOC and color with removal ranges of 99 to > 99%, 63 to 96%, 61 to 87%, 0 to 96%, resp. The additional removal of organics by the powdered carbon was a function of the amount of carbon added. The powdered carbon did not improve the removal of soluble lead and chromium, although it did improve the removal of suspended solids in the secondary clarifier.
W85-05553

ANAEROBIC TREATMENT OF TANNERY WASTE,
Agricultural Research Service, Philadelphia, PA. Eastern Regional Research Center.
D. G. Bailey, M. H. Tunick, A. A. Friedman, and G. B. Rest.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 673-682, 13 Fig, 4 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Tannery wastes, *Anaerobic digestion, *Rotating biological contactors, Chemical oxygen demand, Sulfide, Aerobic treatment, Effluents, Methane, Retention time, Hydraulic loading, Biological filters.

Anaerobic roughing treatment followed by aerobic polishing may be suitable for application to tannery wastewaters. Sixty per cent total chemical oxygen demand removals were routinely obtained with both systems. In addition, there is evidence that the anaerobic effluents are readily degraded aerobically and that methane gas recovery plus heat exchange should minimize or negate the energy input needed to maintain the reactor at 37 C. Hydraulic retention times of < 24 hrs. were demonstrated with the anaerobic filters (AF). There is also evidence that anaerobic treatment processes are inherently stable. Data generated by the anaerobic contact (AC) and the AF treatment of tannery wastes showed the anaerobic processes tested to be resistant to hydraulic variations and upsets. On several occasions both the AF and the AC organisms were exposed to oxygen through mechanical difficulties. Restarting either system was generally rapid and required only a few days. Despite reactor sulfide levels as high as 600 mg/l, normally considered toxic, the AC system continued to produce methane. Problems observed in this work on anaerobic treatment should not be ignored. Initial anaerobic startup requires a long period of time (up to six mo). The tannery wastewaters studied presented a particular problem due to the formation of inorganic precipitates. They were sufficient to clog the AF and close down the space between discs on the bench scale rotating biological contactors. This result would favor a suspended growth AC process over the AF for tannery wastewaters.
W85-05554

EFFECT OF ANAEROBIC CONDITIONS ON ACTIVATED SLUDGE SETTLEABILITY,
Kapur and Associates, Inc., Waukesha, WI.
Y.-H. Ni.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 683-691, 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Sludge bulking, *Activated sludge process, Organic carbon, Phosphorus, Anaerobic digestion, Aerobic digestion, Organic loading, Sedimentation, Sludge volume index.

The objectives of this study were to determine the loading parameters of an anaerobic-aerobic system that induced sludge bulking. For anaerobic-aerobic sludge systems having an anaerobic volume to aerobic volume ratio of 0.4 or greater (30% or greater anaerobic volume of the total volume) and having an organic loading of 0.2 lb total organic carbon/lb MLSS, serious settleability problems developed and were primarily due to filamentous organisms. The settleability problems were severe enough to cause process failure. For anaerobic-aerobic activated sludge systems operating at ratios of < 0.4, filamentous sludge bulking did not occur. However, the sludge volume indexes (SVI) were not as good as the completely aerobic system (control). Reaeration of a previous anaerobic reactor of a severely bulking activated sludge system improved the settleability of the MLSS. The SVI went from 450 ml/g to a near normal 80 ml/g (compared to the control) in 5 days. Sludge bulking did not affect the organic removal efficiencies. A removal efficiency of > 90% was obtained through the entire test period. In all of the anaerobic to aerobic volume ratios tested, the 'luxury uptake of phosphorus' was not observed. The soluble phosphorus removals ranged fro 23 to 35%.
W85-05555

NEAR ZERO D.O. ACTIVATED SLUDGE CASE HISTORY,
Weyerhaeuser Co., Tacoma, WA.
W. A. Barkley, R. W. Sackellare, J. R. Ellavsky, R. D. Simmon, and J. W. Yount.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 693-704, 10 Fig, 1 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Pulp and paper industry, *Activated sludge process, *Dissolved oxygen, Sludge bulking, Sludge volume index, Yount filament count, Biological oxygen demand, Clarifiers, Suspended solids, Chlorine, Suspended solids, Aerators, Economic analysis.

Information on operating experiences with a new zero dissolved oxygen (DO) activated sludge treatment of pulp and papermaking wastewater at Weyerhauser's Longview, Washington facility is presented. Operation at a near zero DO concentration in an aerobic system with forced oxygen transfer has been demonstrated. To prevent sludge bulking, chlorine oxidizing agents were added to the return activated sludge line to eliminate filamentous organisms. This (1) resulted in greater system controllability, (2) successfully eliminated float incidents; and (3) controlled sludge volume index (SVI) and Yount filament count (YFC) to desired set points. Decreased soluble BOD removal in the aeration tank has been offset by improved clarifier total suspended solids quality. Oxygen use efficiencies have more than doubled (35-40% now). Savings from blower electrical costs alone equal about $200,000/year.
W85-05556

FATE OF NITRATE IN A SINGLE STAGE NITRIFICATION ACTIVATED SLUDGE SYSTEM,
Merck and Co., Inc., Rahway, NJ.
R. T. Donahue, and J. L. Pintenich.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 705-714, 4 Fig, 7 Tab, 1 Ref.

Descriptors: *Wastewater treatment, *Pharmaceutical wastes, *Nitrification, Denitrification, Activated sludge process, Nitrates, Dissolved oxygen, Effluents, Suspended solids, Biological oxygen demand, Chemical oxygen demand, Sludge, Filters.

Substantial nitrification and denitrification were quantified in bench-, pilot-, and full-scale single stage activated sludge systems treating a pharmaceutical wastewater. Denitrification occurred at mixed liquor dissolved oxygen concentrations as high as 6.0 mg/l in batch aeration tests conducted supplementary to these investigations. Study results, expressed graphically in the form of percentage nitrogen imbalance, are summarized. For purposes of comparison, the range of nitrogen balance closure data reported by Luthy and Jones for treatment of a coke plant wastewater is also presented. Their reported range of 0 to 12% is representative of the closure accuracy expected for a nitrification system operating without denitrification. While elevated dissolved oxygen levels generally tend to suppress the denitrification process, an oxygen gradient existed in the activated sludge systems discussed, thereby allowing for anoxic denitrification in some parts of the biological floc. These anaerobic zones are postulated to occur in the floc centers. This hypothesis is plausible for this pharmaceutical waste since the feed to the activated sludge units contained significant concentrations of sloughed solids from the upstream roughing filter, which provided opportunity for the growth of activated sludge flocs with large diameters.
W85-05557

INFLUENCE OF ORGANIC SHOCK LOADS ON THE PERFORMANCE OF AN ANAEROBIC FLUIDIZED BED SYSTEM,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. Barnes, P. J. Bliss, B. Grauer, E. M. Kuo, and K. Robins.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 715-723, 11 Fig, 1 Tab, 23 Ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Fluidized beds, *Shock loads, Biochemical oxygen demand, Organic acids, Volatile acids, Industrial wastewater, Hydrogen ion concentration, Hydrogen.

The response of an anaerobic fluidized bed system to shock loads of high biological oxygen demand (BOD) concentration (ranging from 8,700 mg/liter to 45,700 mg/liter) imposed over a 1-hr period is reported. The shock loads were chosen so that the total load did not exceed twice the average daily load for continuous reliable operation. A synthetic wastewater was used. For small shock loads (three times a designed load of approximately 12 kg BOD/cu m bed/day), the system exhibited little disruption and continued to provide a high decree of treatment. For high BOD loads, 10-20 times the designed load, the system was stimulated to produce the intermediate products, acetic acid, propionic acid, and hydrogen. These intermediates were converted to the end products but the microbial mass required a finite time to re-adjust to these transients. Once the anaerobic fluidized bed has recovered from a major shock load, it returns to its normal stable operation and will respond in a similar manner to a similar shock load. The stability and response of the reactors could be judged from both the overall performance of the system and the concentrations of intermediates and end products. While total volatile acid concentrations stabilized at continuous loading to reflect the substrate and reaction system, the increase in acids after an organic shock load can be monitored relatively easily by direct measurement and as the pH value. The concentration of the individual intermediate, acetic acid, propionic acid, and hydrogen and particularly the hydrogen gas yield, showed a rapid response to process changes. The recovery of the fluidized bed system suggests that it is suitable for treating wastes of a variable nature but for maximum substrate removal efficiency some form of load equalization is desirable.
W85-05558

RESPONSE OF PHENOL-ACCLIMATED ACTVATED SLUDGE PROCESS TO QUANTITATIVE SHOCK LOADING,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich, and A. F. Gaudy.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 725-736, 7 Fig, 2 Tab, 29 Ref.

Descriptors: *Wastewater treatment, *Mathematical models, *Phenols, *Shock loads, Activated sludge process, Inhibitors, Organic compounds, Kinetics, Detention time.

The kinetic model can be used as an aid in understanding the behavior of the activated sludge process. The use of the model in transient analysis showed the engineering wisdom of employing an inhibitor function when designing for phenolic wastes. From a practical engineering point of view, it is clear that successful treatment calls for design of low, rather than high, specific growth rates and for providing the operator with the means to keep the specific growth rate low, regardless of the changing influent conditions. An examination of the model equations showed that in addition to the five biokinetic constants, there are four engineering parameters which affect mu and thus Se. Mu can be kept low by using relatively high levels of return sludge and providing for higher hydraulic recycle flow, alpha, and a longer detention time, t(1/D). An equalization basin can be used to level out the temporary highs in Si thus lowering the level of growth rate to which the system is subjected.
W85-05559

BIOLOGICAL TREATABILITY OF PHOTOPROCESSING WASTEWATER: PART I,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
R. N. Kinman, K. McKee, B. Mackey, D. L. Nutini, and N. Neely.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 737-749, 7 Fig, 16 Tab.

Descriptors: *Wastewater treatment, *Photoprocessing wastewater, *Activated sludge process, *Microorganisms, Biological treatment, Biological oxygen demand, Chemical oxygen demand, Sludge, Effluents, Contact stabilization.

Data from the operation of a control plant and a test plant treating photoprocessing wastewater are presented and indicate that photoprocessing wastewater is amenable to biological treatment. The test receiving 4% by volume photoprocessing wastewater, which resulted in higher BOD and COD loadings, produced a satisfactory and typical contact stabilization activated sludge effluent very similar to the control plant effluent. No problems were encountered in treating the waste by the contact stabilization activated sludge process. Microorganisms were similar in both plants and indicated a well balanced micro flora and fauna.
W85-05560

ATP AS A MEASURE OF ACTIVE BIOMASS CONCENTRATION AND INHIBITION IN BIOLOGICAL WASTEWATER TREATMENT PROCESSES,
McNamee, Porter and Seeley, Ann Arbor, MI.
S. J. Kang, L. B. Pugh, and J. A Borchardt.
In: Proceeding, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 751-759, 10 Fig, 11 Ref.

Descriptors: *Wastewater treatment, *Inhibition, *Biomass, *Activated sludge process, *Rotating biological contactors, Volatile solids, Biocides, Substrates, Nitrification, Dissolved oxygen, Hydrogen ion concentration, Biological treatment, Copper, Zinc, Lead.

Based on experiments conducted both on pilot scale and full scale municipal waste treatment processes, adenosine triphosphate (ATP) is an accurate and reliable method of measuring active biomass concentration. Using autotrophic nitrifying cultures, the relationship between ATP and substrate utilization rate was established. Effects of pH and dissolved oxygen on nitrification were also reproduced by ATP measurement. The utility of ATP was demonstrated both in activated sludge and rotating biological contactors (RBCs). The relationship among ATP, film thickness, and volatile solids was observed for three stages of RBCs and it was shown that the biomass activity as measured by ATP exhibits a rapid growth before the presence of a significant layer of biofilm. The specific ATP content (ATP per unit weight of VSS) was observed to be 0.33 mg/g VSS in the first stage and 0.6 mg/g VSS in the second and third stages. The lower value for the first stage is due to the presence of nonactive biomass in the outer layer and anaerobic organisms in the inner layer. Because of the advantages of the ATP methodology, it can be a useful tool in identifying the presence of inhibitory substances in the feed for biological cultures. The mechanism of inhibition can be identified by observing the relationship between the ratio between normal and inhibited growth rate and inhibitor concentration. This was demonstrated for known inhibitors: copper, an admixture of zinc and lead, and organic wastes containing biocide.
W85-05561

TREATMENT OF APPLE PROCESSING WASTEWATER BY THE ANAEROBIC FILTER PROCESS,
Northeastern Univ., Boston, MA. Dept. of Civil Engineering.
M. J. Laquidara, and C. R. Ott.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 761-767, 8 Fig, 1 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Biological filters, *Waste treatment, *Food processing wastes, Anaerobic digestion, Biochemical oxygen demand, Methane, Phosphorus, Nitrogen, Chemical oxygen demand, Temperature effects, Nutrients, Detention time, Effluents, Operating costs, Energy efficiency.

The objectives of this study were to determine the treatment capabilities of the anaerobic filter process when fed a mid-strength apple processing wastewater as a function of: (1) operating temperature; (2) nutrient content; and (3) hydraulic detention time. With respect to nutrients the waste had abundant phosphorus but was severely limited in nitrogen. Anaerobic filter treatment efficiency was maximum at 35 C and efficiency decreased with decreasing temperature. Treatment efficiencies (based on COD removal) of 90% and above are possible with waste strengths of 2,000 mg/liter, a one-day detention time. Effluent BOD values only slightly higher than secondary treatment standards can be produced. This implies that, while effluent polishing would be required treatment would be minimal. Because methane gas is produced, it could be used to help maintain the filter's operating temperature. COD/N ratios as high as 150 are acceptable. This ratio is significantly higher than for aerobic systems, and since this waste is nitrogen deficient a savings in nutrient supplement cost would be realized. The system can be very energy efficient. Frictional headloss through the filter was negligible, even after seven months of operation; thus, energy for pumping is mainly a function of system layout.
W85-05562

LIBRARY OF THE UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

OXIDATION OF A CORN-MILLING WASTEWATER WITH HYDROGEN PEROXIDE,
Arizona Univ., Tucson. Dept. of Civil Engineering.
D. deRoulhac, G. L. Amy, and N. C. Burbank.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 769-780, 5 Fig, 3 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Food-processing wastes, Hydrogen peroxide, Fenton reaction, Zein prolamine, Infrared spectroscopy, Organic compounds, Flocculation, Hydrogen ion concentration, Cost analysis.

A study was conducted to determine if the Fenton reaction would be useful in breaking down zein, a corn prolamine protein, and thereby useful in treating cornmilling wastewater. Infrared spectra were inconclusive in following zein because (1) different solvents and (2) other organics masked the anticipated zein spectrum. The results indicated that the use of Fenton's reagent can remove organic matter from a corn-milling wastewater by a combination of: (1) ferrous ion catalyzed H202 oxidation; and (2) ferric hydroxide flocculation. However, the doses and pH conditions required for a 44% reduction in NVTOC (H202 = 250 mg/liter, FeSO4 = 25 mg/liter, and pH = 3.0) do not constitute a basis for a cost/effective pretreatment scheme.
W85-05563

ANAEROBIC-AEROBIC TREATMENT OF A WHEAT STARCH PLANT EFFLUENT: A CASE HISTORY,
Sorigona, Inc., Woodbury, NY.
W. A. Bonkoski, J. E. Sointio, and G. R. Gillespie.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 781-787, 2 Fig, 6 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Wheat, *Food processing wastes, Anaerobic-aerobic treatment, Biological treatment, Iron, Cost analysis, Methane, Nutrients, Biological oxygen demand, Chemical oxygen demand.

The selection, installation and start-up of a combined anaerobic-aerobic system designed to handle wastewater from the wheat starch facility operated by Industrial Grain Products, Ltd. at Thunder Bay, Ontario is described. The anaerobic part of the system is both a net energy producer and a net cost reducer due to the production of methane gas and the elimination of the necessity to dry bran by heating it. Experience in the initial stages of start-up showed that the wastewater was deficient in certain micronutrients, particularly iron. Although start-up of the wastewater treatment plant is not yet completed, critical process control parameters have reached suitable levels and it is expected that the remainder of the plant start-up will proceed in a fashion similar to other full scale installations.
W85-05564

PERFORMANCE OF A POTATO PROCESSING WASTEWATER TREATMENT PLANT: A CASE HISTORY,
Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan, R. C. Landine, and A. A. Cocci.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 789-803, 2 Fig, 12 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Food-processing wastes, *Potatoes, Clarifiers, Trickling filters, Biological oxygen demand, Load distribution, Hydrogen ion concentration, Sludge, Mud water.

This paper presents an analysis of the data collected in the monitoring program for the purpose of identifying the causes of the poor performance of the treatment facility for a large potato processing plant. High efficiency of BOD removal occurred when the trickling filter was operating below its design capacity of 5 kg BOD/m3/day. When this loading rate was exceeded, removal efficiency dropped to between 10 and 40%. Mud water impacts on the treatment system, increases organic load, fine and colloidal matter affecting trickling filters, toxic chemicals and heavy metals in its stream impacting on the biological system. Independent treatment and disposal of mud water should be seriously considered. The poor performance of the primary clarifier (in respect of BOD removal) was due to change in wastewater characteristics; the long storage time for sludge, pH shifts and dissolution of solids results in increases in soluble BOD. Toxicity by chemicals, pH variations, and mud water contributed to the poor performance of the trickling filter system which was already under stress because of excessive loading rates. There is a need for a pretreatment system interposed between the primary clarifier and the trickling filter system to reduce the load on trickling filters.
W85-05565

ANAEROBIC PRETREATMENT FACILITY ALSO PROVIDES SLUDGE DISPOSAL CAPABILITY AND SOURCE OF RENEWABLE ENERGY FOR FOOD PROCESSOR,
ADI Ltd., Fredericton (New Brunswick).
R. C. Landine, C. J. DeGarie, A. A. Cocci, A. L. Steeves, and G. J. Brown.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 805-815, 9 Fig, 4 Tab.

Descriptors: *Wastewater treatment, *Food processing wastes, *Potatoes, Anaerobic-aerobic treatment, Biological treatment, Methane, Biological oxygen demand, Chemical oxygen demand, Suspended solids, Activated sludge process, Ammonia, Nitrogen compounds, Denitrification, Aerobic treatment, Operating costs.

This paper describes the design loadings and unit operations of a combined anaerobic-aerobic facility for treating potato processing wastewater. The entire treatment facility was economical to construct and simple to operate, requiring only two operators. The monetary value of the methane biogas recovered is greater than all the operating costs including labor, chemicals, electricity, maintenence, discharge tax and sundries. The anaerobic portion of the plant, an ADI-BVF, provided > 90% removal of BOD, COD and SS while operating under higher loadings than assumed for design and at temperatures < 20 C. The ADI-BVF is operating without any addition of chemicals or heat. Primary and secondary sludge are disposed in the ADI-BVF where they are anaerobically decomposed to enhance biogas production. No sludge of any kind has been removed from the facilities after two years of operation, nor is there any evidence of a need to remove sludge in the near future. Biogas is recovered and used in the factor boilers to make process steam. The activated sludge plant removed over 90% of the BOD and ammonia. Overall removals were: COD 98%, BOD 99.5%, SS 98% and total nitrogen 80%. High nitrogen removals were attributed to denitrification in the aeration plant.
W85-05566

RECOVERY AND APPLICATION OF SOLIDS FROM CRAB-PROCESSING WASTEWATER,
North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
A. C. Chao, L. Tzou, and C. T. Young.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 829-838, 11 Fig, 2 Tab, 12 Ref.

Descriptors: *Wastewater treatment, Food-processing wastes, *Ultrafiltration, Feed additives, Byproducts, Organic compounds, Suspended solids, Amino acids.

The organic substances in the crab-processing wastewater can be concentrated by use of an ultrafiltration process. This paper presents an equation to calculate the concentrate factor of the ultrafiltration process (C.F.) versus the operating time (t). Comparison of the calculated and the experimental data shows that the proposed equation is valid in predicting the time needed for the ultrafiltration process to achieve certain concentration factor levels. The quantity or the concentration of organic substances in the concentrate stream can then be calculated based on the known concentration factor. The calculated concentration of suspended solids in the concentrate stream were also checked by the experimental results. The quality of the concentrated organic matter was indicated by its amino acids compositions. The results indicate that the recovered organic substances contain all the essential amino acids and can be considered as nutritious as soy bean meal. Since it does not contain heavy metals nor mutagenic substances that may cause long-term health hazards, the recovered material can be used as feed additives, biological reactor feed solution additives, or dietary supplement.
W85-05567

ALASKA SEAFOOD PROCESSING INDUSTRY,
Alaska Univ., Fairbanks. Dept. of Environmental Quality Engineering.
T. Tilsworth, and W. D. Morgan.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 847-854, 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Food processing wastes, *Seafood processing wastewater, Alaska, Solids, Byproducts, Economic aspects, Hydrocyclones, Water reuse, Water conservation.

This report is an overview of the seafood industry and its environmental and economic considerations in Alaska. The Alaska seafood industry is a major component of the state's employment force and economy. Processing of the industrial waste must be balanced with reasonable but adequate protection of the environment. Treatment technology exists to accomplish this objective economically and hydrocyclones appear to be promising in this regard. Environmental regulations for this industry are still being promulgated, and the industry must be prepared to adapt to them. Solids removal prior to disposal is essential in order to reduce pollution, enhance byproduct recovery, and permit water conservation and reuse. Byproduct recovery is a consideration which should be given more weight and evaluation.
W85-05568

FAST-TRACK DESIGN, CONSTRUCTION, AND START-UP OF A CHEESE MANUFACTURE WASTEWATER PRETREATMENT PLANT,
CH2M/Hill, Denver, CO.
R. W. Davis, and H. K. Houmes.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 855-861, 1 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Food-processing industry, *Dairy industry, Construction, Design criteria, Biological filters, Biological treatment, Management planning.

The design, construction and start-up of the combined fast-track and phased management approach of a cheese wastewater pretreatment plant is described. Major and long-lead equipment was prepurchased by the owner. The biological filter tower media, tankage and clarifier mechanisms were identified as critical, long-lead equipment. Structural designs incorporated standard components available in the area; however, flexibility was designed into each component to allow adaptation to a connecting or appurtenant component. The earthwork, concrete structures, and electrical work was phased to meet the startup and treatment requirements during the course of the project. The biological treatment system was built within twelve weeks without stopping either the old physical chemical treatment plant or cheese production.
W85-05569

AQAT: A MOBILE WASTEWATER TREATABILITY ASSESSMENT SYSTEM,
Conoco, Inc., Ponca City, OK.
J. R. Wolfe, R. L. Huddleston, and L. W Cresswell.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, MA. p 915-918, 2 Fig.

Descriptors: *Wastewater treatment, *Pilot plants, Activated sludge process, Rotating biological contactors, Biological wastewater treatment, Automation, Activated carbon, Ozonation, Filters, Ion exchange, Gas chromatography, Spectrophotometry.

AQAT (Aquatic Quality Assurance Trailer) is a complete, mobile, state-of-the-art pilot wastewater treatment system with both complete treatment and analytic equipment. The system consists of an equalization tank, two dissolved air flotation units, four small-scale activated sludge units, a rotating biological contactor, four granular activated carbon columns, a multimedia filtration column, two ion exchange columns, and an ozonation unit. Treatment performance closely approximates that of a full-scale system so that scale-up problems are minimized. Four studies (at a PVC plant, two refineries, and a chemical plant) have been completed successfully. The AQAT has proved to be a versatile and useful tool for wastewater treatability studies.
W85-05573

DEVELOPMENT AND VALIDATION OF A WASTE STRENGTH EQUALIZATION BASIN DESIGN TECHNIQUE,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
J. P. Menez, and J. W. Patterson.
In: Proceedings, 38th Industrial Waste Conference, West Lafayette, IN, May 10-12, 1983. Purdue Univ., Butterworth Publishers, Boston, Ma. p 919-929, 11 Fig, 5 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Equalizing basins, *Waste load, *Design criteria, Shock loads, Influent streams, Effluents, Computer models, Retention capacity.

A study was conducted to develop and evaluate a simple design procedure for waste strength equalization, by correlating the characteristics of the fluctuating influents with the equalized effluents as a function of the instantaneous basin detention time of the waste. A completely mixed equalization basin was used to simulate the performance of a unit receiving an influent randomly varying in both flow rate and waste strength. Design models were developed and validated against the results of a laboratory pilot scale equalization unit. To select the optimum volume of basin, efficiency curves were constructed for both concentration and mass loadings. The design equations have been further evaluated by computer simulation, and the results indicate that the apparent disparate objectives of simultaneous equalization of waste concentration and waste flow rate can be economically achieved. Waste strength equalization, when accomplished with a constant liquid volume in the equalization basin, is an efficient method to dampen the concentration and the mass loading of the waste. Large retention volume to equalize waste strength fluctuations does not appear to be necessary because there is little or no efficiency gained by such an increase in the volume of the basin. For the cycles studied, a retention volume of about one third of total cycle inflow was usually sufficient to achieve economical waste strength equalization.
W85-05574

POLLUTION CONTROL IMPLICATIONS OF FLUIDIZED BED TECHNOLOGY FOR COAL-FIRED STEAM ELECTRIC POWER GENERATION.
CH2M Hill Canada Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 5C.
W85-05575

TOXIC METAL REMOVAL FROM ELECTROPLATING WASTEWATER USING SILYLATED SILICA GEL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
P. G. Malone, and R. A. Karn.
Available from the National Technical Information Service, Springfield, VA 22161, as AD/A120 030, Final Report, September 1982. Miscellaneous Paper EL-82-3. 27 p. 4 Fig, 8 Tab, 14 Ref. Project No. 4A161101A91D.

Descriptors: *Wastewater treatment, *Metal-finishing wastes, *Copper, Silica, Gels, Chromium, Nickel, Zinc, Cadmium, Costs.

A preliminary study was undertaken to evaluate the usefulness of silylated silica gel in removing toxic metals from electroplating wastewater. A number of complexing and chelating systems immobilized on silica gel are available. Most involve relatively complicated syntheses, produce materials that are not stable at room temperature for long periods of time, or have very low metal removal capacities. An immobilized diamine produced from N-(beta-aminoethyl)-gamma-aminopropyl-trimethoxysiline was found that could be prepared using a simple procedure and could be stored at room temperature without deterioration. Samples of material prepared in the laboratory could remove 22-24 Cu per gm silica gel. Small-scale column studies using samples of electroplating wastewater showed that levels of Cd, Cr, Cu, Ni and Zn could be reduced significantly. Cost estimates based on the coating system used in this study show that $0.124 worth of silane are required to remove 1 gm Cu. Theoretically, the costs could be reduced to $0.052/gm Cu removed. Metals removed on immobilized diamine can be recovered by stripping the silica gel column with strong oxidizing acid. The diamine coating can be replaced by treating the silica gel with additional silane. The stability, ease of preparation, and ability to recover metals make immobilized diamine a useful system for electroplating wastewater treatment.
W85-05579

CHARACTERIZATION AND TREATABILITY OF DRAINAGE SAMPLES FROM COAL PILES AT STEAM ELECTRIC POWER STATION.
Dearborn Environmental Consulting Services, Mississauga (Ontario).
For primary bibliographic entry see Field 5A.
W85-05594

EFFECTS OF NITRATE, PHOSPHATE AND POTASSIUM FERTILIZATION ON GROWTH AND NUTRIENT UPTAKE PATTERNS OF PHRAGMITES AUSTRALIS (CAV.) TRIN. EX STEUDEL,
Michigan State Univ., East Lansing. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W85-05609

NITROGEN AND PHOSPHORUS REMOVAL BY CYPRESS SWAMP SEDIMENTS,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
F. E. Dierberg, and P. L. Brezonik.
Water, Air, and Soil Pollution, Vol. 24, No. 2, p 207-213, February, 1985. 3 Tab, 18 Ref.

Descriptors: *Nitrogen removal, *Phosphorus removal, *Sediments, *Cypress swamps, Wastewater treatment, Nitrates, Leaching, Ammonium, Swamps, Wetlands.

Removal of nutrients from wastewater (effluent) by sediments in cypress swamps was studied in laboratory leaching columns filled with wet surface sediments. Columns were leached with low-nutrient groundwater, treated wastewater, and treated wastewater amended with nitrate (20 to 30 mg N/L) and phosphate (9.5 mg P/L) for 21 mo. From 99 to 100% of the nitrate-nitrate and P was removed from the amended wastewater eluants throughout the investigation; average concentrations of nitrate-nitrate and P in effluent from amended wastewater columns did not exceed concentrations in leachate from columns eluted with groundwater. Ammonium removal was approximately 50% in columns receiving treated wastewater. Sediments of cypress swamps have a large capacity to remove nutrients from secondary effluent. (Author's abstract)
W85-05695

KINETIC LIMITATIONS ON THE SELECTIVE PRECIPITATION TREATMENT OF ELECTRONICS WASTES,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
S. B. Karra, C. N. Haas, V. Tare, and H. E. Allen.
Water, Air, and Soil Pollution, Vol. 24, No. 3, p 253-265, March, 1985. 8 Fig, 6 Tab, 8 Ref.

Descriptors: *Electronics industry, *Industrial wastewater, *Precipitation, Kinetics, Wastewater treatment, Chromium, Lead, Nickel, Fluorides, Tartrates, Citrates, Waste age.

The precipitation of metals was studied in a synthetic wastewater simulating the composition of semiconductor manufacturing. Equilibrium information does not suffice to specify the process due to the kinetic limitations resulting from the formation of highly stable metal complexes. Maximum removals of Cr, Pb, and Ni can be obtained by precipitation processes, if the wastewater is treated soon after it is generated. The removal of Cr was significantly and adversely affected by waste aging due to the slow rate of dissociation of Cr-fluoride complexes once they are formed. Segregation of Cr bearing wastes from other wastewaters will improve the efficiency of Cr removal by precipitation, if the wastewater is to be stored for a period before treatment. The effect of waste age on Cr removal is approximated by the theoretical results obtained using the MINEQL model modified for kinetic limitations. Citrate and tartrate inhibit the precipitation of Pb and Cu. The removal of Ni was not kinetically limited; however, the observed removals were higher than the removals predicted. (Moore-IVI)
W85-05698

FULLER'S EARTH AND FIRED CLAY AS ADSORBENTS FOR DYESTUFFS; EQUILIBRIUM AND RATE STUDIES,
Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
G. McKay, M. S. Otterburn, and J. A. Aga.
Water, Air, and Soil Pollution, Vol. 24, No. 3, p 307-322, March, 1985. 13 Fig, 4 Tab, 14 Ref.

Descriptors: *Fire clay, *Fullers earth, *Adsorbents, *Dye industry wastes, Dyes, Wastewater treatment, Industrial wastes, Astrazone Blue, Telon Blue, Kinetics, Temperature, Agitation.

There is considerable need to treat colored effluents, such as dyehouse wastes, prior to their discharge into receiving waters. Fuller's earth and fired clay were studied to determine their potential to remove a basic dye (Astrazone Blue - Basic Blue 69) and an acidic dye (Telon Blue - Acid Blue 25). The adsorption capacities of a fired clay were 7 mg dye/g fired clay and 40 mg dye/g fired clay for Telon Blue and Astrazone Blue, respectively, indicating its use in treating dyehouse effluents is of little or only very limited significance. The equilibrium saturation adsorption capacities were 1200 mg dye/g Fuller's earth and 220 mg dye/g Fuller's earth for Astrazone Blue and Telon Blue, respectively. The kinetics of the adsorption processes were studied in an agitated batch adsorber. The 90% equilibrium value was achieved in less than 1 h. Increased agitation increased the rate of dye adsorption. Increasing the initial dye concentration increased the treated effluent outlet concentration for a given mass of adsorbent. Decreasing particle size increases the rate of dye adsorption and increased temperature increases the initial rate of adsorption. (Moore-IVI)
W85-05701

ADVANCED MEMBRANE FILTRATION PROCESS TREATS INDUSTRIAL WASTEWATER EFFICIENTLY,
Memtek Corp., Woburn, MA.
T. V. Tran.
Chemical Engineering Progress, Vol. 81, No. 3, March, 1985. 3 Fig, 4 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Membrane filtration, *Industrial wastewater, Membrane processes, Radioactive wastes, Particulate matter.

Advances in membrane filtration processes have made this technology an acceptable method for effectively treating industrial wastewater. The superior performance level resulting from chemical pretreatment combined with membrane filtration enables this process to be successfully used by a number of industries. The concentration of contaminants in discharge water after treatment by membrane filtration is consistently below current discharge limits and in many cases makes the water suitable for recycling. This margin of safety makes the use of membrane filtration suitable for today's industrial environment as well as the more stringent requirements anticipated for the future. An effective membrane filtration process combines a basic understanding of the wastewater chemistry with innovative high-flux membranes. The membrane provides a positive barrier against all particulate matter while delivering a consistently high flow rate of clean effluent. Uses for low-level radioactive wastewater are also discussed. (Baker-IVI)
W85-05770

ELECTROCHEMICAL GENERATION OF HIGH-CONCENTRATION OZONE FOR WASTE TREATMENT,
Oxy-Tech, Inc., Berkeley, CA.
P. C. Foller, and M. L. Goodwin.
Chemical Engineering Progress, Vol. 81, No. 3, p 49-51, March, 1985. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Ozone, *Electrochemical generation, Disinfection, Chemical reactions, Oxidation, Kinetics.

The variety of aqueous chemical waste streams that may be treated by ozone, which is generally recognized to be environmentally advantageous, may increase substantially with the advent of electrochemical generation technology. Research and development leading towards field tests of the technology and its eventual commercial availability will be continuing. Electrochemical ozone generation has commercial potential in small scale waste treatments, in which the administration of hypochlorite based oxidants is not effective enough, leads to high operating costs, or is environmentaly disadvantageous. Two reasonably attractive ways in which ozone has been electrochemically generated are considered. Oxidation kinetics involved in the use of ozone for wastewater treatment are delineated. (Baker-IVI)
W85-05771

WET OXIDATION FOR INDUSTRIAL WASTE TREATMENT,
Michigan Technological Univ., Houghton.
C. R. Baillod, R. A. Lamparter, and F. A. Barna.
Chemical Engineering Progress, Vol. 81, No. 3, p 52-56, March, 1985. 7 Fig, 4 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Chemical oxygen demand, *Economic aspects, *Wet oxidation, Temperature effects, Biological wastewater treatment.

For those wastes that are not acceptable at a biological treatment facility, and the alternative method of disposal is hauling as a hazardous waste under the Resource Recovery and Conservation Act regulations, wet oxidation is an economically attractive method of treatment in reducing oxygen demand and altering the biotreatability. In the case of a biotreatable waste, the economic picture is reversed. Further, while biological treatment charges are based on chemical oxygen demand, the cost of wet oxidation is not much greater than typical municipal or industrial charges. Equipment selection and cost factors are given for compressor, feed pump, preheater heat exchanger, reactor, and steam generator. A summary of the cost of major purchased equipment items is given. (Baker-IVI)
W85-05772

EFFLUENT REUSE IN SOUTHEAST FLORIDA.
Biocycle, Vol. 26, No. 2, p 39-40, March, 1985. 3 Fig.

Descriptors: *Wastewater irrigation, *Water reuse, *Florida, Effluents, Infiltration, Water supply development, Water resources development, Overland flow, Runoff.

In South Florida the practice of using reclaimed wastewater as a substitute for former potable water uses is rapidly becoming a necessary option as potable groundwater resources are limited. Potential users of reclaimed wastewater such as managers of golf courses and parks have requested water management, health and environmental agencies to closely examine the feasibility of such reuse with particular attention given to slow rate irrigation, overland flow, and high rate infiltration. For slow rate irrigation the effluent may be applied by either surface or sprinkler techniques. Application rates range between one and four inches per week. A two inch/week application rate is typical and recommended as a general guideline. Overland flow treatment systems generally include a holding pond for storage during adverse conditions, or an alternate disposal system. Wastewater is applied by sprinkling or flooding upper reaches of terraced, sloped, vegetated surfaces such as sod farms, forests, fodder crops, or pastures. This method is used on soils with low infiltration capacity and high runoff potential, due either to high clay content or restrictive layers. High rate infiltration requires a high hydraulic capacity with application rates being usually one to ten inches per day. (Baker-IVI)
W85-05776

ADVANCED WATER RECYCLING SYSTEM REQUIRED FOR NEW SOUTH AFRICAN MILL,
Main (Charles T.), Inc., Boston, MA.
For primary bibliographic entry see Field 3C.
W85-05777

OZONE ENHANCED BIOLOGICAL ACTIVATED CARBON IN DENVER, COLORADO: A PILOT PLANT STUDY,
Arber (Richard P.) Associates, Inc., Denver, CO.
W. F. Lorenz, K. D. Linstedt, and E. R. Bennet.
Ozone: Science and Engineering, Vol. 6, No. 2, p 71-86, 1984. 10 Fig, 7 Tab, 7 Ref.

Descriptors: *Activated carbon, *Ozonation, *Wastewater treatment, *Water treatment, *Denver, *Colorado, Aeration, Total organic carbon, Ammonium, Oraganic carbon.

Results of research into wastewater renovation have been incorporated into a 3785 cu m/day demonstration plant for assessing the practicality of producing potable water from wastewater treatment plant effluent. The pilot study was performed to determine if ozone addition in conjuction with carbon contacting would be likely to result in enhanced activated carbon performance in the demonstration plant. Five parallel ozone and activated carbon systems were compared for their effectiveness in treating unchlorinated effluent from a wastewater facility. Data were gathered over four months of continuous operation. The five treatment trains included 1) air/carbon (aeration prior to activated carbon contact), 2) ozone/carbon with 5 mg/l of applied ozone, 3) ozone/carbon with 15 mg/l of applied ozone, 4) ozone/carbon with 30 mg/l of applied ozone, and 5) carbon/ozone/carbon incorporating carbon contact prior to and following 15 mg/l of applied ozone. The initial carbon contact in the carbon/ozone/carbon also served as a control in the study. Ozone treatment followed by carbon contacting demonstrated improved TOC removal over treatment by air/carbon or carbon alone. Maximum TOC removals after ozone and 15 minutes of carbon contact were 57% greater than those for carbon without preozonation. Carbon/ozone/carbon treatment consistently reduced effluent TOC concentrations to levels of less than 0.5 mg/l, with represented greater than 92% TOC removal. Ammonium ion removals of 65 to 70% were achieved after 15 minutes of GAC contact in the preaerated and preozonated systems. The removal was independent of ozone dose. (Collier-IVI)
W85-05826

OZONE DISINFECTION DESIGN AND OPERATION CONSIDERATIONS,
Process Applications, Inc., Fort Collins, CO.
K. L. Rakness, and B. A. Hegg.
Ozone: Science and Engineering, Vol. 6, No. 2, p 87-102, 1984. 7 Fig, 5 Tab, 12 Ref.

Descriptors: *Ozonation, *Disinfection, *Wastewater treatment, Design criteria, Operating costs, Energy, Water treatment.

Wastewater ozone disinfection systems can perform well if attention is given to critical design and operational factors. For example, a continuous dew-point of -60 C is recommended. Equipment duplication, system flexibility, and dew-point monitoring with alarms are also recommended. Variable energy consumption for producing ozone is typically available within the generation equipment. Variability in the energy consumption of the feed-gas supply and pretreatment systems should also be provided. Improper contact basin design can cause a significant increase in ozone dosage needed to achieve a given level of disinfection. Ozone transfer efficiency, mixing and short-circuiting are factors affecting performance. Fine bubble diffuser contacting systems with 5-7m deep basins and with multiple, vertical stages represent a good design condition. Other important design and operation considerations include providing ozone destruct equipment, welded stainless steel piping, and isolated location, monitoring equipment, control equipment, and operator training. (Author's abstract)
W85-05827

OZONATION OF AQUEOUS SOLUTIONS OF NITROBENZENE,
Naples Univ. (Italy). Ist. di Chimica Industriale e Impianti Chemici.
V. Caprio, A. Insola, and G. Volpicelli.
Ozone: Science and Engineering, Vol. 6, No. 2, p 115-121, 1984. 5 Fig, 9 Ref.

Descriptors: *Ozonation, *Nitrobenzene, *Wastewater treatment, *Chemical reactions, Oxidation, Oxalic acid, Water treatment.

The ozonation of nitrobenzene in aqueous solution was investigated by determining COD removal, ozone consumption and product distribution at different degrees of ozonation. Results reveal that complete nitrobenzene elimination is achieved at relatively short ozonation times, with no appreciable accumulation of unsaturated intermediates. Oxidative consumption of about 2.5 oxygen atoms per mole of absorbed ozone was observed in this ozonation stage. Much longer ozonation times are required to reach complete oxidation of intermediates to oxalic acid and carbon dioxide, with an oxidative consumption corresponding to 1.8 oxygen atoms per mole of absorbed ozone. A reaction scheme was proposed on the basis of the observed product distribution. (Author's abstract)
W85-05829

EWTUS IN CHINA,
W. Baozhen.
Effluent and Water Treatment Journal, Vol. 25, No. 2, p 43-55, February, 1985. 12 Fig, 3 Tab, 14 Ref.

Descriptors: *Developing countries, *China, *Wastewater treatment, Biological wastewater treatment, Ponds, Aquaculture, Aquatic plants, Costs, Aquatic ecosystems.

It is estimated that the municipal wastewater treatment plants in China total about forty in number with total treatment capacity of one million cu m per day, which is less than 2% of the total daily discharge of municipal wastewater throughout the country. As a developing country, China cannot make the huge investment needed to construct the large number of conventional secondary wastewater treatment plants. Neither can it operate these plants due to lack of finances, energy and skilled operating personnel. Thus the strategy for wastewater treatment in China has to be to put stress on the development of innovative and alternative treatment techniques instead of conventional ones. Quite a few Chinese cities have treated wastewaters through the use of fish farming ponds. Hydrophyte ponds have also been used in which aquatic plants are grown to purify wastewater and then harvested as feed for poultry and pigs as well as aquatic vegetables for human beings. In ecosystem ponds the incoming wastewater is treated and used by ecological systems established artificially or semi-artificially. These systems in combination with primary conventional treatment have many advantages, such as low capital cost and low operation and maintenance costs, and huge profit potential. Two types of systems are taken as examples for cost and profilt analysis: the primary treatment facilities to the fish pond system, and the primary treatment facilities to the ecoponds to the irrigation field system. (Baker-IVI)
W85-05834

USSR RUNOFF TREATMENT,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow (USSR).
A. P. Nechaev.
Effluent and Water Treatment Journal, Vol. 25, No. 2, p 57-59, February, 1985. 3 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Storm runoff, *USSR, Runoff, Organic compounds, Minerals, Salts, Chemical analysis, Urban runoff, Settling ponds.

Runoff generated as a result of precipitation, snow melting, washing and water flushing within municipal and industrial territories is one of the sources of water pollution. The damage caused to water bodies is by periodic momentary discharges of great amounts of contaminants contained in rain runoff - often considerably exceeding the self-purifying ability of the receiving water bodies. Calculations in the USSR show that during the first hour of rainfall about 200 kg of undissolved impurities, up to 20 kg of oil products and up to 50 kg of organic compounds may be washed away from 1 ha of urban territory. The decrease of contaminants drained from industries is of utmost significance in the runoff treatment problem. Measures to reduce contamination include: control of storage and transportation of raw materials, intermediate products and industrial wastes; elimination of industrial waste discharge including spent oil products to the storm sewerage system; increase in operation efficiency of dust and gas treatment plants; and the organizing of regular mechanized disposal from industries. Various types of settling tanks are used on large scale for the treatment of runoff in the USSR. As the runoff is characterized by relatively low mineral salt content and organic impurities content it seems to be expedient to use it for industrial water supply purposes. (Baker-IVI)
W85-05835

5E. Ultimate Disposal Of Wastes

CHICAGO EXPERIENCE IN LARGE-SCALE LAND APPLICATION,
Metropolitan Sanitary District of Greater Chicago, IL.
G. W. Hall, J. C. Moore, III, and T. S. Skuse.
BioCycle, Vol. 26, No. 1, p 38-44, January/February, 1985. 5 Fig, 4 Tab.

Descriptors: *Sludge application, *Waste disposal, *Land disposal, *Chicago, *Illinois, Prairie Plan, Land reclamation, Strip mines, Municipal wastes, Recreation, Conservation, Costs.

The Metropolitan Sanitary District of Greater Chicago and Fulton County together developed a program, the Prairie Plan, to deal with the problems of sewage solids utilization for the city and strip-mined land reclamation for the county. In October of 1970 the Metropolitan Sanitary District of Greater Chicago purchased 7,156 acres of land in Fulton County. The site is located about 90 miles southwest of Chicago. The Prairie Plan is a large scale recycling program which provides benefits to both parties, including a safe, cost effective method for disposition of sewage solids, restoration of strip-mined lands to productive use, and provides recreation, conservation and wildlife preservation areas. Several awards have been given to the project. Effective management has enabled the plan to respond and adjust to changing requirements. The plan from 1970 through 1982 has cost $126.4 million: in land - $5.9 million, capital facilities - $33.3 million; application and other costs - $32.8 million, and transportation - $60.2 million. By the end of 1982 there remained an undepreciated value of $17.2 million for capital facilities. (Baker-IVI)
W85-05058

MUNICIPAL WASTEWATER INCREASES CROP YIELDS,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 3C.
W85-05059

PROCESS DESIGN MANUAL FOR LAND APPLICATION OF MUNICIPAL SLUDGE,
SCS Engineers, Inc., Long Beach, CA.
For primary bibliographic entry see Field 5D.
W85-05127

DESIGN MANUAL, MUNICIPAL WASTEWATER STABILIZATION PONDS,
Clemson Univ., SC.
For primary bibliographic entry see Field 5D.
W85-05133

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NEW TECHNOLOGY FOR WASTEWATER TREATMENT AND SEWERAGE IN RURAL AND SUBURB AREAS.
Tampere Univ. of Technology (Finland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W85-05195

POLICY AND REGULATIONS IN SCANDINAVIA,
National Board of Waters, Helsinki (Finland). Office for Water Supply and Sewerage.
For primary bibliographic entry see Field 5D.
W85-05197

PRINCIPLES OF COMPOSTING,
Helsinki Univ. (Finland). Dept. of Microbiology.
M. Salkinoja-Salonen.
In: Proceedings of the International Conference on New Technology for Wastewater Treatment and Sewerage in Rural and Suburb Areas, Hanasaari, Finland, October 3-6, 1983. Tampere Univ. of Technology, Finland. 1984. p 177-189, 1 Fig, 7 Tab, 21 Ref.

Descriptors: *Waste disposal, *Solid waste disposal, *Composting, *Microbial degradation, *Pathogens, *Land disposal, *Biodegradation, Wastewater treatment, Wastewater disposal, Streptococcus, Soil amendments, Domestic wastes, Feces, Heavy metals, Separation techniques, Heavy metals, Organic compounds, Organic wastes, Wastes, Landfills, Scandinavia.

Of the solid refuse produced in 1981 in Helsinki, 79% of household and business refuse was suitable for composting. Composting is a process where microorganisms oxidize the major part of the organic matter into CO2, H2O and inorganic salts, and a lesser part into microbial biomass and stable organic matter known as humus. For composted refuse to have a positive market value, it must have nutrient value to plants, not contain materials toxic to plants or animals and be safe from the hygienic point of view. The presence of thermostabile coliform bacterial or fecal streptococci is considered indicative of fecal contamination. Fecal bacteria were reduced to 1/1000 or less in a household waste compost in Helsinki. Various studies showed that the destruction of bacteria in compost piles was not temperature dependent. The destruction of poliovirus which was complete after 8 days of composting was also not temperature related. Heavy metals are not removed by composting. In the Netherlands, plastic, glass and metals are removed from the compost by blowing or screening. Use of compost in Sweden is confined to landfills. In Helsinki, compost prepared from sorted wastes was low in heavy metals and rich in trace elements such as Se. The composting of hazardous wastes such as oil, pesticides and TNT contaminated materials is still being investigated and shows promise for waste treatment.
W85-05206

TESTING OF BIOLOGICAL (COMPOSTING) TOILETS AND PRACTICAL EXPERIENCES IN NORWAY,
Norges Landbrukshoegskole, Aas. Inst. for Georesources and Pollution Research.
For primary bibliographic entry see Field 5D.
W85-05207

BARK CHIP DECOMPOSITION LATRINES,
Kymi Provincial Environmental Conservation Bureau, Kouvola (Finland).
For primary bibliographic entry see Field 5D.
W85-05208

LAND TREATMENT OF MUNICIPAL WASTEWATER: SELECTED EXAMPLES IN THE UNITED STATES,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5D.
W85-05324

TOLUENE, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
March 1984. 104 p, 29 Fig, 8 Tab, 208 Ref.

Descriptors: *Toluene, *Hydrocarbons, *Spill control, *Water pollution control, Aquatic life, Hazardous materials, Toxicity, Waterfowl, Skimming, *Toxic wastes.

Toluene is a colorless, watery liquid with an aromatic odor. Its synonyms include Toluol, Methylbenzene, and Phenylmethane. Toluene is a flammable liquid. Vapor forms explosive mixtures with air and flashback may occur along the vapor trail. For humans, toluene is toxic via inhalation, ingestion, and skin contact. Toluene is toxic to aquatic life. It may be hazardous to waterfowl and animals through ingestion or contact. Toluene has no food chain concentration potential. It is harmful to some species at concentrations as low as 10 mg/l. For spill control, access to the spill site needs to be restricted. The warning of flammable needs to be issued and the fire department and manufacturer have to be notified. Sources of ignition including traffic and equipment have to be eliminated. The flow has to be stopped and the spill contained. Contact with liquid and vapor should be avoided. The contaminated water has to be kept from entering sewers or watercourses. Emergency control procedures on water include: contain with booms, weirs or natural barriers. Use (oil) skimming equipment or suction hoses to remove slick, followed by the application of sorbents. All equipment should be spark- or explosion-proof.
W85-05336

FIFTH ANNUAL MADISON CONFERENCE OF APPLIED RESEARCH AND PRACTICE ON MUNICIPAL AND INDUSTRIAL WASTE.

Wisconsin Univ.-Extension, Madison. Dept. of Engineering and Applied Science.
For primary bibliographic entry see Field 5D.
W85-05364

CASE STUDY OF LEACHATE AND GAS MANAGEMENT AT A SANITARY LANDFILL,
Reitz and Jens, Inc., St. Louis, MO.
For primary bibliographic entry see Field 5D.
W85-05365

CHOOSING SEWAGE ASH DISPOSAL SITES IN THE TWIN CITIES METROPOLITAN AREA,
Metropolitan Council, St. Paul, MN.
For primary bibliographic entry see Field 5D.
W85-05366

DEVELOPMENT OF A SLUDGE/REFUSE CO-DISPOSAL PROGRAM,
Donohue and Associates, Inc., Sheboygan, WI.
J. W. Garvin, L. N. Hicks, and J. C. Batzner.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 101-108, 2 Tab.

Descriptors: *Co-disposal of wastes, *Solid waste disposal, *Sludge disposal, *Industrial wastes, *Sanitary landfills, *Waste management, *Wastewater treatment, *Wastewater disposal, Waste recovery, Waste characteristics, Waste disposal, Landfills, Odor, Sludge, Sludge thickening, Pulp and paper industry, Sludge drying, Sludge solids, Wisconsin.

The sludge/refuse co-disposal program was developed in 1979 for the Outagamie County, Wisconsin sanitary landfill in response to a need to dispose of waste sludge from the Midtec paper mill operation. During the development of the sludge handling program, various combinations of excavated trenches and co-mixing with refuse materials were attempted. Prior to the selection of co-disposal as a waste-management technique, feasibility evaluations of waste types, quantities and availability were carried out. An analysis of alternatives for implementation of a co-disposal program must also be considered. These criteria include regulatory guidelines, receiving site design, receiving site operations, on-site mixing of waste types, and other handling methods such as trench or lagoon filling operations or intermediate dewatering and composting to accomodate operational conditions. Some advantages of co-disposal are its low cost, environmental acceptability, ease of implementation and operation and potential for methane gas recovery. Some major disadvantages of co-disposal are its sensitivity to weather changes, dependent upon strict schedules for waste delivery, odor, and inability to adjust to variations in sludge water content.
W85-05367

RED HILL DISPOSAL SITE: A CASE STUDY,
Brown, Vence and Associates, San Francisco, CA.
K. Runyon, R. C. Slade, and C. R. Leitzell.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 129-145, 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Case studies, *Groundwater pollution, *Landfills, *Water pollution control, *Waste disposal, *Water quality control, *Leaching, Land disposal, Leachates, Surface-groundwater relations, Surface water, Conductivity, Water quality, Waste recycling, Wastewater management, Water pollution sources, Fate of pollutants, Path of pollutants, Membranes, Waste management, California.

A case study of groundwater and surface water contamination problems at the Red Hill Disposal Site landfill located in Calaveras County, California is presented. Since landfilling began at the Red Hill site in 1975, the County Department of Public Works has collected water samples on a quarterly basis. Water samples taken from Canyon A showed a gradual increase in conductivity from 1975 to 1978 and hence a decline in water quality. Conductivity declined in early 1979 after the installation of the cutoff dam and drain in the upper portion of Canyon A. This decrease in conductivity also reflects dilution effects resulting from three seasons of abnormally heavy rainfall subsequent to drought years. The annual percentage increase in refuse delivered to Red Hill is expected to remain below 10%. To protect groundwater from leachate in Canyons A and B, several measures were planned which included application of a clay liner to Canyon A, excavation of the hilltop in Canyon B, application of a membrane liner to Canyon B, modification of the leachate handling system, continuing the program for buying back reusable wastes, and obtaining equipment and approvals for brush burning.
W85-05368

INVESTIGATIONS OF LEACHATE CONTAMINATION OF GROUND AND SURFACE WATERS AT THE FRESH KILLS LANDFILL, NEW YORK CITY,
For primary bibliographic entry see Field 5B.
W85-05369

LEACHING BEHAVIOR OF LEAD AND CADMIUM AT VARIOUS PH CONDITIONS,
Residuals Management Technology, Inc., Madison, WI.
D. L. Nagle, T. P. Kunes, and R. R. Stanforth.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 210-224, 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Heavy metals, *Leachates, *Landfills, *Metal-finishing wastes, *Hydrogen ion concentration, *Hazardous materials, *Waste characteristics, *Waste identification, Leaching, Metals, Waste dumps, Municipal wastes, Lead, Cadmium, Waste disposal, Wastewater disposal, Land disposal, Waste management.

The standard USEPA EP leaching test procedure for determining whether a waste is hazardous requires that a waste sample be leached in a pH 5.0 +/- 0.2 acetic acid leaching solution for 24 or 28 hr. A waste is classified as hazardous if toxic metals are released in concentrations greater than 100 times the National Interim Primary Drinking Water Standards. The pH 5 value was selected, in part, to represent pH conditions at an actively decomposing municipal waste landfill. To evaluate the pH dependence on leaching of lead and cadmium from foundry wastes, four samples of ferrous foundry emission control residuals and one sample of brass foundry sand were leached using the USEPA leaching procedure with pH values ranging from 4.2 to 8.8. Results showed that, in all cases, the leachate concentration of lead and cadmium increased as the leachate pH decreased, sometimes as much as an order of magnitude over the range of a pH unit. Within EPA's acceptable range of 4.8 to 5.2, test results can show a waste to be hazardous at pH 4.8 and nonhazardous at 5.2. These data also show that landfill pH conditions are important in the selection and design of a disposal system and are essential in developing the degree of hazard criteria currently being considered by the USEPA. (Author's abstract)
W85-05370

CHEMICAL CHARACTERISTICS OF LEACHATE FROM MUNICIPAL SOLID WASTE LANDFILLS IN WISCONSON,
Wisconsin Dept. of Natural Resources, Madison. Bureau of Solid Waste Management.
P. Kmet, and P. M. McGinley.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 225-254, 31 Fig, 5 Tab, 13 Ref.

Descriptors: *Leachates, *Landfills, *Solid wastes, *Waste characteristics, *Waste identification, *Solid waste disposal, *Municipal wastes, *Groundwater pollution, Waste disposal, Leaching, Waste management, Wastewater treatment, Municipal wastewater, Wastewater analysis, Organic compounds.

Leachate quality data from 16 active municipal solid waste landfills, some of which have practiced co-disposal of hazardous wastes was compiled and analyzed. Analysis of pH, suspended solids, specific conductance, biological oxygen demand, chemical oxygen demand, hardness, alkalinity, sulfates, chlorides, numerous metals and priority pollutants confirms that leachates are contaminated to a strength greater than or equal to that of municipal wastewater for most parameters measured. Several contaminants in particularly Fe and total dissolved solids exceeded drinking water standards. In general, leachates were slightly acidic with a very high organic and dissolved solids concentration. Lesser, but still substantial quantities of total kjeldahl N, hardness, alkalinity, chlorides and sulfate were also present. Examinations of 5 municipal waste dump leachates for 114 priority pollutant organics revealed the presence of 36 of these compounds in leachate samples. All municipal solid waste leachate currently generated in Wisconsin is treated at existing municipal wastewater treatment plants. Close monitoring of leachate chemical characteristics is desirable to prevent treatment plant upset.
W85-05371

ANALYSIS OF UNDERDRAIN FOR WASTE DISPOSAL LEACHATE,
Golder Associates, Atlanta, GA.
J. F. Clerici, and G. H. Collison.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 255-271, 7 Fig, 1 Tab, 5 Ref.

Descriptors: *Leachates, *Linings, *Subsurface drainage, *Drainage systems, *Drains, *Subsurface drains, Leaching, Drainage patterns, Waste disposal, Landfills, Waste dumps, Seepage.

A simple method was devised to evaluate various underdrain system alternatives for waste disposal leachate control. The method assumes that the lateral flow gradient in the underdrain is equal to the slope of the bottom of the underdrain. The method was applied to the analysis of a nominal 40 ha pond for a blanket, pipe, and combination pipe and blanket underdrain system. Results indicated that a two layer blanket underdrain is the most feasible system. A coarse bottom drain layer with a filter material layer between it and the tailings appears to be the most functional design. A 2% bottom slope is considered a minimum. Significant reductions in the saturated drain thickness and seepage can be achieved by placing the collection system around the perimeter of the pond bottom. Efficiency studies of the proposed underdrain system showed that, for a wide range of drain permeabilities, the thickness of the liner does not substantially affect the rate of pond seepage. The effect of increasing the drain layer permeability one order of magnitude higher than the design value will not significantly reduce the estimated pond seepage rate.
W85-05372

LEACHATE DISPOSAL ALTERNATIVES IN A SOLE SOURCE AQUIFER ENVIRONMENT,
Dvirka and Bartillucci, Syosset, NY.
J. D. Cameron, and M. W. Stewart.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison, p 272-293, 2 Tab, 44 Ref.

Descriptors: *Leachates, *Waste disposal, *Wastewater disposal, *Wastewater treatment, *Waste recycling, *Sanitary landfills, *Groundwater pollution, *Waste characteristics, *Cost analysis, Leaching, Wastewater renovation, Landfills, Linings, Aquifers, Liquid wastes, Waste dumps, Wastewater analysis, Wastewater collection, Land disposal, Aquaculture, New York.

When an area is dependent upon aquifers as its sole source of potable water supply, special efforts must be made to prevent contamination of groundwater by landfill leachate. Consistent with this effort is the installation of impermeable liners beneath sanitary landfills to prevent groundwater contamination from leachate flows and the use of appropiate measures for collected leachates. Three alternatives to the leachate waste disposal problems of the Brookhaven, N.Y. sanitary landfill were exaimined. These included conventional treatment with discharge to surface or groundwater, transport of wastes to the wastewater treatment plant, and an aquaculture system. A detailed study of the leachate characteristics was made prior to the testing of disposal options. Those alternatives that did not involve a groundwater discharge were considered more favorable than those that did. Economically, transporting of wastes was feasible in the short term, but would prove to be expensive in the long term if fuel costs increase. Aquaculture did not prove to be a viable alternative since long periods of freezing might pose problems. A waste recycling plan was considered to hold promise for the future but required further development for large scale operation. It was recommended that the Brookhaven landfill adopt a plan to transport its leachates by truck to the County's major wastewater treatment facility while continuing to pursue a more cost-effective solution.
W85-05373

USE OF AQUACULTURE FOR THE TREATMENT OF LANDFILL LEACHATE IN COLD CLIMATES,
Anderson-Nichols and Co., Inc., Boston, MA.
M. A. Sills, and J. J. Struzziery.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 294-300, 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Landfills, *Wastewater treatment, *Wastewater renovation, *Aquaculture, *Algae, *Duckweed, *Leachates, *Cold regions, Waste recycling, Design criteria, Cost analysis, Air temperature, Planning, Wastewater composition, Waste characteristics.

The planning, design and operational considerations used in the selection of aquaculture leachate treatment systems for landfills in Fitchburg, Massachusetts and Nashua, New Hampshire are described. The key planning and design variables for such systems were found to be the performance objectives of the treatment units, the annual average air temperature, the quantity of leachate generated, the toxicity and treatability of the leachate, the specific types of aquaculture species to be used, the process related environmental conditions of the land, and cost considerations. An accurate determination of leachate flow rates and quality and treatability are also important factors in the aquaculture system. For the Fitchburg landfill, the aquaculture leachate system is composed of a two cell shallow, lined duckweed pond followed by overland flow through a wetland and discharge to a stream. The Nashua system includes chemical precipitation followed by a three cell aerobic facultative algae lagoon with discharge to the city sewerage sytem. The duckweed treatment system provides a fairly high quality effluent with low energy and land requirements for relatively low leachate flow rates while the mechanically aerated algae lagoon system provides variable degrees of treatment efficiences for much higher flow rates and is generally more flexible to effluent limitations and land area constraints.
W85-05374

'CONTAINMENT' STRATEGIES TO MANAGE ABANDONED HAZARDOUS WASTE SITES IN A COST EFFECTIVE MANNER,
Weston Environmental Consultants-Designers, West Chester, PA.
J. W. Thorsen.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 314-329, 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Waste management, *Water pollution control, *Wastewater treatment, *Waste storage, *Waste treatment, *Waste disposal, *Leachates, *Hazardous materials, Groundwater pollution, Wastewater management, Groundwater management, Leaching, Liquid wastes, Waste dumps, Chemical treatment, Toxic wastes.

The potential components of waste containment strategies that may be used at different types of hazardous waste storage sites include waste management, surface management and groundwater management. The three basic waste management components that may be required to implement the waste containment strategy are dewatering the wastes, stabilization/fixation/conditioning the wastes and the use of geotextile fabrics. The key factors to determine rates and quantities of liquids that may be removed from the waste mass area are the transmisitivity of the waste mass, the percent liquids in the waste mass, the particle size and the chemical composition. The two primary control mechanisms to provide for surface protection of the waste mass in the waste containment strategy are the placement of covers and cap systems and the provision for run-on and run-off controls. The basic classes of covers that may be used are multilayer systems, asphaltics, concrete, synthetics, natural soils, and soil admixtures. Run-on and run-off controls are important to minimize the amount of water reaching the waste mass. Groundwater controls to aid waste containment strategies include flow diversion (passive controls), flow manipulation (active controls) and groundwater treatment by destruction of toxic wastes, volume reduction of toxic wastes or stabilization of hazardous materials.
W85-05375

FINDING AN ACCEPTABLE APPROACH FOR DISPOSAL OF COAL COMBUSTION RESIDUES IN CALIFORNIA,
Stanley Consultants, Inc., Muscatine, IA.
M. N. Macaulay, and E. R. Slattery.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 330-343, 8 Fig, 1 Tab, 10 Ref.

Descriptors: *Hazardous materials, *Waste disposal, *Fly ash, *Waste characteristics, *Leachates, *Waste recycling, *Landfill, *Waste management, *Pilot plants, Water quality, Wastewater treatment, Land disposal, Waste dumps, Regulations, California.

The Department of the Navy proposes to convert spreader stoker boilers from fuel oil to low sulfur western coal at the MINSY boiler plant, Vallejo, California. Flue gas cleaning (FGC) waste and bottom ash will be produced from the converted boilers. The FGC waste system will be captured in bag houses and will consist of fly ash, reaction products of desulfurization and excess lime. The bottom ash will be collected in underground hoppers. Laboratory characterization of waste samples approximating the waste to be produced by the MINSY boiler conversion project showed that the material will not be considered hazardous according to federal criteria but will be considered hazardous according to leachate testing criteria established by the state of California for Cd, Cu and Zn. The physical properties of the conditioned wastes will be enhanced by bottom ash additions. Marketing of the FGC waste should be pursued as a method of reducing the quantity of waste directed to the landfill. A long-term disposal system should not be planned and constructed until after sufficient water quality data is collected from a specially designed short-term disposal system. Following completion of a short-term demonstration project an agency review of water quality data will provide a basis for issuance of final long-term disposal requirements at the designated landfill site on Mare Island.
W85-05376

FIELD INVESTIGATION AND REMEDIAL ACTION AT A SITE CONTAMINATED WITH COAL TARS,
TRC Environmental Consultants, Inc., East Hartford, CT.
D. F. Unites, and J. J. Housman, Jr.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 344-358, 4 Fig, 4 Tab, 4 Ref.

Descriptors: *Groundwater pollution, *Water pollution control, *Waste disposal, *Coal gasification, *Organic compounds, *Organic wastes, *Waste recycling, Boreholes, *Wastewater treatment, Waste dumps, Coal, Organic compounds, Hydrocarbons, Phenols, Industrial wastes, Recycling, Tar, Water pollution, Pennsylvania, Test holes.

Beginning in the early 1800's and continuing in the first half of the twentieth century, literally hundreds of privately operated coal gasification works served the coal gas needs of growing municipalities and industries across the United States. By the end of World War II, gas lighting had become virtually extinct. For the gas fuel market that remained, the small coal gasification plants could not complete with cheaper pipeline natural gas supplied by the large gas companies. As a result, small gasification works were rapidly forced out of business. Plants were dismantled and properties sold. Quickly forgotten were the coal tar residues generated and often discarded at or near these locations. Depending on the disposal methods and site geology, these sites can present an environmental hazard even after 30 years of inactivity. The main hazards are groundwater contamination by phenols and aromatic hydrocarbons and direct skin contact with the tars. Remedial actions at a coal gasification sites may include removal of the material, containment or a combination of these. At a site in Stroudsburg, Pennsylvania, geological conditions were such that containment and pumping removal were the most cost effective alternatives. High costs of treating contaminated groundwater were eliminated and the recovered tar was able to be sold. (Author's abstract)
W85-05377

IMPACT OF SEWERAGE IRRIGATION ON THE CHEMISTRY OF GROUND AND SURFACE WATERS,
Kentucky Geological Survey, Lexington.
M. A. Townsend.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 364-378, 6 Fig, 3 Tab, 10 Ref.

Descriptors: *Wastewater disposal, *Wastewater renovation, *Land disposal, *Path of pollutants, *Wastewater irrigation, *Spray irrigation, *Groundwater pollution, *Groundwater recharge, Hydrogeology, Sodium, Chlorine, Sulfates, Nitrate, Fate of pollutants, Water pollution sources, Liquid wastes, Ions.

A study was made of the hydrogeology and effects of sewage spray irrigation at the 135-acre Keyville, Texas site. In addition the chemical changes in waste water as it percolates through the soil were investigated. Secondarily treated effluent (a sodium-bicarbonate-chloride water) is sprayed on the land surface at an average rate of 8.0 cm/week. Results showed that the Na, Cl, and sulfate levels were unaffected as the wastewater percolates

ough the alluvium and moved across the site hin the gravel stratum. However, the concen- ions of ammonia, nitrate, and phosphate de- ased. A 40 to 60% increase in Na, Cl, and fate was noted in Third Creek, a stream that verses the study area indicating recharge of the eam by groundwater from the irrigation site. e marked decrease in concentration of Na, Cl, l sulfate between 1965 and 1980 indicates that installation of an oxidation ditch and spray gation system at the site has improved the qual- of both the irrigation water and Third Creek. charge measurements indicate a 65 to 80% in- ase in flow of Third Creek through the study a. Mass balance of dissolved ions showed that additional source of more dilute groundwater harges the creek.
5-05378

OHYDROLOGIC MODELLING FOR IN- STRIAL WASTE DISPOSAL SITE EVALUA- ON,
lder Associates, Atlanta, GA.
r primary bibliographic entry see Field 5B.
5-05379

LD INVESTIGATION OF A SUPERFUND E,
siduals Management Technology, Inc., Madi- , WI.
G. Nichols.
Proceedings of the Fifth Annual Madison Con- nce of Applied Research and Practices on Mu- ipal and Industrial Waste, WI, September, 22- 1982. Wisconsin Univ. -Extension, Dept. of gineering and Applied Science, Madison. p 404- , 2 Fig, 5 Tab, 7 Ref.

scriptors: *Waste disposal, *Land disposal, roundwater pollution, *Organic compounds, th of pollutants, *Waste dumps, *Organic sol- ts, *Test wells, Landfills, Aquifers, Organic stes, Hazardous materials, Solvents, Water qual- Boreholes, Fate of pollutants, Carcinogens.

200 acre area disposal site for solvents, inks and er hazardous wastes was studied to determine effects on groundwater quality. The site is locat- west of Minneapolis in an area of coarse grained cial soils that are used locally as an aquifer. The d investigation involved the installation of ten rings, 24 wells, and several water stations. Re- ts showed that shallow groundwater throughout area is contaminated primarily with organics l that the pollution has spread throughout much the soil column. Two carcinogens (tetrachlor- hylene and anthracene) were found in high ncentrations. The soil layer that is used as an ifer may also be threatened. More work is ded to determine the degree of contamination site, and the need for treatment of surface water l soils, and which areas of the site must be sed.
5-05380

FECT OF SLUDGE QUALITY AND RATE, IL PH, AND TIME ON HEAVY METAL SIDUES IN LEAFY VEGETABLES,
ricultural Research Service, Beltsville, MD. Bi- gical Waste Management and Organic Re- rces Lab.
L. Chaney, S. B. Sterrett, M. C. Morella, and C. Lloyd.
Proceedings of the Fifth Annual Madison Con- nce of Applied Research and Practices on Mu- ipal and Industrial Waste, WI. September 22-24, 2. Wisconsin Univ. -Extension, Dept. of Engi- ering and Applied Science, Madison. p 444-458, ig, 5 Tab, 21 Ref.

scriptors: *Land application, *Heavy metals, admium, *Sludge, *Solid waste disposal, *Soil endments, Absorption, *Vegetable crops, Waste posal, Hydrogen ion concentration, Crops, Ag- ulture, Zinc, Metals, Lettuce, Collards, Chard.

maine lettuce, chard, and collards were grown field plots to evaluate crop uptake of Cd as ected by sludge Cd concentration, application e, soil pH, and time since application. Cd concentrations in crops grown on calcareous, low Cd sludge plots were similar to unamended controls. Acidic heat-treated sludge plots, and both acidic and limed Nu-Earth plots caused significant increase in lettuce Cd. Foliar Cd was increased by the lowest rate of these sludges, but higher rates caused only small further increase in lettuce Cd (at both pH levels). These results indicate a substantial influence of sludge Cd concentration on Cd uptake by crops, suggesting that sludge also supplied Cd-adsorption capacity to the soil. Sludge-applied Cd remained crop available for the 6 years studied. In contrast with lettuce and chard which accumulated high levels of Zn and Cd, collards were only slightly higher in Cd even on acidic Nu-Earth plots. (Author's abstract)
W85-05382

NATURAL BUFFERS FOR SLUDGE LEACHATE STABILIZATION,
Dames and Moore, Bethesda, MD.
K. S. Makeig.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 459-474, 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Sludge disposal, *Leachates, *Nitrates, *Buffer zone, *Models, Trenches, *Path of pollutants, Sludge, Waste disposal, Model studies, Leaching, Land disposal, Permeability coefficient, Denitrification, Nitrogen, Aquifers, Advection, Waste dumps, Fate of pollutants.

A study was made to quantify the amount of buffer area needed around a narrow trench used for burial of sludge to allow the soil to stabilize leachate without threatening the surrounding groundwater supplies. A vertical buffer (thickness of unsaturated soil below the trench) can be calculated by comparing the cation exchange capacity of the soil with the exchangeable cations in the sludge leachate. Data from the Washington Suburban Sanitary Commission based on past sludge disposal practices in the metropolitan Washington, D.C. area indicate a vertical buffer < 3 ft thick is sufficient. The width of the horizontal buffer (a strip of land between the trench and the site boundary) is calculated from the nitrogen loading of the soil and the mobility of nitrate in the upper aquifer based on hydraulic conductivity and the sludge/soil interaction. The minimum width of a horizontal buffer for nitrates can be estimated by means of a simple, three-dimensional advection-dispersion model. The model can also be used to predict nitrate concentrations for various buffer widths. Natural stabilization in the soil can be supplemented by the planting of nitrate-using plants, the diversion of precipitation from the site, and lowering of the water table to increase the vertical buffer distance.
W85-05383

WATER QUALITY EFFECTS AND GROWTH BENEFITS OF ENTRENCHING SEWAGE SLUDGE IN SANDY FOREST SOILS,
North Central Forest Experiment Station, East Lansing, MI.
A. R. Harris, and D. H. Urie.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, Madison. p 475-494, 8 Fig, 5 Tab, 13 Ref.

Descriptors: *Sludge disposal, *Leachate, *Path of pollutants, Absorption, Deciduous trees, *Sludge utilization, *Soil amendments, *Growth rates, Waste disposal, Recycling, Land disposal, Waste recovery, Solid wastes, Water quality, Leachates, Nitrates, Denitrification, Nitrogen, Trees, Sludge solids, Forest soils, Fate of pollutants, Nutrients.

Sewage sludge with 10% dry solids was entrenched at loading rates of 75 and 150 t/ha to measure its effects on water quality. Also, sludge cylinders 60 cm in diameter and 100 cm in depth with 10-, 15-, 20-, and 40-% dry solids were buried in a hybrid poplar nursery to measure rooting and other growth effects. Lateral leaching was minimal, and leaching from the bottom of the trench had minimal effect on groundwater quality because of dilution. In the nursery, concentrations of soluble constituents were directly related to dry solids content. Sludge constituents stayed bound tightly except for the soluble portion. pH increased in the soil. Growth response of hybrid poplars was directly related to availability of sludge nutrients. The high sludge loading rate results in nitrate pollution of any underlying water table aquifers but surrounding natural ecosystems should be able to denitrify and/or to assimilate the additional nitrogen. (Author's abstract)
W85-05384

ASSESSMENT OF POTENTIAL AGRICULTURAL AND INDUSTRIAL USES OF A LIME WATER-SOFTENING WASTE SLURRY,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5G.
W85-05385

FACTORS AFFECTING THE VOLATILIZATION OF AMMONIA FROM LAND APPLIED SEWAGE SLUDGES,
Ohio State Univ., Columbus. Dept. of Agronomy.
T. J. Logan, W. C. Donovan, and R. H. Miller.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, Madison. p 522-531, 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Sludge, *Ammonia, *Volatility, *Nitrogen, *Soil properties, *Sludge disposal, *Sludge utilization, *Land disposal, Nutrients, Fertilizers, Vegetation, Soil water, Lime, Air temperature, Soil physical properties, Soil chemistry, Soil amendments, Limiting nutrients, Particle size.

A forced-air (60 liters/min) PVC cylinder manifold chamber was used to collect NH3 volatilized from sewage sludges applied to soil in bins in the laboratory. A series of experiments were conducted in which the effect on NH3 volatilization of a single variable was studied while holding all other conditions in a 'standard state.' The standard conditions included: Columbus Jackson Pike anaerobically digested sewage sludge applied at 5 mt/ha (dry weight) to a Crosby silt loam soil (pH 6.7) at 0.1 atm. initial moisture content. The soil was bare and the sludge was unincorporated during the 24 hr. study period. Air temperature was 26 +/- 2 degrees. The variable conditions were: soil moisture (air-dry, 0, 0.1 and 15 atm.), soil pH (5.1, 6.7, 7.5), sludge type (anaerobically digested Columbus liquid sludge, partially dewatered Columbus sludge, aerobic Medina sludge, lime stabilized primary Ashland sludge, composted Columbus sludge), time of incorporation (0, 1, 3, 6, 12, 24 hr) or unincorporated after sludge application, surface cover (bare, sod, straw), air temperature (12.8, 18.3, 26.7 degrees). Volatilization was significantly increased with increasing temperature and with increasing time before incorporation. There was a nonsignificant trend for greater volatilization at higher soil pH's. NH3 volatilization was higher from the sod and straw soil treatments than from bare soil when sludge contained large particles but not when the sludge was homogenized. Volatilization was greatest at 0 atm. (saturation) and lowest with air-dry soil. The greatest absolute and the highest percentage NH3 losses were from the lime stabilized Ashland sludge which had a pH of approximately 12. (Author's abstract)
W85-05386

EFFECTS OF MUNICIPAL SEWAGE SLUDGE-CAKE ON NITROGEN AND PHOSPHORUS DISTRIBUTIONS IN A PINE PLANTATION,
Department of Energy, Washington, DC. Office of Health and Environmental Research.
D. D. Richter, D. W. Johnson, and D. M. Ingram.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, Madison. p 532-546, 1 Fig, 5 Tab, 24 Ref.

Descriptors: *Sludge disposal, *Sludge utilization, *Nitrogen, *Phosphorus, *Pine trees, *Soil-water-

plant relationships, *Leaching, *Forest soils, Land disposal, Trees, Phosphates, Nitrates, Ammonia, Nitrogen compounds, Soil water, Leachates.

Anaerobically digested and dewatered sewage sludge-cake was applied at a rate of 275 mg/ha to a recently clearcut Sequoia silt loam (Typic Hapludult) that was subsequently planted to loblolly pine. The sludge represented an application of about 1500 kg N/ha and 675 kg P/ha. After four growing seasons N and P distributions were determined in the plant-soil system. Soil solutions were sampled from B horizons in the first and fourth years after treatment to evaluate leaching losses of NO3(-), NH4(+), and PO4(3-). Four years after the sludge treatment, differences between sludge-treated and control plots in soil N and P amounted to about 1180 and 868 kg/ha, respectively, in the surface 15 cm of mineral soil. Residual effects persisted for soil-extractable PO4(3-), NO3(-), and NH4(+) with 30-, 10-, and 1.5-fold increases, respectively, in the surface 15 cm of mineral soil. Concentrations of NO3(-)-N in subsoil solutions increased shortly after the sludge treatment, although mean concentrations for individual water collections were not elevated above the USEPA drinking water standard of 10 ppm. Four years after treatment, mean NO3(-)-N concentrations in subsoil solutions were less than 2 ppm. Mean concentrations of NH4(+)-N and PO4(3-)-P in subsoil solutions did not exceed 1.0 and 0.03 ppm. (Author's abstract)
W85-05387

CASE HISTORY OF A CITY'S SUCCESSFUL LAND APPLICATION PROGRAM OF LIQUID SLUDGE ON SOD,
Burgess and Niple Ltd., Columbus, OH.
H. R. Stonerook, and R. E. Birkbeck.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, Madison. p 557-569, 4 Fig, 7 Tab, 3 Ref.

Descriptors: *Sludge disposal, *Sludge utilization, *Wastewater disposal, Heavy metals, *Land disposal, *Liquid wastes, *Wastewater irrigation, *Sod, Cost analysis, Waste disposal, Monitoring, Groundwater pollution, Wastewater renovation, Grasses, Turf grasses, Ohio.

The city of Orville, Ohio has successfully disposed of sludge from its wastewater treatment plant for eight years by applying it to a commercial sod farm. Sod can accomodate a sludge vehicle at all stages of growth. There is no erosion from the applications and minimum surface runoff. Heavy metals are removed from the application site with the sod and there is no danger of consumption by animals or humans. To minimize abuse to the growing sod, sludge is delivered using high flotation type vehicles. The city, with pipe donated by the sod company, constructed a permanent sludge pump station utilizing a Moyno type pump to convey sludge from the concentrating channel at the treatment plant to the receiving lagoons adjacent to the sod farm. Site monitoring includes sampling of drainage ditches, streams, a storm sewer and an irrigation well. Maximum downstream values of Cd, Cu, Pb and Zn are slightly higher than upstream values. Monitoring of the west sod farm shows that downstream average values of Cr, Cu, Ni and Zn are significantly higher than upstream values. Samples of an industrial storm sewer show high average values of Cr, Cu and Zn. The irrigation well shows no significant change in water quality from upstream conditions. The total annual cost of sludge disposal in Orrville is estimated to be $68.85/dry ton of solids.
W85-05388

APPLYING LIQUID SLUDGE TO FOREST LAND: A DEMONSTRATION,
North Central Forest Experiment Station, East Lansing, MI.
J. H. Cooley.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, Madison. p 547-556, 2 Fig, 6 Ref.

Descriptors: *Sludge, *Liquid wastes, *Wastewater disposal, *Land disposal, *Spray irrigation, *Wastewater irrigation, *Sludge utilization, *Forests, Waste disposal, Municipal wastes, Cost analysis, Michigan, Linings, Wastewater renovation, Michigan.

Liquid sludge was spread on a site in northern lower Michigan where jack pine had been clearcut and the slash burned. The municipal sludge was hauled from the wastewater treatment plant to the application site in 2,000-gallon tank trucks that were designed for cleaning septic tanks. Liquid sludge was either spread directly from the trucks or unloaded into temporary storage ponds. In both procedures, sludge was pumped up to 720 feet through aluminum irrigation pipe to a portable booster pump and then up to 160 feet through branch lines to spray irrigation guns. Spreading sludge directly from trucks, a crew of two drivers and one on-site worker applied about 5.700 gallons/man-day. Spreading from ponds, a crew of two truck drivers and two on-site workers applied about 7,000 gallons per man-day. Since the project did not continue long enough to establish useful life of the components, equipment costs could not be specifically determined. Michigan now requires PVC liners to prevent excessive leakage from temporary waste storage ponds. In view of this, portable aboveground storage tanks or spreading directly from trucks might be more cost effective.
W85-05389

LAND APPLICATION OF MUNICIPAL WASTEWATER TREATMENT PLANT SLUDGE, INDIANAPOLIS, INDIANA,
Reid, Quebe, Allison, Wilcox and Associates, Inc., Indiannapolis, IN
E. E. Horsley, R. Riemer, and C. M. Robson.
In: Proceedings of the Fifth Annual Madison Conference of Applied Reearch and Practices on Municipal and Industrial Waste, WI, September 22-24, Madison. p 570-577, 2 Tab.

Descriptors: *Land disposal, *Sludge utilization, *Sludge disposal, *Wastewater irrigation, *Wastewater disposal, *Spray irrigation, *Waste disposal, Crops, Municipal wastes, Hydrogen ion concentration, Corn, Soybeans, Heavy metals, Cadmium, Regulations, Polychlorinated biphenyls, Indiana.

During expansion of the Belmont Wastewater Treatment Plant in Indianapolis, it was decided to land-spread sludge from sludge lagoons and to fill lagoons with compacted fill for future plant construction. The subcontractor chose a rural area for sludge spreading and conducted an extensive public relations program to gain acceptance for the sludge spreading project. The contractor developed his own guidelines for sludge application which were approved by regulatory agencies. Only 1.12 kg of Cd/ha were to be applied. All soils were to be tested for Cd and heavy metals before sludge application and the results were to be filed at the County Courthouse. Soil pH had to be at least 6.5 before sludge application. No sludge could be applied after crops were planted. In the first year, only corn and/or soybeans could be planted. Prior to harvest, crops were to be tested for PCB levels. No grazing of animals was permitted for one crop-year after sludge application. The EPA and state agencies also required that application rates be determined for each site based on both sludge and soil characteristics, a hold harmless agreement between the landowner and state be established, and liability insurance in excess of $1 million be purchased to protect the state of Indiana. Due to severe weather conditions and equipment problems, the sludge spreading program took 3 years to complete. Analysis of crops for PCB and Cd showed that residues of these substances were well below limits for food crops.
W85-05390

LANDSPREADING OF SLUDGE IN NEW YORK STATE,
Clark (Philip J.), Corning, NY.
D. A. Faga.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22
Madison. p 578-595, 1 Ref.

Descriptors: *Land disposal, *Sludge disp
*Public health, *Wastewater disposal, *Recyc
*Wastewater renovation, *Waste manage
*Waste recovery, Heavy metals, Cadmium, N
York, Hazardous materials, Regulations, Envi
mental policy, Environmental effects, Veget
crops, Public policy, Solid Waste disposal.

At present, New York State has declared a
year moratorium on the land-spreading of sl
on prime agricultural land. The EPA, Food
Drug Administration and federal Departmen
Agriculture maintain that the use of high qu
sludges on agricultural land, coupled with pr
management procedures, should safeguard the
sumer from contaminated crops and minimize
potential adverse effect on the environment.
Director of Toxic Chemicals Laboratory and
fessor of Vegetable Crops at Cornell Unive
had discouraged land spreading of sludge on
cultural land, holding that it is hazardous and
sludge is best incinerated. Others also feel tha
2-year moratorium should become a perma
ban. In the interim of the moratorium, the fe
government will test the effects of sludge la
preading on vegetable crops. The Coordinato
the program on land recycling of munic
wastewater and sludge at Penn State found
sludge application to spoiled mine areas resul
the growth of healthy vegetable cover of gr
and legumes. Part 360 and Part 364 of the S
Environmental Conservation Law address the
ulation of solid waste management facilities
the registration of septic tank cleaners and indu
al waste collectors, respectively. The main e
of a ban on sludge spreading would be incre
disposal costs.
W85-05391

**VEGETABLE PROCESSING WASTEFLO
LIABILITY OR ASSET,**
Wisconsin Univ.-Madison. Dept. of Soil Scie
G. A. Blondin, S. J. Comiskey, and J. M. Harki
In: Proceedings of the Fifth Annual Madison
ference of Applied Research and Practices on
nicipal and Industrial Waste, WI, September 2
Madison. p 596-610, 1 Fig, 4 Tab, 21 Ref.

Descriptors: *Waste recovery, *Recyc
*Sugars, *Alcohols, *Fruit crops, *Veget
crops, Food processing wastes, *Reverse osm
Wastewater renovation, Wastewater disposal,
analysis, Waste management, Peas, Carrots, Be
Beets, Potatoes, Corn, Industrial wastes, M
brane processes.

Wastewater from six major U.S. vegetable p
(pea, snap bean, sweet corn, beet, potato,
carrot) was examined in Wisconsin canneries
determine the daily fermentable sugar concen
tions in selected wastewaters, total ferment
sugar recovery from reverse osmosis memb
processable wastewaters, and performance of
tain of these wastewaters during initial stage
sugar concentrate production by membrane p
esses. Corn and potato wasteflows were foun
be the best sources of recoverable ferment
sugars; the snap bean wasteflows were the poo
and wasteflows from pea, carrot and beet w
intermediate. By selectively harvesting only t
to five wasteflows from each process veget
pack, the average concentration of recover
soluble hexose in the suitable wastewaters is
creased by a factor of 14 to 18 over that of
average total plant effluents. The value of f
stock of about 1.6 million tons of ferment
sugar, the major reduction in wasteflow BOD
disposal costs, and the reuse value of reverse os
sis permeate water would exceed process cost
a wide margin and increase incentive for indus
participation in such a project. The net en
yield of the alcohol which could be produce
about 50% of the total energy used by the fruit
vegetable processing industry
W85-05392

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ASE STUDY OF DESIGN PROCEDURES FOR LAND TREATMENT OF WASTEWATER YSTEM, DALTON, GEORGIA,
older Associates, Atlanta, GA.
or primary bibliographic entry see Field 5D.
/85-05393

SSESSMENT OF THE RESIDUAL EFFECTS F LONG-TERM SPRAY DISPOSAL OF AN NDUSTRIAL SLUDGE,
ennessee Univ., Knoxville.
D. Wolt.
: Proceedings of the Fifth Annual Madison Conrence of Applied Research and Practices on Mucipal and Industrial Waste, WI, September 22-24, adison. p 622-633, 3 Fig, 3 Tab, 6 Ref.

escriptors: *Sludge disposal, *Solid waste disposs, *Spray irrigation, *Wastewater irrigation, Heavy metals, *Absorption, *Fate of pollutants, Land disposal, Waste disposal, Crop yield, Calcin, Wastewater renovation, Sludge utilization, Diested sludge, Industrial wastes.

erobic digest sludge (1.5% solids) derived from y-products of synthetic fiber manufacture was ray disposed for seven years at estimated dry lids loadings of 500 kg per ha per day. Ineffecve spray head operation resulted in the heaviest udge loadings at the centers of individual spray sposal plots. These loadings diminished radially tward from plot centers and approached zero at ot perimeters. Excessive hydraulic loadings led eventual failure of the spray field. A portion of e spray disposal field comprising five spray heads as soil sampled and then reclaimed by chisel owing, installing agricultural tile underdrain, and plying gypsum. Following reclamation efforts, e experimental area was again soil sampled and tablished to rye which was evaluated for yield d elemental uptake. Crop yield was inversely lated to levels of past sludge addition and apeared to reflect soil heavy metal contents on the ray field. Soil Ca, from gypsum application, apeared to partially ameliorate potential toxic metal ffects, probably from inhibition of heavy metal ptake by plants. Following the residual cropping ssessment, spray disposal plots were established to lidland bermudagrass overseeded with rye. Varius sludge spray disposal schemes were investigatd to determine what levels of waste loading could e tolerated for continued utilization of the reaimed spray disposal field. (Author's abstract)
/85-05394

AND APPLICATION OF KRAFT PAPER ILL SLUDGES,
orth Carolina State Univ. at Raleigh. Dept. of oil Science.
. G. Simpson, L. D. King, and B. L. Carlile.
: Proceedings of the Fifth Annual Madison Conrence of Applied Research and Practices on Mucipal and Industrial Waste, WI, September 22-24, adison. p 634-646, 1 Fig, 6 Tab, 4 Ref.

escriptors: *Fly ash, *Sludge disposal, *Sludge tilization, *Soil amendments, *Pulp wastes, *Land isposal, *Soil properties, *Heavy metals, Nitroen, Nitrogen compounds, Phosphorus, Calcium, lagnesium, Minerals, Hydrogen ion concentraon, Industrial wastes, Corn, Forages, Soil chemisy, Crop yield, Absorption.

Kraft paper mill sludges and coal fly ash were valuated as soil amendments for agriculture land pplication in laboratory and field tests and onarm demonstrations. In the laboratory mineralizaon study, at 16 wk of incubation, inorganic I(NH4 + NO3) levels as a percent of applied N in he primary and secondary sludge treatments averged 14% and 35%, respectively. Recovered udge N averaged 70% for both sludges. Net nmobilization of N was observed for the primary udge treatments through 4 weeks. By 2 weeks, no et N immobilization was measured for secondary udge treatments. Both primary and secondary udge applications increased soil pH and extractale levels of P, K, Ca, Mg, and Na. In the field, ixtures of primary and secondary sludge-fly ash pplied at rates of 108 and 54 mT/ha, respectively gnificantly increased fescue and corn yields compared to control plots. Yields from sludge amended plots were similar to yields obtained with commercial fertilizer. Sludge amendments did not effect metal uptake by crops. The effects of sludge additions on Hayesville loam topsoil and Codorus loam topsoil after crop harvest were increased pH and extractable levels of P, Ca, and Mg. One acre onfarm demonstrations of the effect of sludges on fescue and corn silage plots gave encouraging results. Cooperating farmers are now enthusiastic about continued land application of the sludges.
W85-05395

WASTE DISPOSAL MODELLING,
Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
D. O. Pronger.
Water and Pollution Control, Vol. 123, No. 1, p 22-23, January-February, 1985. 2 Fig.

Descriptors: *Waste disposal, *Radioactive wastes, Canada, Model studies, Public health, Safety, Hazardous wastes.

Scientists who must develop toxic waste disposal techniques that accomodate nature's ever changing conditions are faced with difficult problems. Research currently underway at the Whiteshell Nuclear Research Establishment in Pinawa, Manitoba for radioactive waste disposal is expected to have some application to other areas of waste control. To contain and isolate nuclear fuel wastes, Atomic Energy of Canada Limited is developing a system of multiple barriers. Man-made barriers would include a stable, immobilized waste form, a corrosion-resistant metal container, and special impermeable material surrounding the container. Burial deep underground within a stable rock body in the Canadian Shield would further isolate the wastes, the rock acting as a natural barrier to the release of radioactive elements into the surrounding environment. This disposal concept is now being assessed for its safety and technical feasibility. (Baker-IVI)
W85-05463

RIVER QUALITY AND SEWAGE EFFLUENT STANDARDS,
Thames Water Authority (England). Northern Div.
For primary bibliographic entry see Field 5G.
W85-05515

5F. Water Treatment and Quality Alteration

STUDIES OF THE HALOGENATION OF DISSOLVED ORGANIC MATERIAL DURING THE CHLORINATION OF SALINE COOLING WATERS, THE MODEL COMPOUNDS RESORCINOL DIACETATE AND RESORCINOL DIMETHYL ETHER,
Southampton Univ. (England). Dept. of Chemistry.
A. G. Howard, R. A. Pizzie, and J. W. Whitehouse.
Water Research, Vol. 19, No. 2, p 241-248, 1985. 8 Fig, 2 Tab, 21 Ref.

Descriptors: *Water treatment, *Cooling water, *Halogenation, *Dissolved solids, *Organic matter, *Chlorination, *Saline water, *Resorcinol diacetate, *Resorcinol dimethyl ether, Seawater, Bromine, Haloforms, Hydrogen ion concentration.

In view of the complex nature of dissolved organic material (DOM) found in natural waters, it was necessary to employ model compounds to elucidate the consequences of water chlorination. Resorcinol has been widely adopted as a simple monomeric model of DOM. Incorporation of resorcinol into polymeric material with ester and ether linkages was simulated using resorcinol diacetate and resorcinol dimethyl ether; the effect of chlorination on these compounds was studied in seawater. Resorcinol diacetate (3.5 ppm) was chlorinated (2 ppm) in seawater buffered to acidities chosen to lie within approximately one pH unit of a typical seawater pH of 8.2; under these conditions the products were mainly brominated. At a lower pH, tribrominated resorcinol diacetate, was the major product with no observable formation of haloforms. At higher pH values a mixture of mono-, di-, and tribrominated resorcinol diacetates was formed together with measurable quantities of haloforms. At low chlorine concentrations, ring substitution products dominated while at higher chlorine levels ring cleavage occured and trihalomethanes were produced. Electrophilic chlorination of the model compounds in seawater appears to be slower than the formation of HOBr by oxidation of naturally occurring bromide. To minimize haloform production from compounds such as those studied, current evidence suggests that the chlorine sources should be acidic and dilution should be achieved as rapidly as possible in order to minimize the formation of localized pockets of highly concentrated chlorine. Minimizing haloform production will only result in the production of a more varied and less readily characterizable halogenated DOM. (Collier-IVI)
W85-04979

VIRION CONFORMATIONAL FORMS AND THE COMPLEX INACTIVATION KINETICS OF ECHOVIRUS BY CHLORINE IN WATER,
North Carolina Univ. at Chapel Hill. School of Medicine.
D. C. Young, and D. G. Sharp.
Applied and Environmental Microbiology, Vol. 49, No. 2, p 359-364, February, 1985. 8 Fig, 19 Ref. EPA grant R804635020.

Descriptors: *Viruses, *Echovirus, *Chlorine, *Disinfection, Water treatment, Hydrogen ion concentration.

Aberrant inactivation kinetics were observed when monodispersed echovirus type 1 (Farouk) was inactivated with chlorine. An initial 1 to 2 log unit decrease in titer was followed by a lag period, during which the titer stayed the same or increased, and this was followed by a final decline in titer. First-order kinetics were obtained with poliovirus type 1 under the same conditions. Isoelectric focusing studies of echovirus before chlorine treatment showed that the virus distributed into two pH-dependent and interconvertible isoelectric forms. After chlorine treatment all remaining virus infectivity was associated with a third pH-independent isoelectric form. The complex inactivation kinetics appeared to be due to shifts between these conformational forms during inactivation in certain ionic environments. Under certain conditions the conformational shifts resulted in substantial resistance of monodispersed echovirus to chlorine. (Author's abstract)
W85-05048

WATER REUSE: WHERE ARE WE HEADED,
Orange County Water District, Fountain Valley, CA.
For primary bibliographic entry see Field 5D.
W85-05116

ION-EXCHANGE PROCEDURES (IONENAUSTAUSCHVERFAHREN).
Wasser, Luft und Betrieb, Vol. 27, No. 12, p 18-20, December, 1983. 4 Fig, 3 Ref.

Descriptors: *Ion exchange, *Water treatment, *Wastewater treatment, Cation exchange, Anion exchange, Counterflow, Costs, Regeneration.

Ion exchange is only suited for the treatment of very lightly polluted water due to the limited capacity of its resins and the high cost of regenerating chemicals. The water must be free of mechanical pollution and oils and fats. Procedures offered include complete or partial water softening; decarbonization; removal of some or most salts; wastewater treatment (removal of cations by selective exchangers); reclamation of precious metals like platinum, gold, or silver out of the products of regenerating the exchanger; and application in rinse-water circulation in the metal-processing industry to reduce wastewater production. For salts removal, water is first routed through a cation-exchanger and then through an anion-ex-

changer; in order to continue to supply the production process with salts-free water during regeneration, a tank to store treated water, two tracks of exchangers, or serial switching of exchangers may be used. The two principal operational types of exchanger are the unidirectional-flow, fixed-bed procedure and the counterflow, floating-bed procedure. The advantage of the counterflow procedure is a savings in regenerating chemicals (120-150% of theoretical requirements are needed for counterflow, 250-400% for unidirectional flow). Variations of the counterflow, floating-bed procedure are the lift-bed and rinse-bed exchangers. A combined-bed filter (combination of cation and anion resins) can be used as a secondary procedure where low conductivity (< 5 microS/cm) is required. Cartridge exchangers are available for laboratory, pharmaceutical, and medical applications, where due to low volume on-site regeneration is impractical. (Gish-IVI)
W85-05137

RECYCLING UNDILUTED DRAGOUT FROM TOXIC PLATING SOLUTIONS,
Ramirez Associates, Far Hills, NJ.
E. R. Ramirez, and F. D. Koch.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 173-180. 8 Fig, 4 Tab, 4 Ref.

Descriptors: *Electroplating, *Wastewater, Waterless rinses, Dragout, Toxic plating solutions.

The use of waterless rinse liquids has opened a new dimension in the electroplating industry where toxic chemicals are commonplace. This includes chromium plating, brass plating followed by solvent based coatings, precious metal plating and electronic parts plating. Waterless rinses have several advantages. Custom formulations can be used to meet a wide variety of needs and applications. No wastewater or very little wastewater is formed in a given plating step. Recovered dragout, in many cases, can be reused; it always is confined. Waterless rinse liquids can be reused indefinitely without ill effects. No water stains are observed on the metal surface. This is especially valuable to jewelry type finishes. Waterless rinses can incorporate antitarnish and/or corrosion inhibitor additives which will allow steel parts, for example, a 60-day storage period without visible corrosion. Waterless rinses require less space than conventional rinses. Rinse coats are between 0.5 and 1 cent/sq ft of surface processed. Processed parts can be air dried through proper formulation. The limitations of waterless rinse technology are: waterless rinses cannot be used between plating steps and waterless rinses are combustible hydrocarbons.
W85-05242

WASTE HAULER/DISPOSER MEETS PRETREATMENT GUIDELINES,
QED Corp., Ann Arbor, MI.
F. E. Bernardin, Jr., D. Mioduszewski, and W. Hartman.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 369-373. 4 Tab.

Descriptors: *Activated carbon, *Leaching, *Runoff, *Wastewater treatment, *Wastewater disposal, Waste disposal, Lime, Activated carbon, Effluent, Industrial wastes.

Chem-Met Services Inc. is engaged in transport and treatment of liquid industrial wastes. During treatment the liquids are converted into a stabilized solid suitable for disposal at an offsite solid waste landfill. The treatment system has no direct process liquid effluent, however, precipitation runoff constitutes concern. The sampling and site survey conducted by QED field personnel provided both representative wastewater samples and also background in the Chem-Met treatment process capabilities and restrictions. The source of input to the runoff pond is rain or snowmelt. The rainwater can soak through any of the waste-lime mixture, which is sometimes retained on the site for a short period before removal to the landfill, leaching out the watersoluble components, which also end up in the pond. Due to the high and variable organic content, high TDS and potential for toxicity, physical chemical treatment was selected. The data indicate that a physical chemical system using granular activated carbon adsorption could be an economic treatment alternative. A small scale pilot test combined with high values for standard BOD tests indicate that treatment with GAC to remove toxic or biologically resistant materials followed by discharge to the municipal POTW for biological treatment is the most economical and viable approach for treatment of the runoff pond water. The major elements of the system are pH control, filtration and adsorption. The treatment system is electrically operated and manually controlled. An onsite laboratory monitors effluent quality.
W85-05260

IMPACT OF PRIORITY POLLUTANTS ON PUBLICLY OWNED TREATED WORKS PROCESSES: A LITERATURE REVIEW,
Montgomery (James M.), Inc., Walnut Creek, CA.
L. L. Russel, C. B. Cain, and D. I. Jenkins.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 871-883. 4 Tab, 26 Ref.

Descriptors: *Sewage systems, *Ordinances, *Industrial wastewater, Organic wastes, Standards, Inorganic compounds, Literature review.

Compounds most frequently found and regulated in sewer use ordinance are tabulated. There is a substantial range in the reported threshold values of the impacts, and there is a similar wide range in the reported levels found in waste treatment processes. An individual discharger may be hundreds of times higher than the discharger shown in this paper; however, his impact is diluted by the large quantities of water discharge into sewage systems. The reported threshold levels in the organics area are generally substantially greater than the levels found in waste treatment facilities. This is partly due to the impact of air stripping on the volatile compounds and their consequent removal during transport in the sewage system. The control of routine discharges of organics is generally not an area that needs substantial effort in the setting of industrial waste sewer use ordinances. Special conditions, such as the presence of a large manufacturing concern tributary to a moderate or small sized waste treatment facility would justify limits on organics. Standards for many toxicants, particularly inorganics, is justified. For the practicing engineer, the most difficult area becomes the assessment of what levels are significant with respect to impact on the treatment facility. It is necessary to both maximize the use of our waste treatment investment and to protect it.
W85-05300

INVESTIGATIONS ON THE INFLUENCE OF ALGOGENIC ORGANIC MATTER ON FLOCCULATION AND FLOCSEPARATION (UNTERSUCHUNGEN ZUR BEEINFLUSSUNG DER FLOCKUNG UND FLOCKENABTRENNUNG DURCH ALGENBURTIGE ORGANISCHE SUBSTANZEN),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
H. Bernhardt, O. Hoyer, and B. Lusse.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 1, p 16-17, February, 1985. 13 Fig, 6 Tab, 14 Ref.

Descriptors: *Water treatment, *Organic matter, *Flocculation, *Algae, Surface waters, Turbidity, Eutrophication, Diatoms, Filtration, Flocculants, Iron.

The flocculation and filtration of water from eutrophic surface waters is often disturbed by algogenic organic compounds which arise in the water as metabolic or breakdown products of algae. As a result of this disturbance, the turbidity is insufficiently retained in the filter, flocs break prematurely through the filter and increased concentrations of flocculant occur in the filtrate. With extracellular organic matter (EOM) obtained from optimized algal mass cultures, flocculation tests were carried out. These tests showed that, depending on the amount of flocculant used, at low concentrations the EOM behaved like an anionic flocculation aid whereas at higher concentrations (> 1 mg/l C with a dosage of 5 mg/l Fe(3+)) it caused the flocculation disturbances described. Also, the high molecular weight fraction of the EOM exerted a greater influence on the flocculation process than the low molecular weight fraction (cut-off 2,000 Daltons). EOM from Chlorella cultures exerted no flocculation aid effect. The flocculation was influenced to different extents according to the algal species and growth phase. EOM obtained from the late stationary phase or the dying phase of an algal culture generally exerted a greater influence on flocculation than EOM from the logarithmic growth phase. Experiments with organic matter isolated from the eutrophic Wahnbach pre-reservoir during a mass development of diatoms (50,000 cells/ml) gave the same results. Using a dosage of 5 mg/l Fe(3+), the flocculation is impaired by > or = 1 mg/l DOC. In the presence of 4-5 mg/l DOC of the low molecular weight fraction, iron is bound in complexes and occurs in a soluble form. The effect of the extracellular organic matter from the different algal cultures and growth phases on the retention properties of the flocs in the filter is quantified with the filtration coefficient lambda. It could be demonstrated with the changes of lambda max values, that the effect of the EOM on the flocculation process was dependent on the amount of flocculant used, and that the disturbance of flocculation could be compensated to a certain extent by increasing the flocculant dosage. A comparison of the effects of the EOM from different algal cultures and different growth phases is given. (Author's abstract)
W85-05451

REACTION MECHANISMS INVOLVED IN THE INFLUENCE OF ALGOGENIC ORGANIC MATTER ON FLOCCULATION,
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
H. Bernhardt, O. Hoyer, H. Schell, and B. Lusse.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 1, p 18-30, February, 1985. 26 Fig, 1 Tab, 38 Ref.

Descriptors: *Flocculation, *Filtration, *Water treatment, *Organic matter, *Algogenic matter, Polysaccharides, Chemical reactions.

Algogenic organic substances, especially neutral and acidic polysaccharides, can influence flocculation and floc filtration according to the ratio of their occurrence to the flocculant used and to the surface concentration of the negatively charged particles in the water to be treated. Low concentrations of organic matter improve flocculation by attachment to the surface of quartz particles by means of hydrogen and covalent bonds, thus favoring the agglomeration of the quartz particles already destabilized by polynuclear hydroxo complexes. In the presence of higher concentrations of algogenic organic matter, surface complexes are formed between the dissolved polymer anions and the positively charged iron hydroxo complexes and iron oxide hydroxides being formed after addition of the ferric salt. In the presence of higher concentrations of algogenic matter, an extensive or even complete loading of the active centers of the quartz particles occurs depending on the ratio of dissolved organic carbon to surface concentration. Their negative charge density is thus increased and the destabilization process significantly obstructed. More flocculant, and additional amounts of a cationic polyelectrolyte are then needed. These mechanisms can be used as models in the development of remedial procedures for preventing disturbances to flocculation processes during treatment of drinking water. (Baker-IVI)
W85-05452

ORIGINAL PURITY - DEMANDS AND CRITERIA ACCORDING TO THE NEW MINERAL WATER AND TABLE WATER ORDINANCE (URSPRUNGLICHE REINHEIT - ANFORDERUNG UND KRITERIEN NACH DER NEUEN MINERAL- UND TAFELWASSER-VERORDNUNG),

nische Univ. Muenchen (Germany, F.R.).
fuer Wasserchemie und Chemische Balneolo-

Quentin.
chrift fur Wasser und Abwasser Forschung,
18 No. 1, p 36-40, February, 1985. 1 Tab, 6

riptors: *Mineral water, *Water quality,
ulations, *Germany (Federal Republic),
r pollution, Water quality standards, Stand-

ording to the new ordinance (Verordnung
Naturliches Mineralwasser, Quellwasser und
wasser (Mineral- un Tafelwasser-Verord-
), 1 August, 1984. BGBl. I, 1036-1045, 1984.
ral Republic of Germany) mineral waters
natural origin have to have 'original purity'.
this expression is not defined, a general basis
he original purity and orientating values for
al substances are given. First of all a differen-
n between geogenic constituents and anthro-
nic pollutants in mineral waters is necessary.
e criteria are important for the official certifi-
n of mineral waters and for their routine con-
s well. (Author's abstract)
-05453

IVER'S SEVEN DECADES OF EXPERI-E WITH CHLORAMINATION,
ver Water Dept., CO.
Dice.
nal of American Waterworks Association,
77, No. 1, p 34-37, January, 1985. 1 Fig, 5
1 Ref.

criptors: *Chloramines, *Drinking water, *Dis-
tion, Water treatment, Denver, Colorado,
e control, Odor control, Bacteria, Water distri-
n, Water quality control.

Denver Water Department has had nearly 70
s of success with the chlorine-ammonia proc-
f disinfection of drinking water, having begun
treatment in 1916 or 1917. This method is
to control tastes and odors, bacterial concen-
ons, and growths in the distribution system.
success of this program can be attributed to a
quality raw water, a comprehensive monitor-
program that provides data for studies, ongo-
nvestigations, and a well operated distribution
m maintenance program. Utilities that are in-
gating the use of chloramines should consider
quality of the source water and the extent of
monetary resources available for comprehen-
monitoring and maintenance. (Baker-IVI)
-05473

NVERTING FROM CHLORINE TO LORAMINES: A CASE STUDY,
tgomery (James M.), Inc., Pasadena, CA.
reft, M. Umphres, J.-M. Hand, C. Tate, and
. McGuire.
nal of the American Water Works Associa-
Vol. 77, No. 1, p 38-45, January, 1985. 5 Fig,
b, 30 Ref.

criptors: *Disinfection, *Chloramines, *Cali-
ia, Drinking water, Water treatment, Costs,
ncial aspects, Taste control, Odor control,
ervoirs, Water quality control, Trihalometh-
s.

Metropolitan Water District of Southern Cali-
ia, one of the largest water utilities in the US,
changed from chlorine in its disinfection proc-
to chloramines for controlling the formation of
alomethanes (THM). Informative pamphlets
e distributed to the customers to explain the
ons for the change and the adjustments that
e users would find necessary because of the
nge. The effectiveness of chloramine disinfec-
was carefully investigated before the change
n chlorine treatment was implemented. Various
es evaluated included chlorine and chloramine
mistry and by products, disinfection capability,
e and odor control, growth control in uncov-
d reservoirs, effectiveness of chloramine residu-
n distribution system piping, health effects of
oramines, implications for Metropolitan's member agencies, technological feasibility, and costs. Bench scale studies indicated that removal of THM precursors would not be sufficient to control THMs on a long term basis, thus indicating the necessity for the entire system to be converted to chloramine disinfection. The conversion to chloramines required modification of the operations at the five filtration plants and two finished water reservoirs. Modifications at Lake Mathews, a raw water reservoir that currently has a major chlorination facility, were also considered. The actual capital cost for modifications excluding Lake Mathews was 5.2 millon dollars. Annual costs, including ammonia, materials, electricity, and miscellaneous items are estimated to be $650,000. (Baker-IVI)
W85-05474

STATE REGULATION OF CHLORAMINATION,
Missouri Dept. of Natural Resources, Jefferson City. Public Drinking Water Program.
D. J. Hack.
Journal of the American Water Works Association, Vol. 77, No. 1, p 46-49, January, 1985. 5 Fig, 2 Tab.

Descriptors: *Disinfection, *Chloramine, *Regulations, Monitoring, Policy, Trihalomethanes, Water treatment, Bacteria, Drinking water.

The results of a survey conducted by the American Water Works Association Disinfection Committee into the practice of chloramination in the US states and territories are presented. One area of the study explored the policies and experiences of state water supply regulatory agencies with regard to the use of chloramines. Most of the information was gathered through a questionnaire sent in March 1984 to the director of each state's or territory's public water supply regulatory agency. Forty-six percent of the respondents reported that none of their public water suppliers used chloramination. In response to the question of changes in the use of chloramination as a result of trihalomethane regulations, 86% reported no change in policy. To a question designed to determine minimum combined chlorine residual and detention time requirements for the use of chloramines as the primary disinfectant, 29% responded that they will not allow chloramines as a primary disinfectant; 41% reported having not yet established minimum residual and detention time requirements. As concerns bacteriological monitoring, 38% of those responding reported that their requirements for additional monitoring follow EPA recommendations. Thirty percent reported that they do not require water suppliers proposing a change to conduct additional monitoring. (Baker-IVI)
W85-05475

BLENDING CHLORAMINATED AND CHLORINATED WATERS,
Southern California Metropolitan Water District, La Verne.
S. E. Barrett, M. K. Davis, and M. J. McGuire.
Journal of the American Water Works Association, Vol. 77, No. 1, p 50-61, January, 1985. 11 Fig, 6 Tab, 26 Ref.

Descriptors: *Chloramine, *Chlorination, *Disinfection, *California, Chlorine, Water quality control, Drinking water, Water treatment, Trihalomethanes, Ammonia.

The Metropolitan Water District of Southern California recently changed its primary disinfectant from free chlorine to chloramines to help control trihalomethanes. The effects of blending chloraminated and chlorinated waters were studied by developing blend-residual curves to simulate the systems involved. Experimentally determined blend-residual curves compare reasonably well with a simple computational model and with the trend predicted from conventional breakpoint curves. The computational model allows the prediction of acceptable blends of chloraminated and chlorinated waters for use in a distribution system without experimentally determining each case. When the contact time for blending the chloraminated and chlorinated waters is short (on the order of 5 min), free chlorine, monochloramine, and dichloroamine may exist together in the region of the breakpoint. If there is a change that a chlorine to ammonia-nitrogen ratio of >5:1 exists, additional analyses for the various chlorine species and for excess and total ammonia-nitrogen may be needed as a check on the operation of the distribution system. (Baker-IVI)
W85-05476

TECHNICAL NOTE: MONOCHLORAMINE REMOVAL FROM WATER BY ACTIVATED CARBON,
Brown and Caldwell, Seattle, WA.
J. D. Komorita, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol. 77, No. 1, p 62-64, January, 1985. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Water treatment, *Monochloramine, *Potable water, *Activated carbon, Public health, Hemodialysis, Ammonium chloride, Organic matter, Disinfection.

Monochloramine is becoming a popular alternative to chlorine for the disinfection of water supplies as it does not react with humic substances to form trihalomethanes. Monochloramines must be removed from water used for hemodialysis and the production of soft drinks as well as from water used in fisheries. A study of tap water was carried out to determine the effects of particle size, contact time, and dissolved organic matter on carbon column effluent concentration when a typical influent monochloramine concentration was used. In general, the smaller the carbon particles and the longer the contact time (CT), the greater the life of the carbon for destruction of ammonium chloride. The estimated replacement frequency for a kidney dialysis unit utilizing a GAC removal system containing 1 cu ft of carbon operating 8 hr/d with a flow rate of 3.74 gpm and a CT of 2 min is 4 days for 10x30 mesh carbon, 83 days for 12x40 mesh carbon, and 213 days for 20x50 mesh carbon. If the flow rate were changed, the replacement frequency would have to be modified. These replacement frequencies are specific for the tap water tested. When the water was spiked with peat fulvic acid to a total organic carbon of 7.5 mg/L and fed to 20x50 mesh carbon, the volume processed to an ammonium chloride breakthrough concentration of 0.1 mg as Cl2/L was decreased by about 70 and 40 percent for CTs of 0.75 and 1.0 min, respectively. The dissolved organic compounds in other waters may have a different effect on bed life. The type of carbon used may have a significant effect on its performance for ammonium chloride removal. (Baker-IVI)
W85-05477

EXPERIENCE WITH CHLORINE DIOXIDE IN BRUSSELS, PART 3: OPERATIONAL CASE STUDIES,
International Inst. of Hydraulic and Environmental Engineering, Delft (Netherlands).
W. J. Masschelein.
Journal of the American Water Works Association, Vol. 77, No. 1, p 73-80, January, 1985. 11 Fig, 2 Tab, 11 Ref.

Descriptors: *Potable water, *Chlorine dioxide, *Belgium, *Brussels, Water treatment, Chloramines, Disinfection, Chlorination, Costs, Trihalomethanes.

Brussels, Belgium obtains much of its potable water supply from the River Meuse. The river is affected by human sewage, algal blooms, humic substances, and the infusion of hard groundwater. Chlorine dioxide is used at treatment plants, pumping stations, and clear water reservoirs along the aqueducts for bacterial disinfection and to prevent trihalomethane formation. The policy of postdisinfection with chloramines generated on-site and subsequent treatment with chloride dioxide has had excellent results in controlling trihalomethanes in the distributed water. A cost evaluation was performed in 1981. Besides the advantages of using chlorine dioxide for disinfectant and for eliminating residual taste and odor, one benefit for mainte-

nance of an active residual concentration of disinfectant in the distribution system is that it is compatible with existing chloramines without increasing the concentration of trihalomethanes. Another benefit of chlorine dioxide is that it promotes better coagulation-flocculation, especially when colored compounds are present in the raw water. Safe and efficient use of chlorine dioxide requires appropriate dilution and injection rates. Particular attention must be paid to the mixing conditions in the reactor, the appropriate reagent concentrations, and the residual akalinity in the reactor effluent or in stored, concentrated solutions. (Baker-IVI)
W85-05479

WINTER WATER AND WASTEWATER OPERATIONS,
For primary bibliographic entry see Field 5D.
W85-05481

INTERACTIVE COMPUTER MODELING, MONITORING, AND CONTROL OF MELBOURNE'S WATER SUPPLY SYSTEM,
Melbourne and Metropolitan Board of Works (Australia).
G. O. Cosgriff, P. E. Forte, M. A. Kennedy, J. V. Russell, and R. D. Smith.
Water Resources Research, Vol. 21, No. 2, p 123-129, February, 1985. 4 Fig, 8 Ref.

Descriptors: *Computers, *Water conveyance, *Model studies, *Monitoring, *Melbourne, *Australia, Water resources development, Planning, Decision making, Telemetry, Automation.

Application of computer-based telemetry and modeling techniques has revolutionized the planning and operations of Melbourne's water supply system and has provided a basis for many cost effective changes throughout the area. These engineering tools have already increased feedback and analysis capabilities, which in turn has resulted in a better understanding of the hydraulic system by use of common display terminals through the planning, plant design, operations and maintenance functions in the organization. Such changes have been achieved through a multidisciplinary approach which enabled the integration of a broad spectrum of skills within the area to produce an integrated system, the benefits of which extend beyond the immediate application and into the philosophy of the structure of the organization itself. (Baker-IVI)
W85-05492

BACTERICIDAL PROPERTIES OF A NEW WATER DISINFECTANT,
Auburn Univ., AL. Dept. of Chemistry.
D. E. Williams, S. D. Worley, W. B. Wheatley, and L. J. Swango.
Applied and Environmental Microbiology, Vol. 49, No. 3, p 637-643, March, 1985. 7 Fig, 4 Tab, 15 Ref.

Descriptors: *Water treatment, *Disinfection, *Agent I, Bacteria, Chloramines, Calcium hypochlorite, Temperature effects, Hydrogen ion concentration, Water quality, Organic compounds.

The N-chloramine compound 3-chloro-4,4-dimethyl-2-oxazolidinone (agent I) has been compared with calcium hypochlorite as to its efficacy as a bactericide for the treatment of water. Calcium hypochlorite proved to be a more rapid water disinfectant than agent I against three species of bacteria in demand-free water. The differences between the efficacy of the two agents in demand-free water are dependent on pH, temperature, and the species of bacteria. For water containing an appreciable organic load, agent I is the better disinfectant under all conditions when total chlorine concentrations in the range used for water disinfection in the field are employed. Any discussion of the specific mechanistic actions of the two disinfectants should be deferrred until additional experiments are performed. (Baker-IVI)
W85-05511

ASPECTS OF WATER AND SEWAGE TREATMENT IN AUSTRALIA,
Gutteridge, Haskins and Davey, Melbourne (Australia).
A. G. Strom.
Journal of the Institute of Water Engineers and Scientists, Vol. 38, No. 6, p 493-510, December, 1984. 6 Fig.

Descriptors: *Wastewater treatment, *Water treatment, *Australia, *Reviews, Urban areas, Costs, Lagoon treatment, Effluents, Water quality.

A review is presented of water treatment and sewage treatment practices in Australia today. These comprise a wide range of techniques, with overseas influences adapted well in the main to Australian conditions. The paper deals with processes and aspects of processes and gives examples. The main urban centers in Australia are now adequately served in terms of treatment of water and sewage, and new technology is adopted readily and in the main, sensibly. The situation in the country towns is both good and bad. The good is that with ample space and favorable climate, the economical lagoon treatment of sewage is possible. The bad is that water treatment costs are often unnecessarily high because pressure for, and reliance on, state funding results in higher water standards than are necessary in the circumstances. New forms of water treatment such as Sirofloc and Sirotherm have resulted from some basic research and innovation, but more generally overseas research is drawn upon. Applied research has developed mainly lagoon treatment, re-use of effluent, and refinement of the denitrifying Pasveer Ditch for small communities. The sparse population and lack of significant industry has resulted in minimal incidence of water-borne enteric disease or of chemical or other industrial pollution of water sources. This may partly explain why many country towns have tolerated supplies of very poor apparent quality for so long. (Baker-IVI)
W85-05514

EXPERIENCES IN THE USE OF EAST ANGLIAN SANDS AND GRAVELS ('CRAGS') AS A SOURCE OF WATER SUPPLY,
East Anglian Water Co., Cambridge (England).
K. B. Clarke, and J. H. Phillips.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 6, p 543-549, December, 1984. 2 Fig, 5 Ref.

Descriptors: *Water supply development, *Water treatment, *Crags, *East Anglia, *England, Water resources development, Aquifer properties, Groundwater management, Iron, Manganese, Filtration, Hydrogen sulfide, Wells.

The crag is an unpromising acquifer and had previously been of little use as a source of public water supply in Suffolk except for three small coastal towns. Typically it is a heavily iron stained sand with occasional lenses of gravel. When it became apparent that the East Anglian Water Company might be forced by the advent of the Sizewell B Nuclear Power Station to develop a major water source in the crag, advice was sought on many issues. Attempts made to use the crag for water supply were said to have two major disadvantages. Firstly, there was the sanding up of wells after a few years use, caused by the slow ingress of fine sand into the wells. The second problem was the heavy iron content of the water. The use of a reverse circulation rig proved ideal for well sinking in the crag, mains water was available on or near the sites developed and this allowed a supply, at times up to 22,700 l/hr during the passage of open textured zones in the crag. Crag waters are high in iron and manganese, and also contain hydrogen sulfide. Where iron and manganese occur together their removal seems especially difficult. A pilot plant was set up to give guidance. Iron upon oxidation tends to be precipitated in almost colloidal form, and in some works a coagulent aid has been used with success. Removal of manganese within the filter seems to be a process which depends on the reaction with manganese already present on the sand grains. If iron is also being removed the grains appear to become choked with it and removal of manganese is minimal. The process finally adopted at the plant was one of do
filtration. After aeration the water passes thro
upward flow filters which reduce the iron leve
less than 0.1 mg/l. The water is then chlorin
and allowed to stand for six hours. Finally wat
pumped from the tank through pressure filters
supply. (Baker-IVI)
W85-05517

AUTOMATED IODOMETRIC METHOD F DETERMINATION OF TRACE CHLORA ION USING FLOW INJECTION ANALYSIS,
Miami Univ., Oxford, OH. Dept. of Chemis
For primary bibliographic entry see Field 5A.
W85-05519

WATERBORNE DISEASE IN COLORA THREE YEARS' SURVEILLANCE AND OUTBREAKS,
Colorado Dept. of Health, Denver. Disease C
trol and Epidemiology Div.
R. S. Hopkins, P. Shillam, B. Gaspard, L. Eisna and R. J. Karlin.
American Journal of Public Health, Vol. 75, N
p 254-257, March, 1985. 1 Tab, 6 Ref.

Descriptors: *Public health, *Human dise
*Colorado, Bacteria, Giardia, Rotavirus, Epid
ology, Water treatment, Filtration, Coliforms.

A steady increase was noted in the numbe
reported waterborne disease outbreaks occur
in the US since the early 1960s. Efforts were m
to more closely survey such outbreaks. In susp
ed occurrences, water samples were collected
examined for total coliforms and fecal coliform
outbreaks of suspected giardiasis, 1,000 ga
each of treated and untreated water were filt
through a one micron filter and the filter exam
for the presence of Giardia cysts. From Jul
1980 through June 30, 1983, 18 outbreaks
investigated which involved from 15 to 1,500
viduals. Giardia lamblia was confirmed or susp
ed in nine, rotavirus in one, and no agent coul
identified in eight outbreaks. Seventeen occu
in surface water systems, none of which had
quate chemical pretreatment and filtration. E
tive, inexpensive surface water treatment met
could substantially reduce the risk of waterb
disease. Investigation of water systems exhib
positive coliform results during the first year
tected no outbreaks. Activities important to e
tive surveillance included educational outr
programs to local health agencies, physicians
the public, and the designation of one individu
whom all water related public complaints
health department inquiries were directed. (Ba
IVI)
W85-05521

HYDRAULIC GRADIENT CONTROL GROUNDWATER CONTAMINANT REM AL,
Geological Survey, Menlo Park, CA.
D. F. Atwood, and S. M. Gorelick.
Journal of Hydrology, Vol. 76, No. 1/2, p 85
January, 1985. 11 Fig, 1 Tab, 17 Ref.

Descriptors: *Groundwater pollution, *Water
lution control, *Groundwater management, Li
programming, Solute transport, Groundw
flow, Simulation, Hydraulic gradient, Cleanup
erations, Decontamination, Plumes, Aqui
Wells.

A procedure is presented which integrates the
of linear programming, groundwater flow sim
tion and solute transport simulation to solve p
lems involving groundwater contaminant con
This procedure selected the best wells and
pumping/recharge schedules to contain a cont
nant plume, while a well or system of wells w
the plume removes contaminated water. W
used for hydraulic gradient control are pi
from preselected well sites and must be outsid
the zone of contaminated groundwaters. Pum
at upgradient wells or recharging at downgrad
wells produces a flat or inward gradient a
plume boundary. As the plume decreases in

otential gradient control wells initially within the ne of contamination (and therefore inactive) come surrounded by clean water. Once the wells e outside the contaminant plume they may be lected by the management model to help control e hydraulic gradient. Well sites distant from the ume boundary in later periods may be shut down the management solution. The procedure used r selecting the best wells to use consists of two rts. In stage I, a combined groundwater flow and lute transport model is used to simulate contami- nt removal under an assumed velocity field. The sult is the approximated plume boundary loca- n as a function of time. In stage II, a linear ogram, which includes a groundwater flow odel as part of the set of constraints, determines e optimal well selection and their optimal, pump- g/recharge schedules by minimizing total pump- g and recharge. The simulation-management odel eliminates wells far from the plume perime- r and activates wells near the perimeter as the ume decreases in size. This successfully stabilizes e hydraulic gradient during aquifer cleanup. Baker-IV)
'85-05533

ZONE ENHANCED BIOLOGICAL ACTIVAT- D CARBON IN DENVER, COLORADO: A ILOT PLANT STUDY,
rber (Richard P.) Associates, Inc., Denver, CO.
or primary bibliographic entry see Field 5D.
'85-05826

INETICS AND PRODUCTS OF THE REAC- IONS OF OZONE WITH VARIOUS FORMS F CHLORINE AND BROMINE IN WATER,
idgenoessische Anstalt fuer Wasserversorgung, bwasserreinigung und Gewaesserschultz, Due- endorf (Switzerland).
'. R. Haag, and J. Hoigne.
zone: Science and Engineering, Vol. 6, No. 2, p 03-114, 1984. 7 Fig, 1 Tab, 20 Ref.

escriptors: *Ozonation, *Chemical reactions, Chlorine, *Bromine, *Water treatment, Oxida- on, Halogens, Disinfection.

zone may react with various halogen compounds uring water treatment. The oxidation of Br(-) by 3 in natural waters produces HOBr as a second- ry oxidant and disinfectant. HOBr can result in ie formation of bromoform. HOBr will be oxi- ized further to BrO3(-) at high pH and high O3/ r(-) ratios. Under such conditions, the ozonolysis f organic matter will become inefficient because onsiderable amounts of O3 are destroyed catalyti- ally by the Br(-)/OBr(-) couple. Ozonation of aline cooling waters for antifouling would appear o offer little advantage over less-expensive chlor- ation because, among several reasons, the same isinfecting oxidant (HOBr) is produced. Free hlorine reacts with O3 to produce 77% Cl(-) and 3% ClO3(-); however, Cl(-) is not reoxidized to IOCl so no catalytic O3 destruction occurs. (Col- er-IVI)
'85-05828

5G. Water Quality Control

'VALUATION OF ALTERNATIVE POLICIES 'OR CONTROLLING AGRICULTURAL NON- 'OINT SOURCE POLLUTION,
Virginia Polytechnic Inst. and State Univ., Blacks- urg. Dept. of Agricultural Economics.
'or primary bibliographic entry see Field 6B.
'85-04989

SIDE EFFECTS OF 58 YEARS OF COPPER SULFATE TREATMENT OF THE FAIRMONT LAKES, MINNESOTA,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
M. J. Hanson, and H. G. Stefan.
Water Resources Bulletin, Vol. 20, No. 6, p 889- 900, December, 1984. 7 Fig, 7 Tab, 26 Ref.

Descriptors: *Copper sulfate, *Fairmont Lakes, *Minnesota, *Algae, *Algicides, Ecological effects, Fish populations, Dissolved oxygen, Fish kills, Chlorophyta, Cyanophyta.

The shallow Fairmont Lakes in southern Minnesota have been treated with copper sulfate for 58 years to reduce excessive algal growth. Copper sulfate was applied to five lakes at cumulative rates up to 1647 kg/ha (1470 lb/acre), totaling 1.5 million kilograms. Data collected since treatment of the Fairmont Lakes began in 1921 provide alarming insights into lake responses to sustained chemical treatment with copper sulfate. Short-term and long-term effects have occurred. Short-term effects include: a) the intended temporary killing of algae, b) dissolved oxygen depletion by decomposition of dead algae, c) accelerated phosphorus recycling from the lake bed and recovery of the algal population within 7 to 21 days, and d) occasional fish kills due to oxygen depletion or copper toxicity or both. Long-term effects are shown to include: a) copper accumulation in the sediments, b) tolerance adjustments of certain species of algae to higher copper sulfate dosages, c) shift of species from green to blue-green algae and from game fish to rough fish, d) disappearance of macrophytes, and e) reductions in benthic macroinvertebrates. The conclusion is that while copper sulfate treatments enjoy great popularity because they kill and remove algae almost instantaneously, other immediate or cumulative side effects can be harmful to many other aquatic organisms. (Author's abstract)
W85-04996

REMOVAL OF VOLATILE CHLORINATED HYDROCARBONS FROM GROUNDWATER (ENTFERNUNG LEICHTFLUCHTIGER CHLORKOHLENWASSERSTOFFE AUS GRUNDWASSER),
M. Kertess.
Wasser, Luft und Betrieb, Vol. 27, No. 11, p 20-22, November, 1983. 1 Fig.

Descriptors: *Chlorinated hydrocarbons, *Groundwater pollution, *Water pollution control, *Wastewater treatment, Volatile compounds, Trichlorethylene, Tetrachlorethylene, Adsorption, Methylene chloride, Trichlorethane, Dichlorethylene.

Efforts of a chemical company in Hannover, Federal Republic of Germany to remove volatile chlorinated hydrocarbons (CHC) originating on its site and polluting nearby emergency drinking-water wells are described. Tri- and tetrachlorethylene were found to be polluting the wells in 1976, and responsibilty for clean-up was passed to the company when government agencies could not provide a technically feasible solution. A company specializing in wastewater technology designed a fully automatic compact treatment facility with a 97% removal rate. The facility is based on the application of pollution-removing products and chemically reacting adsorbents: for heavily polluted wastewater, these are used for both preliminary and tertiary treatment with activated-charcoal treatment as a second stage; while for lightly polluted wastewater and water, these are applied as a second and final stage preceded by activated-charcoal treatment. Treatment cost at the facility is DM 1.00/cu m. The question should be addressed as to whether CHC should be banned by law. Cooperation between government and the private sector is not encouraged by fines and responsibility for clean-up being placed on the polluter without suggestions for clean-up implementation. In this case, tri- and tetrachlorethylenes, 1,1,1-trichlorethane, and methylene chloride have largely been removed, but cis-1,2-dichlorethylene has now emerged as the main component so that the problem of CHC pollution has not yet been solved. (Gish-IVI)
W85-05136

CONTINUOUS DETECTION OF POLLUTANTS ON SURFACES OF RUNNING WATER (KONTINUIERLICHER NACHWEIS VON VERUNREINIGUNGEN AUF OBERFLACHEN VON FLIESSENDEN GEWASSERN),
Strohlein GmbH and Co. 4044 Kaarst 1.
For primary bibliographic entry see Field 5A.
W85-05140

RESERVOIR RELEASE IMPROVEMENT,
Tennessee Valley Authority, Chattanooga. Div. of Water Resources.
C. E. Bohac, E. D. Harshbarger, J. L. Davis, R. J. Ruane, and S. Vigander.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 847-859. 16 Fig, 2 Tab, 12 Ref.

Descriptors: *Reservoir releases, *Baffles, *Dissolved oxygen, Wastewater treatment, Cost analysis, Dams, Aeration, Fisheries, Recreation, Norris Dam.

Significant amounts of air can be induced into hydroturbine draft tubes by properly designed baffled aspiration systems. There is an energy and capacity loss associated with the baffles and additional losses associated with the presence of air in the draft tube. Based on tests at Norris Dam, dissolved oxygen uptake on the order of 3-4 mg/l is possible using baffles at the expense of a loss of 2-3% in unit efficiency. Blowers might prove to be more advantageous than baffles because blowers would confine the power loss to only the period of aeration. In general, the cost of providing minimum flows below TVA reservoirs by bypassing generators is likely to exceed the benefits derived from improved fisheries or recreation. The relative cost analysis suggests that cost increases rapidly for providing DO increases above 2-3 mg/l. The comparison of aeration to advanced waste treatment systems points to the possibility that release improvement would be more economically efficient than the imposition of additional treatment requirements for DO control in certain instances.
W85-05298

LIMING OF ACIDIFIED WATERS: A REVIEW OF METHODS AND EFFECTS ON AQUATIC ECOSYSTEMS,
General Research Corp., McLean, VA.
For primary bibliographic entry see Field 5C.
W85-05310

PROTECTING THE NATION'S GROUNDWATER FROM CONTAMINATION.
Office of Technology Assessment, Washington, DC.
Available from Supt. of Documents, GPO, Washington, D.C. 20402. OTA-0-233, October 1984, 244 p. 6 Fig, 40 Tab, 174 Ref.

Descriptors: *Groundwater pollution, *Groundwater management, *Water quality control, *Water quality management, *Water pollution prevention, *Water pollution control, *Reviews, *Environmental effects, Environmental policy, Federal government, Environmental protection, Local governments, Hazardous materials, Water pollution sources, Fate of pollutants, Path of pollutants, Drinking water.

Contamination of groundwater in the United States has occurred in every state and should warrant attention. The protection of groundwater quality involves activities to detect, correct and prevent contamination in order to minimize associated impacts. Federal and State programs generally focus on managing only selected point sources of contamination, particularly point sources associated with hazardous wastes. Under the National Interim Primary Drinking Water Regulations of the Safe Drinking Water Act, only 22 mandatory water quality standards have been established. Many states have set their own standards for drinking water and groundwater quality. The extent to which people relying on private wells are being exposed to groundwater contaminants is unknown. Data are also unavailable about the impacts of groundwater contamination on non-drinking water uses. Corrective action programs such as the Comprehensive Environmental Response, Compensation and Liability Act have concentrated on hazardous waste sites and generally do not involve the cleanup of contaminated groundwater. Likewise, most programs to prevent groundwater contamination have focussed primarily on hazardous wastes and other toxic materials. A focus on sources is one approach to prevent contamination. Another

approach is through restrictions on the manufacture or generation, distribution and use of contaminants, such as pesticides. Technological constraints to protect groundwater quality may include difficult geological environments that inhibit monitoring efforts. Non-technological constraints may include lack of time or money required to implement programs. National policy must remain flexible in its ability to respond to different groundwater quality problems characterized by varying site conditions.
W85-05348

FIELD INVESTIGATION AND REMEDIAL ACTION AT A SITE CONTAMINATED WITH COAL TARS,
TRC Environmental Consultants, Inc., East Hartford, CT.
For primary bibliographic entry see Field 5E.
W85-05377

GROUNDWATER QUALITY PROTECTION: POLICIES AND TECHNICAL RESOURCES,
Wisconsin Univ.-Extension, Madison. Dept. of Engineering and Applied Science.
P. R. O'Leary.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, 1982. Wisconsin Univ. -Extension, Dept. of Engineering and Applied Science, Madison. p 421-432, 9 Ref.

Descriptors: *Groundwater management, *Public policy, *Design criteria, *Water quality standards, *Water quality control, *Water quality management, *Models, *Public participation, Regulations, Standards, Waste disposal, Groundwater pollution, Water pollution control, Fate of pollutants, Monitoring, Public relations.

Interest in developing groundwater quality protection programs is receiving national attention. Identifying the appropriate level of protection is a difficult technical and public policy issue. Standards may be groundwater quality based, setting maximum levels of contamination, or the standards may take the form of disposal site construction specifications. In order to ensure the disposal facility will not cause a groundwater problem, the designer must be prepared to model both the performance of waste systems and contaminant movement in the groundwater flow system. Careful follow up groundwater monitoring is also needed to verify the results. Parallel considerations are the availability of technical expertise to accomplish the necessary analysis and the financial commitment to develop high quality data. Recognizing that the public has a keen interest in protecting groundwater quality, techniques must be employed to enhance public understanding. (Author's abstract)
W85-05381

ASSESSMENT OF POTENTIAL AGRICULTURAL AND INDUSTRIAL USES OF A LIME WATER-SOFTENING WASTE SLURRY,
Illinois State Geological Survey Div., Champaign.
J. H. Goodwin, I. G. Krapac, P. C. Reed, and W. R. Roy.
In: Proceedings of the Fifth Annual Madison Conference of Applied Research and Practices on Municipal and Industrial Waste, WI, September 22-24, Madison. p 495-521, 7 Fig, 8 Tab, 29 Ref.

Descriptors: *Spray irrigation, *Trace elements, *Slurries, *Lime, Waste recovery, *Land disposal, *Wastewater renovation, *Water treatment, *Leachates, *Calcium, *Recycling, Hydrogen ion concentration, Conductivity, Alkalinity, Minerals, Soft water, Hazardous material, Computer models, Illinois.

The Illinois State Geological Survey in cooperation with the Northern Illinois Water Corporation had conducted a program of sampling and analysis of lime slurry from lime water-softening treatment of well water currently sold as an agricultural liming material to be sprayed on fields. Slurry solids were analyzed for six major, three minor, and 17 trace elements, dry and wet specific gravity and density, x-ray mineralogy, particle size, and moisture content. Water samples were analyzed for 21 elements and Eh, pH, EC and alkalinity values. Preliminary studies of the vertical and areal variability of the chemical composition of the solids showed that there were statistically significant differences for some elements among some sample populations. However, these differences are probably small enough to be homogenized during large-scale extraction of the slurry for agricultural or industrial uses. The ASTM-A Water Shake Extraction Procedure and the U.S. EPA Extraction Procedure were used to assess the solubility of slurry samples. Field leachate samples were collected from slurry lagoons at the water treatment plants to provide a basis for comparison with laboratory extracts. Concentrations of several potentially toxic trace substances in the laboratory extracts and field leachates were less than EPA hazardous waste criteria and water quality standards. Solubility modeling of the samples using the computer program WATEQ2 suggested that Ca(2+) activities in the ASTM-A extracts and leachate samples were largely influenced by aragonite solubility.
W85-05385

WASTE DISPOSAL MODELLING,
Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
For primary bibliographic entry see Field 5E.
W85-05463

POLLUTING SEWERS BROUGHT UNDER CONTROL,
Marion County Health Dept., Indianapolis, IN. Bureau of Environmental Health.
R. S. Morse, and H. M. Eckrich.
Journal of Environmental Health, Vol. 47, No. 2, p 68-70, September/October, 1984. 4 Fig.

Descriptors: *Marion County, *Indiana, *Water pollution control, *Sewers, Overflows, Combined sewer overflows, Public participation, Public health, Maintenance, Diversion points.

Dry weather overflows from combined sewers have had the potential of creating major public health hazards and of causing environmental damage to seven Marion County, Indiana, streams for many years. On the part of the Health Department the following steps were taken: the setting of goals, objectives, and action plans; a structured approach to monitoring combined sewer overflow points and follow-up of points in violation; systematic reporting to the Department of Pubic Works of flowing points with follow-up or correction; involvement of the public; and the education of public officials responsible for funding and supporting the efforts of the Department of Public Works. The Department of Public Works took the following steps: more frequent monitoring of diversion points; the purchase of new sewer maintenance equipment; more prompt response to reports of overflows, with field reports sent to the Health Department; sewer maintenance at night and on weekends, as needed; securing of manholes that had a history of vandalism; construction of bars across street inlets; personal involvement in supervision; and repairs on particularly tedious diversions with follow-up through frequent walking of these sewers to check 13 otherwise inaccessible diversion points. (Baker-IVI)
W85-05470

APPLYING ANALYTICAL TECHNIQUES TO SOLVE GROUNDWATER CONTAMINATION PROBLEMS,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
I. H. Suffet, J. Gibs, J. A. Coyle, R. S. Chrobak, and T. L. Yohe.
Journal of the American Water Works Association, Vol. 77, No. 1, p 65-72, January, 1985. 10 Fig, 9 Tab, 32 Ref.

Descriptors: *Groundwater pollution, *Monitoring, *Water analysis, Drinking water, Water quality control, Chemical analysis, Monitoring, Pollutant identification.

Approaches for analyzing chemical compounds in drinking water are described along with broad spectrum analysis techniques that are effective tools in arriving at optimum methods to treat groundwater contamination. For both broad spectrum analysis and individual compound analysis, the desired range of concentration of contaminants must be selected. Then the objectives of groundwater monitoring can be carried out. Effective groundwater monitoring programs were demonstrated through three case studies. In trace analysis, consistent efficiency of recovery for any compound is generally more important than absolute recovery for quantitative analysis. Consistent efficiency of recovery means that each time an analysis is run, the same percentage of recovery is obtained. Whether the efficiency is 50% or 90%, it must be reproducible. An accurate analysis is aided by consistent efficiency. The key is obtaining consistent data with which to evaluate the problem. Environmental analysis problems include the pitfalls of a large background matrix, sampling bias, and flaws in the measurement system. Quality assurance procedures must be used during environmental sampling to maintain the integrity of the sample. The appropriate method must be used to fit the experimental goal since environmental analysis is still an imperfect science. (Baker-IVI)
W85-05478

HEAVY SNOW LOADS PLAGUE RESERVOIR ROOF,
Culp/Wesner/Culp, Cameron Park, CA.
For primary bibliographic entry see Field 8A.
W85-05482

RIVER QUALITY AND SEWAGE EFFLUENT STANDARDS,
Thames Water Authority (England). Northern Div.
K. Bowden, and D. D. Young.
Journal of the Institute of Water Engineers and Scientists, Vol. 38, No. 6, p 511-527, December, 1984. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Water quality control, *Water quality standards, *Trent-Severn Water Authority, *Thames Water Authority, *England, Standards, Regulations, Effluents, Planning, Reviews.

Issues affecting management of river water and sewage effluent quality in England since the adoption of the approach to river quality objective and discharge consent conditions proposed by the National Water Council six years ago are examined. Experiences of two water authorities, the Severn-Trent Authority and the Thames Water Authority, which have faced quite different problems during the last decade, are reviewed. Severn-Trent Water Authority is responsible for a variety of river catchments, some of which have suffered grave pollution since the last century. The main features of the river water quality objectives for this area were the complete elimination of the grossly polluted class 4 condition and the upgrading of most of the class 3 rivers to class 2 or better. The situation in the Thames Water Authority was quite different with a much higher proportion of waters of the Thames and Lee catchments being of good quality. There was continuing growth of population, industrial activity and demand in the Thames valley west of London stimulated by factors such as the development of road and air communications and the movement of population away from the metropolis. The determination of standards for each of these authorities is discussed with emphasis on effluent standards for an isolated discharge, multiple discharges, generalized catchment quality models, the River Wey Catchment Quality Review, and extending the approach to private dischargers. For the future, three dominant stimuli for change are expected: the changing economic and political climate, national and international legislation, and innovative thinking by engineers and scientists. (Baker-IVI)
W85-05515

MULTISOLUTE MASS TRANSPORT WITH CHEMICAL INTERACTION KINETICS,

otre Dame Univ., IN. Dept. of Civil Engineer-
g.
or primary bibliographic entry see Field 5B.
'85-05534

REAKTHROUGH OF BRINE THROUGH OMPACTED FINE GRAINED SOILS,
'indsor Univ. (Ontario). Dept. of Civil Engineer-
g.
. J. Ridley, and J. K. Bewtra.
: Proceedings, 38th Industrial Waste Conference, 'est Lafayette, IN, May 10-12, 1983. Purdue niv., Butterworth Publishers, Boston, MA. p 879-91, 9 Fig, 8 Tab, 33 Ref.

escriptors: *Compacted soils, *Brines, *Transort theory, Chlorides, Anions, Seepage, Soil posity, Path of pollutants, *Groundwater movement.

study of the breakthrough of brine using a 30% aCl brine, demonstrated that the use of compacted fine grained soils for containment purposes can inimize but not eliminate the advance of a Cl(-) ont. Compaction increases the degree of orientaon and aggregation of clay particles, thereby reating a network of smaller sized pores where ovement of the solute occurs mainly by diffusion. he tailing phenomenon observed in the breakrough curves of some of the compacted soils ppears to be influenced more by changing pore elocity than unsaturated flow or aggregated edia. Anion exclusion is an important factor in creasing the transport of Cl(-) through the soils y 1.79 to 6.38 times than if it had been associated niformly with all the soil water. The rate of ansport of anions through a compacted soil apears to be enhanced by the compaction process. eepage or convective transport theory is often sed to predict breakthrough of a pollutant from a oil mass. If the permeant does not physically or hemically react with the compacted soil, seepage heory can yield false results. Cl(-) concentrations each terminal breakthrough concentration (TBC) .74 to 2.11 times faster than seepage theory predicts, implying that dispersive transport should lso be considered. If the rates of breakthrough to TBC are compared using water and brine determined hydraulic conductivity, the water data would underestimate the breakthrough to TBC by s much as 585 times.
W85-05571

EFFECT OF GIBBERELLIC ACID ON THE BUOYANCY OF SPIRODELA INTERMEDIA W. KOCH,
Universidad Nacional del Sur, Bahia Blanca (Argentina). Dept. de Agronomia.
M. G. Klich, M. B. Mujica, and O. A. Fernandez.
Aquatic Botany, Vol. 21, No. 1, p 63-69, January, 1985. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Plant growth substances, *Gibberellic acid, *Aquatic weed control, *Plant physiology, Aquatic plants, Light intensity, Temperature effects, Herbicides.

Under the environmental conditions of this study 0.1 mg/l of gibberellic acid (GA3) did not affect the growth or buoyance of S. intermedia. Concentrations of 1 and 3 mg/l modified the ability of the fronds to float; an effect influenced by the experimental conditions. When the concentration of GA3 applied was 1 mg/l the percentage of submerged fronds increased from 22 to 62 with increasing light intensity and temperature. At a concentration of 3 mg/l, 57% of the fronds sank at 24 C and 2150 lux and 100% under all the other conditions. Before sinking the plants shed their roots. Concentrations of 1 and 3 mg/l of GA3 reduced both numbers and surface area of fronds. Fresh weights were higher than those of either the 0.1 mg/l of GA3 or control treatments. The differences are statistically significant. When fresh weight per square surface area and the percentage of submerged fronds for each treatment are compared, the higher fresh weight values correlate with numbers of fronds sinking. Plant water content values obtained from fresh and dry weight data, show that increments in total weight were due to an increase in the water content. The air cavities of fronds grown in the presence of GA3 although variable in shape and size were smaller and flatter than those of fronds grown in the absence of the hormone, which were big and tended to be spherical to ovoid in form. Fronds grown in the presence of 1 and 3 mg/l of GA3 had 1-3 fissures on the adaxial epidermis across the distal part, leaving the aerenchyma completely exposed while those grown at 0.1 mg/l of GA3 showed only slight fissure initiation. The action of GA3 may be an effective complement to mechanical control of unwanted aquatic plant species since it is a natural component of the plant mechanism. (Baker-IVI)
W85-05610

CHANGES IN THE QUALITY OF RIVER OISE WATER DURING RETENTION IN THE STORAGE BASIN AT MERY (FRANCE) (EVOLUTION DE LA QUALITE DE LA RIVIERE OISE LORS DE SA RETENTION DAMS LE BASSIN DE 'STORAGE' DE MERY (FRANCE)),
Universite Libre de Bruxelles (Belgium). Lab. d'Oceanographie.
For primary bibliographic entry see Field 2H.
W85-05635

INFLUENCE OF RECENTLY DROWNED TERRESTRIAL VEGETATION ON THE QUALITY OF WATER STORED IN IMPOUNDING RESERVOIRS,
Societe Degremont, Rueil-Malmaison (France).
P. C. Mouchet.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1608-1619, December, 1984. 12 Fig, 3 Tab, 32 Ref.

Descriptors: *Reservoirs, *Water quality control, *Vegetation, Decomposing organic matter, Water resources development, Environmental effects, Biochemical oxgyen demand, Chemical stratification.

When an impoundment is filled for the first time, the ecosystem changes from a terrestrial to an aquatic one. Once filled, the terrestrial vegetation dies and decays resulting in chemical stratification. The flooding of meadows will fix in the medium a quantity of dry organic matter of some 2.5 kg/sq m; a European type deciduous forest will fix approximately 50 kg/sq m. The flooding of a forest of 300 t/ha would lead to a BOD5 of some 30 g of oxygen/sq m when only taking into consideration the leaves, branches, bark and litter, sufficient to deprive a water column 3 to 4 m high for 5 days of all oxygen. Over twelve months the quantity of carbon mineralized would be at least 150 to 200 g/sq m, that is an oxygen demand of 400 to 500 g/sq m. The flooding of a meadow of 10 t/ha would result in a BOD of about 5 g/sq m after 5 days, 10 g/sq m after 15 days; over a full year the quantity of C-org mineralized would be some 20 g/sq m that is, an oxygen demand of some 50 g/sq m. The bottoms of reservoirs often are not cleaned because of the high cost of such an operation, but the increase in investment and operating expenses for treating water as a result of its eutrophication makes this preliminary operation worthwhile. In all cases it is imperative to clear all tree vegetation whether standing or not, including stumps and litter. It should not be burnt on site as this leaves phenol compounds and nutrients, which must be completely removed prior to filling. Grassy vegetation can be left, especially if it has only grown after deforesting, if the reservoir can be completely drained at least once several months after storage and if the soil does not require stripping. The soil should be stripped depending on its organic matter and phosphorus content. (Baker-IVI)
W85-05646

USE OF LIME SLURRY FOR DEACIDIFICATION OF RUNNING WATER,
Rogaland Distriktshoegskole, Stavanger (Norway).
H. Abrahamsen, and D. Matzow.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1981-1985, December, 1984. 3 Fig, 8 Ref.

Descriptors: *Water treatment, *Norway, *River Vaaraana, *Lime slurry, *Deacidification, Water quality control, Lakes, Rivers, Lime, Toxicity, Mortality, Trout, Salmon.

In southern and western parts of Norway, the precipitation and runoff are extremely high, while the lakes are small with a short water retention time. This makes it uneconomical to lime the lakes, and therefore it is important to find methods for liming running water. A description is offered of a lime slurry dosing system used in the River Vaaraana (Norway) to help combat acidification of rivers. The catchment is 33.5 sq km and average runoff is 50 l/second/sq km. The catchment upstream of the dosing system is 18.5 sq km. Experiments were conducted with one summer old fingerlings of Atlantic salmon and sea trout exposed in the river. The fish were kept in keepnets with a volume of 40 L and placed in wood ploughs in the river. No mortality downstream of the point of liming occurred during the experiment. Upstream of the point of liming, the mortality reached 85% for sea trout and 90% for salmon within 120 hr. (Baker-IVI)
W85-05679

RECLAMATION OF THE PEARL RIVER, A PERSPECTIVE OF UNPOLLUTED VERSUS POLLUTED WATERS,
Tulane Univ., New Orleans, LA.
G. E. Gunning, and R. D. Suttkus.
Fisheries, Vol. 10, No. 1, p 14-16, January-February, 1985. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Water pollution control, *River reclamation, *Pearl River, *Louisiana, Wastewater treatment, Water quality control, Fish, Invertebrates, Mussels, Annelids.

Historically the Pearl River (Louisiana) received large amounts of municipal sewage and industrial wastes. The river was ultimately reclaimed by installation of primary and secondary treatment facilities for both effluents. No violations of state or federal water quality criteria were observed in the 10-year period subsequent to installation of treatment facilities. Positive results of pollution abatement and river reclamation were: (1) an increase in clean water species of fishes and invertebrates, (2) a decrease in pollution tolerant species such as the annelid Tubifex, (3) reestablishment of unionid mussel populations in the reclaimed river segment, and (4) increased growth rate for some species of fishes. (Author's abstract)
W85-05725

VARIATIONS IN QUALITY IN THE GANGES,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava.
Effluent and Water Treatment Journal, Vol. 25, No. 2, p 61-65, February, 1985. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Water quality control, *India, *Ganges, Temperature effects, Industrial wastes, Domestic wastes, Drinking water, Public health, Safety, Sanitation.

The water quality of the Ganges (India) undergoes significant changes due to seasonal effects, confluence with tributaries, and entry of wastewaters. The lower temperature in the upstream stretches attains equilibrium with the ambient temperature. The upswing in the river's temperature indicates the wastewater outfall points. The clarity of the river is higher in the upland parts of the river in winter months. At waste outfall points, the decreased clarity improves because of the bioflocculation. The clarity of the river cannot be used as an indicator of pollution of the river unless the BOD is also determined. The BOD of the river was greater in summer months due to a decreased flow in the river. The ground water quality influence on the river quality was noted from such variables as conductivity, chlorides and hardness. Coliforms increased at wastewater outfall points but their concentration is reduced within short distances due to flocculation. There is an urgent need for pollu-

tion control in the river for the safety of people who drink the water at various places. (Baker-IVI)
W85-05836

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

SAGE: A NEW PARTICIPANT-VALUE METHOD FOR ENVIRONMENTAL ASSESSMENT,
Appropriate Technology International, Washington, DC.
E. L. Hyman, D. H. Moreau, and B. Stiftel.
Water Resources Bulletin, Vol. 20, No. 6 p 915-922, December 1984. 5 Tab, 26 Ref. U.S. Department of the Interior, Office of Water Research and Technology project 13-34-8408.

Descriptors: *Environmental assessment, *Decision making, *Model studies, *Attitudes, Public opinion, Policy making, Social participation, Social values.

A novel participant-value method for environmental assessment, called SAGE, was developed which has application in evaluating land use/watershed management problems. SAGE stands for Social Judgment Capturing-Adaptive-Goals Achievement-Environmental Assessment and follows the strategy of social judgement theory by inferring value weights back from the choices that people make on a series of alternatives. Additionally, SAGE yields a measure of each participant's assignment of the value weights. These weights are applied to scaled scores for accounts based on measurable attributes of each objective. In order to indicate the political ramifications of decisions and to facilitate sensitivity analysis, the values held by various groups are presented in matrix form arrayed by group affiliation or by judgment types that share common values. Physical, chemical and biological attibutes of alternative action are predicted and scaled into accounts of beneficial and adverse effects on the objectives. SAGE was tested in a practical problem concerning alternative urban development patterns for the Falls of the Neuse Watershed in Piedmont, North Carolina. This preliminary test indicates that with a modest expenditure of time and resources, SAGE can facilitate participation by the public and by decision makers. It is applicable to either specific project analyses or regional planning studies. SAGE clearly separates facts from values in its scaling and weighting procedure. It recognizes the diversity of values held by different groups through its presentation of a cross-tabulated matrix of impacts and value weights. This information helps decision makers understand the sources of agreement and conflict so that a consensus can be built around possible modifications of the proposed project. (Collier-IVI)
W85-04999

MEASURING THE SITE-SPECIFIC RECREATION BENEFITS RESULTING FROM IMPROVED WATER QUALITY: AN UPPER BOUND APPROACH,
Pittsburgh Univ., PA. Dept. of Economics.
J. Ochs, and R. S. Thorn.
Water Resources Bulletin, Vol. 20, No. 6, p 923-927, December, 1984. 2 Fig, 9 Ref.

Descriptors: *Recreation, *Water quality, *Benefits, Cost-benefit analysis, Economic aspects, Public policy.

The estimation of the value of recreation benefits resulting from improved water quality is required for many purposes. In particular, the Water Pollution Control Act of 1980 requires the consideration of the reasonableness of costs of reducing water pollution in relation to benefits to be derived from establishing effluent standards (Clean Water Act of 1977). Recreation is often the most important benefit resulting from water quality improvement. Current methods used to calculate recreation benefits are either not site-specific or are expensive and controversial. A relatively simple, inexpensive, and less controversial method of calculating site-specific recreation benefits resulting from improved water quality was developed. The method produces an upper bound estimate which often is adequate for the relevant decision. The upper bound estimates is based on two assumptions: 1) there are alternative equivalent substitute sites for the newly augmented water quality site, and 2)the new augmented recreation opportunities at the site will be used to their maximum supply capacity. Clearly, if an upper bound benefit estimate in a cost-benefit ratio does not produce a favorable ratio, no other benefit estimate will. In cases where this estimate produces an ambiguous result resort must be had to other more precise methods of estimation. (Author's abstract)
W85-05000

PROSPECTS OF USING AUTOMATED MANAGEMENT SYSTEMS IN EARTH-DAM CONSTRUCTION,
For primary bibliographic entry see Field 8A.
W85-05022

MICROSYSTEM SEDIMENT-WATER SIMULATION STUDY FOR THE PROPOSED JORDANELLE RESERVOIR, HEBER CITY, UTAH,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
For primary bibliographic entry see Field 5B.
W85-05305

PROGRAM MANAGEMENT KEEPS ANCHORAGE WATER PROJECT ON SCHEDULE,
Montgomery (James M.), Inc., Pasadena, CA.
W. H. Blackmer, and R. E. Smith
Public Works, Vol. 116, No. 8, p 49-51, January, 1985. 2 Fig.

Descriptors: *Planning, *Water resources development, *Anchorage, *Alaska, Decision making, Planning, Eklutna Water Project, Water conveyance, Water supply, Water treatment facilities.

Anchorage is among the fastest growing municipalities in the country. After extensive studies of 28 alternative sources for a supplemental water supply, it was concluded that the most cost-effective, long-term source is Eklutna Lake, located 35 miles from downtown Anchorage. The Eklutna Water Project has a lake diversion through a tunnel 7,000 ft long, 7 miles of 54 in raw water transmission main, two energy recovery stations, a 35 mgd water treatment facility, and 15-MG clearwell-reservoir, and 22 miles of large diameter potable water transmission main. State appropriated funds will cover 75% of the project. The remaining 25% is from municipal general obligation bonds, approved by voters in 1983 by a 3:1 margin. Five different types of project management systems have been considered. In the plan finally chosen with only a few exceptions, the program management team performs all project tasks including planning, surveying, geotechnical, preliminary engineering, environmental, permitting, public education, and construction management services and operator training. The municipality has kept control over the bidding process through its purchasing division. (Baker-IVI)
W85-05486

INTERACTIVE COMPUTER MODELING FOR POLICY ANALYSIS; THE FLOOD HAZARD PROBLEM,
Wharton School, Philadelphia, PA. Dept. of Decision Sciences.
H. Kunreuther, and L. Miller.
Water Resources Research, Vol. 21, No. 2, p 105-113, February, 1985. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Floods, *Computer models, *Policy making, Decision making, Computers, Model studies, Flood control, Flood damage.

An interactive modeling system is discussed which is designed to support policy analysis for dealing with flood hazards. Policy analysis in this area is complex due to numerous stakeholders with varying concerns, the variety of scenarios that might be considered, and alternative policy options. These conditions arque that a modeling system be flexible and support users in a variety of ways. The system should be viewed as a decision aid rather than a burden. The modeling system described (Wharton Interactive Modeling System WHIMS) attempts to achieve these goals for microanalytic models that deal with samples of homeowners in a flood prone community. (Baker-IVI)
W85-05490

INTERACTIVE COMPUTER TECHNOLOGY FOR PLANNING AND POLICY MODELING,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
K. Fedra, and D. P. Loucks.
Water Resources Research, Vol. 21, No. 2, p 114-122, February, 1985. 7 Fig, 52 Ref.

Descriptors: *Planning, *Decision making, *Water resources development, *Computers, Policy, Regulations, Computer models.

Computer assisted methods of planning and design, information management, and process control have proven to be highly successful, and once implemented, indispensible in numerous fields of application. The potential impacts of increasing access to and use of computer technology and communication are considered, especially with respect to water resources and environmental planning and policy making. The discussion focuses on the interaction between the users of this expanding technology and the technology itself. Specific topics include symbolic interfaces for man-machine interaction, and a display-oriented user interface. (Baker-IVI)
W85-05491

INTERACTIVE DATA MANAGEMENT FOR RESOURCE PLANNING AND ANALYSIS,
Cornell Univ., Ithaca, NY. Dept. of Civil and Environmental Engineering.
D. P. Loucks, M. R. Taylor, and P. N. French.
Water Resources Research, Vol. 21, No. 2, p 131-142, February, 1985. 26 Fig, 16 Ref.

Descriptors: *Water resources development, *Computers, *Data management, *Planning, Evaluation, Decision making.

A number of research projects at Cornell University have focused on the development and application of interactive models and computer programs for studying water resources and environmental management problems. These models and programs have been adapted for use with computer graphic display devices. This interactive computer aided planning system has been designed to facilitate data input, editing, and display; model building and solution; and analysis and synthesis of alternative resource management plans or policies. Approaches taken for managing and displaying data that are needed for, and derived from, this interactive modeling system are discussed. Several applications are presented and some conclusions on how such systems might be developed or expanded in the future are proposed. (Baker-IVI)
W85-05493

MODULAR INTERACTIVE SIMULATION SYSTEM FOR EUTROPHICATION AND REGIONAL DEVELOPMENT,
Minnesota Univ., Minneapolis. Dept. of Agricultural and Applied Economics.
For primary bibliographic entry see Field 5C.
W85-05494

6B. Evaluation Process

EVALUATION OF ALTERNATIVE POLICIES FOR CONTROLLING AGRICULTURAL NONPOINT SOURCE POLLUTION,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
R. A. Kramer, W. T. McSweeny, W. R. Kerns, and R. W. Stavros.

er Resources Bulletin, Vol. 20. No. 6, p 841-December, 1984. 2 Tab, 11 Ref.

criptors: *Nonpoint pollution sources, *Agri-ıral runoff, *Economic aspects, *Costs, *Wa-ıed models, *Nansemond River Watershed, uckatuck Creek Watershed, *Virginia, *Water ıtion control, Model studies, Public policy, off, Best management practices, Rural Clean er Program, Cost sharing, Agricultural Con-ation Program.

potential effectiveness of public policy actions reducing nonpoint source pollution was exam- with an economic analysis of nonpoint source ution management for the Nansemond River Chuckatuck Creek watersheds in Southeast ginia. Parts of these watersheds are included in Rural Clean Water Program (RCWP); water ity in the area is poor, as is characteristic of y tributaries of the Chesapeake Bay. The po-al effects of alternative public policies on farm me, land use, and pollution loadings were in-igated. A linear programming model of the semond and Chuckatuck watersheds was con-cted which focused on the relationships among cultural land use practices and nonpoint source ution. Using statewide enterprise budgets as delines, area specific crop and livestock budgets e developed. Cost data for the best manage-t practices (BMPs) were included in the del. Regulatory programs could have quite dif-nt impacts depending on which pollutant is eted. A program with explicit water quality ls like the RCWP could have a different impact land use practices than a program like the icultural Conservation Program which has a ıary goal of maintaining soil productivity. The ılatory approaches, while effective in reducing ution, decrease net farm income in the water-ds; in no case do the reductions exceed 4% of e line income. Even income declines of this gnitude could have severe impacts on farmers, icularly during periods of financial stress for culture. Cost-share alternatives appear effec- in reducing pollutant loadings and have the tical advantage of raising net farm income. t-share rates greater than 50 percent would e little additional effect on generated soil, nitro-, or phosphorus from crop enterprises, but uld reduce pollution from livestock. (Collier-)
5-04989

W HAMPSHIRE WATER SYSTEMS: ENVI-NMENTAL AND OWNERSHIP CONSIDER-IONS,
w Hampshire Univ., Durham. Dept. of Re-rce Economics and Community Development.
E. Lindsay.
ter Resources Bulletin, Vol. 20, No. 6, p 901-, December, 1984. 2 Tab, 5 Ref. New Hamp-re Agricultural Experiment Station project H-.

scriptors: *New Hampshire, *Water distribu-n, *Utilities, *Ownership, Water treatment fa-ties, Privatization, Costs, Economic aspects.

investigate the ownership effect upon consumer sts for an industry located in New England, an aluation of municipal or publicly-owned water ities and privately owned water firms located in w Hampshire was carried out. Managerial, facil-, and distributional information was available for proximately 120 water systems with the data for systems (61 public, 17 private) was usable. A ear multiple regression econometric model was veloped to measure the influence of several envi-nmentally oriented variables and an ownership riable upon the average total residential water sts for New Hampshire water systems. The im-ementation of leak detection programs and local-d institutional rules and regulations increased residential water costs. Hazardous waste in-ection programs decreased residential water sts. The existence of a water conservation pro-am did not statistically influence these per unit sts. Water systems that were privately owned sulted in per unit costs that were higher relative firms that were publicly owned. New Hamp-ire municipalities that are considering privatizing their presently publicly-owned water systems should make careful evaluation of the resulting costs of such a changeover; privatizing of New Hampshire water systems may not be an economically sound policy. (Collier-IVI)
W85-04997

ANATOMY OF THE GORDON-FRANKLIN (TASMANIA) DAM CONTROVERSY; SOCIO-ECONOMIC, POLITICAL AND ENVIRONMENTAL IMPLICATIONS - A VIEWPOINT,
Tasmania Univ., Hobart (Australia). Environmental Studies.
K. N. Baidya.
International Journal of Environmental Studies, Vol. 23, No. 3/4, p 283-301, October, 1984. 1 Fig, 5 Tab, 31 Ref.

Descriptors: *Social aspect, *Economic aspects, *Environmental effects, *Gordon-Franklin Dam, *Tasmania, *Australia, Legislation, Public participation, Political factors, Conservation, Dams, Environmental policy.

South-West Tasmania is one of the last three great wilderness areas of the Southern temperate regions of the world. There are obvious justifiable reasons for the area to be kept preserved for posterity. The Tasmanian conservation group or ecoactivists have been able to open public debate on the South-West dam issue in recent times, through lobbying, challenging, project evaluation methodologies and even seeking judicial redress. Despite the institution of so many investigation mechanisms like select committees, public debates, Legislative Council committees, the referendum, and parliamentary election, the net result was a zero sum game. Tasmania has the potentialities not only to guide Australia but the whole world in the conservation movement. What she needs is to come out of the so called economic mad rush or rat race. A new dimension must be added to the mere economic problems. This is only possible if and when there is total conceptual change or reorientation of the present political system of Tasmania. (Baker-IVI)
W85-05034

AGRICULTURAL WATER POLLUTION CONTROL: AN INTERDISCIPLINARY APPROACH,
Max C. Fleischmann Coll. of Agriculture, Reno, NV.
W. W. Miller, C. T. K. Ching, J. F. Yanagida, and P. Jakus.
Environmental Management, Vol. 9, No. 1, p 1-6, January, 1985. 7 Tab, 19 Ref.

Descriptors: *Agricultural runoff, *Water pollution control, *Economic aspects, Costs, Alfalfa, Model studies.

Regulation and control of agricultural water pollution is unique and difficult to accomplish. Water quality standards are often proposed without adequate consideration of the overall economic impact on agricultural production. This article illustrates how economists and physical scientists can cooperate to develop appropriate control strategies for agricultural water pollution. Data provided by physical scientists and economists are used in a linear programming model to describe salt discharge as a function of water management, production levels, and an associated effluent charge. Four water management activities were chosen on the basis of different costs of production (including a parametrically varied effluent charge), water requirements, alfalfa yields, and levels of salt discharge. Results indicate that when the effluent charge is low (< $0.20/metric ton salt discharged), maximum production with maximum salt discharge is most profitable. As the effluent charge is increased ($0.20-$0.40/metric ton salt discharged), it becomes progressively less profitable to produce alfalfa at maximum levels of pollutant discharge. When the effluent charge is > $0.40/metric ton salt discharge, alfalfa production is no longer economically feasible. An important aspect of this approach is that it permits policy makers to identify explicitly the relationship between the environmental standard and the effect on agricultural production. (Author's abstract)
W85-05067

DOES YOUR WATER SYSTEM HAVE HYDROELECTRIC GENERATING POTENTIAL,
Boulder City Manager, CO.
R. L. Wheeler, P. Wrenn, and B. Grant.
Public Works, Vol. 116, No. 2, p 70-74, February, 1985. 3 Fig, 1 Tab.

Descriptors: *Water resources development, *Water conveyance, *Hydroelectric power, *Boulder, *Colorado, Power, Energy, Turbines, Pipelines, Cost analysis.

Many water systems in the Rocky Mountain region take advantage of gravity water flow in supply lines from a water source to a treatment plant; water often arrives at the plant under high pressure, which must be reduced to near zero for treatment plant processes. Boulder, Colorado recognized the energy potential inherent in the raw water pipeline system in 1980. A feasibility study was undertaken to determine the best sites for power production, the most efficient types and sizes of hydroelectric equipment for those sites, the costs and paybacks involved, and the effects that such facilities would have on the primary purpose of the water utility: supplying water for a municipal water system. Boulder is taking advantage of wasted pressure in its raw water supply and distribution system. Some ten sites have been identified where pressure reducing valves could be replaced with hydroelectric turbines. (Baker-IVI)
W85-05488

INTERACTIVE WATER RESOURCES MODELING AND MODEL USE: AN OVERVIEW,
Cornell Univ., Ithaca, NY. Dept. of Civil and Environmental Engineering.
D. P. Loucks, J. Kindler, and K. Fedra.
Water Resources Research, Vol. 21, No. 2, p 95-102, February, 1985. 14 Fig, 26 Ref.

Descriptors: *Water management, *Model studies, *Water resources development, Reviews, Computers, Planning, Policy making.

Important short comings of many management and policy models are reviewed and improved human-computer-model interaction and communication is encouraged. If models are to be increasingly used, it is felt that models must be easy to use, easy to understand, and must be adaptive to a wide variety of possible policy alternatives. The increasing availability and use of time sharing computer networks, microcomputers, and interactive computer languages make it possible for most to have access to fast, inexpensive, interactive computing power, supplemented increasingly by color display capabilities if desired. As the first in a series of articles on interactive modeling for water resource and environmental planning and policy making, it is argued that such an approach might lead to more effective modeling and model use. (Baker-IVI)
W85-05489

VAST DIVERSION OF SOVIET RIVER,
For primary bibliographic entry see Field 6G.
W85-05767

APPROXIMATE METHOD FOR THE ANALYSIS OF UNCERTAINTY IN BENEFIT-COST RATIOS,
Adelaide Univ. (Australia). Dept. of Civil Engineering.
G. C. Dandy.
Water Resources Research, Vol. 21, No. 3, p 267-271, March, 1985. 3 Fig, 3 Tab, 9 Ref.

Descriptors: *Statistical analysis, *Uncertainty, *Cost-benefit analysis, *Economic evaluation, Benefits, Project planning, Decision making, Water resource development.

An economic comparison of projects should take uncertainty in benefit-cost ratios into account; a risk-averse decision maker may well prefer project A, which has less uncertainty in its B/C ratio to project B, which has a higher expected B/C ratio but a much greater uncertainty. No complete methodologies exist for treating the problem of

uncertainty in the estimates of benefits and costs for any proposed water resource project. An approximate procedure for uncertainty estimation was developed which does not require the use of a computer but which gives answers which are reasonable given the precision of the underlying data. The method is based on subjective estimates of 'most likely,' 'upper,' and 'lower' values for individual components of benefits and costs and estimates of the correlation coefficients between these components. The main errors introduced by the approach are relatively small. A case study demonstrated application of the method. (Collier-IVI)
W85-05789

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

NEW HAMPSHIRE WATER SYSTEMS: ENVIRONMENTAL AND OWNERSHIP CONSIDERATIONS,
New Hampshire Univ., Durham. Dept. of Resource Economics and Community Development.
For primary bibliographic entry see Field 6B.
W85-04997

ENGINEERING ECONOMIC ANALYSIS OF A PROGRAM FOR ARTIFICIAL GROUNDWATER RECHARGE,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W85-05001

IMPLEMENTATION OF A USER CHARGE SYSTEM INCORPORATING A DEDICATED AD VALOREM TAX STRUCTURE,
Metropolitan Sanitary District of Greater Chicago, IL.
H. A. Smith, J. T. Fornek, and C. Lue-Hing.
In: Proceedings, 37th Industrial Waste Conference, West Lafayette, IN, May 11-13, 1982. Purdue Univ., 1983. p 577-589. 8 Fig, 2 Tab, 1 Ref.

Descriptors: *Taxes, *Tax rates, Sewer systems, Chicago, Clean Water Act, Federal Water Pollution Control Act, Ad valorem taxes, User charges.

The Metropolitan Sanitary District of Greater Chicago is charged with the principal responsibility of collection, treatment and disposal of sewage in the Chicago metropolitan area. Regulations promulgated under the Federal Water Pollution Control Act Amendments of 1972 and the Clean Act of 1977 require that the district administer a system of revenue collection to recover the costs of operation, maintenance and replacement of the district's facilities associated with the collection and treatment of sewerage, and the handling and disposal of solids removed in the treatment process. The residential users are not affected because they continue to pay their User Charge through ad valorem taxes. Commercial and Industrial users are subject to the requirements of the district's self assessing reporting system. Under this system all Commercial and Industrial users must file a certified classification statement. Those Commercial and Industrial users that are small users are classified with residential users. There are no additonal requirements under the self assessing program. However, if their operation changes in such a way that these users are subject to reclassification, a new certified classification statement submittal is required. Users in the Tax Exempt class are dramatically affected because prior to the User Charge Ordinance these users did not pay for wastewater treatment services.
W85-05277

COST SHARING FOR FEDERAL WATER PROJECTS: TRENDS AND IMPLICATIONS,
Minnesota Univ., Minneapolis. Dept. of Agricultural and Applied Economics.
J. J. Waelti.
Water Resources Research, Vol. 21, No. 2, p 153-158, February, 1985. 3 Tab, 15 Ref.

Descriptors: *Federal Water Projects, *Cost sharing, Cost analysis, Financial aspects, Planning, Evaluation, Political aspects, Policy.

Major water policy events beginning with the 1950's are reviewed with respect to their bearing on proposed changes in the much criticized federal policies for nonfederal cost sharing. The cost sharing proposals of the Carter and Reagan administrations are reviewed. These proposals are discussed with respect to theoretical economic efficiency and political equity. Both sets of proposals represented improvements over the traditional system. Both were defeated because of political opposition. The natural of federal water projects may be such that there are political advantages in the existing system for both the executive and legislative branches of government. One such advantage is that water projects are in many respects convenient media for the exchange of votes. While Congress can appropriate any sum of money for any project it wishes, the Administration can make life easy or difficult for the congressional representatives of any given region by including, or not including, funds for a given project in the president's budget message. Innovations such as an independent agency for project evaluation, or cost sharing on a beneficiary pays basis, may be seen by both the legislative and the executive branches of government as reducing the options for vote trading to attain broader national objectives. (Baker-IVI)
W85-05495

ADAM'S TEARS TURNED TO ELECTRICITY.
New Scientist, Vol. 105, No. 1443, p 14-16, February, 1985. 5 Fig.

Descriptors: *Water resources development, *Hydroelectric power, *Sri Lanka, Powerplants, Dams, Planning, Irrigation, Water supply.

Sri Lanka is trying to construct a massive hydroelectric and irrigation scheme in seven years instead of the expected 30. Success could see the country self-sufficient in power as well as in food. Sri Lanka's economy has been devastated by high oil prices with unofficial estimates placing the rate of unemployment at close to 20%. With a considerable amount of foreign expertise, Sri Lanka began to exploit the potential of the Mahaweli River at an increasing rate. The complex of dams, hydropower stations and irrigation networks now being built should nearly double the country's installed capacity from 562 megawatts to 1070 megawatts. Three countries, Britain, Sweden and West Germany, are the most substantial foreign investors. The development of the river and its tributaries is based on an elaborate system of channels, holding reservoirs, dams and hydropower stations. The intention is to use the drop or head of the Hamaweli to generate hydroelectric power at a number of sites along its length. In some cases the water is intended only for irrigation, in others, for both irrigation and power. (Baker-IVI)
W85-05522

ALGORITHM FOR MIXING PROBLEMS IN WATER SYSTEMS,
RMM Technical Services, Inc., Cincinnati, OH.
R. M. Males, R. M. Clark, P. J. Wehrman, and W. E. Gates.
Journal of Hydraulic Engineering, Vol. 111, No. 2, p 206-219, February, 1985. 8 Fig, 3 Ref, 1 Append.

Descriptors: *Algorithms, *Mathematical equations, *Water distribution, *Mixing, Costs, Model studies, Economic aspects, Hydraulics.

The 'Solver' algorithm, developed as an outgrowth of work on cost allocation in water distribution systems, is a simple technique that solves a number of interesting problems in water distribution system analysis. Problems related to mixing water from different sources within the distribution network, travel time from any source to any node of the network, and development of the cost of service to any node in the network can be solved assuming steady-state conditions, given a prior solution of the hydraulics (flow in each link) of the network. All these problems are formulated as the solution of simultaneous linear equations. The Solver algorithm has been coded in Fortran and incorporat within the structure of a multi-purpose system computer programs that allows for the stora display and manipulation of data associated w node-link networks describing water distributi systems. These programs are identified by name Water Supply Simulation Model. The form lation of the Solver algorithm is described in det with examples of its use. (Author's abstract)
W85-05780

MULTIPURPOSE CRITERIA OF SELECTI THE METHOD OF REGULATING THE D LIVERY OF PUMPING STATIONS OF WATER-SUPPLY CANAL,
L. M. Shtabskii.
Hydrotechnical Construction, Vol. 18, No. 7, 317-321, July, 1984. 7 Ref. Translated from Gidr tekhnicheskoe Stroitel'stvo, No. 7, p 31-34, Ju 1984.

Descriptors: *Pumped storage, *Water manag ment, *Water delivery, Canals, Water supply, O timization, Multipurpose projects, Water conve ance.

The method of regulating the water delivery pumping stations of a water supply canal, which the general case represents a cascade of pumpi stations and pressure and open stretches, affe both the capital expenditures for the main str tures and the main technical and economic indic during operation. In some cases, the energy sa ings on pumping water is used for an approxim calculation of the effectiveness of various regul ing methods, which reflects only one, albeit t most important, parameter when comparing diff ent variants. The linear economic-mathematic model is a widespread method of solving the pro lem of selecting the optimal regulation method. particular interest are methods of evaluating v iants of regulating the delivery of large wat management canals founded on a heuristic ba For complex multipurpose systems, when analy ing delivery regulation variants it is possible to u the method of mutipurpose optimization. The m important stage of solving the problem by t multipurpose optimization method is a determin tion of the sets of goals, which express the dire expenditures of various resources for realization the regulating system and determine the consum properties of the entire canal obtained on using t variants of regulation being compared. The co position of goals for a particular water manag ment system should reflect the objective conditio of its functioning and also those management pro lems which are determined for the system by higher level. (Baker-IVI)
W85-05824

ECONOMIC ASPECTS IN THE INVESTIG TION OF GROUND-WATER CONTAMIN TION EPISODES,
Haifa Univ. (Israel).
For primary bibliographic entry see Field 5C.
W85-05840

6E. Water Law and Institutions

CALCULATING REFERENCE LEVELS FRO MAXIMUM LEVELS (BEZUGSWERT-E RECHNUNG AUS HOCHSTWERTEN).
Wasser, Luft und Betrieb, Vol. 27, No. 12, p 2 December, 1983.

Descriptors: *Germany (Federal Republic *Taxes, *Wastewater taxes, Legal aspects, Wat pollution control, Monitoring.

The question of whether wastewater-tax laws the Federal Republic of Germany provide for t calculation of reference levels of pollutants wastewater from maximum levels agreed upon b the parties involved or prescribed by state wat law rather than by actual measurement is a dressed. Neither state wastewater-tax laws nor a ministrative rules deal with the question directl Both federal law and administrative rules in th states of Hessen and Rheinland-Pfalz indicate th

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ontrol levels must be derived from actual measurement. The Hessen rules recognize that provisional levels must be worked with when insufficient data exist to calculate a statisticaly valid mean, but stipulate that the data base must then be improved through increased monitoring and control. The state government of Nordrhein-Westfalen addresses the question of the use of measured values under the threshold of statistical validity by stating that such data may not be used to prove that a standard of 1 kg Hg/yr has been met. Since control levels are only acceptable if derived from measurement, it follows that maximum levels must also be so derived. Reference levels calculated by halving fictitious maximum levels are therefore not permissible. Levels used in monitoring can be set independently of wastewater-tax law but should also be statistically valid so that they can be controlled. (Gish-IVI)
W85-05138

TIGHTENING REGULATIONS FOR HAZARDOUS WASTE MANAGEMENT: MANDATES AND COMPLIANCE STRATEGIES,
Jacobs Engineering Group, Inc., Pasadena, CA.
S. W. Kahane, S. L. Phinney, and A. P. Wright.
Chemical Engineering Progress, Vol. 81, No. 3, p 11-15, March, 1985.

Descriptors: *Regulations, *Hazardous material, *Waste disposal, Resource Conservation and Recovery Act, Comprehensive Environmental Response, Compensation and Liability Act, Clean Water Act, Clean Air Act, Legislation, Waste management, Water quality control.

As the EPA and the states move to a more aggressive program of inspection and enforcement, it is vital that industries take the initiative to protect themselves against unanticipated public exposure and cleanup costs. A case history is presented of a firm that operated within the law in the past but found that current regulations consider past and ongoing disposal practices no longer in compliance. Details are offered of the Resource Conservation and Recovery Act (RCRA). Section 3001 requires the EPA to establish criteria for identifying hazardous wastes. Regulations applicable to generators of hazardous waste are established under Section 3002. Sections 3003 through 3006 regulate hazardous waste transport, treatment, storage and disposal. Subtitle D of the RCRA addresses the management of nonhazardous solid waste. Other key regulations include the Comprehensive Environmental Response, Compensation and Liability Act, the Clean Water Act, Clean Air Act, and the Toxic Substances Control Act. (Baker-IVI)
W85-05768

ORGANICS, PLASTICS, AND SYNTHETICS INDUSTRY DISCHARGE: PERFORMANCE AND REGULATIONS,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
R. A. Reich, and H. J. Campbell, Jr.
Chemical Engineering Progress, Vol. 81, No. 3, p 16-21, March, 1985. 3 Tab, 15 Ref.

Descriptors: *Waste disposal, *Regulations, *Organic compounds, *Plastics, *Industrial wastes, Synthetics industry, Water quality control, Water pollution control.

In March 1983, the EPA proposed Effluent Limitations Guidelines and Standards for the Organic Chemicals and Plastics and Synthetic Fibers (OCPSF) Point Source category. The progress made to date by the OCPSF industry has been substantial for both conventional and priority pollutants, despite the absence of federal guidelines for the industry. Evidence shows that the OCPSF industry discharges, under control through BPJ/BPT (Best Professional Judgement/Best Practicable Control Technology) permit determinations, are not a national problem. In fact, the current discharge of priority pollutants by this industry is well below the level EPA projected following BAT (Best Available Technology) implementation. In light of this progress and the unrealistic BAT levels proposed by the EPA, it is felt that the final OCPSF effluent guidelines need to be more rational and cost effective. (Baker-IV)
W85-05769

AMENDING THE WATER ACT - FRAMING THE ISSUES FOR DEBATE,
B. Ward.
Environmental Forum, Vol. 3, No. 10, p 18-21, February, 1985.

Descriptors: *Clean Water Act, *Political aspects, *Legislation, Federal jurisdiction, Water quality control, Planning, Decision making, Permits, Nonpoint source pollution.

The Clean Water Act is due for reauthorization. Some aspects of the Act have changed. Authorizations are expiring this year for the Title II sewage treatment construction grants program. Construction grants funding this year will be the impetus for congressional amendments. Funding for Title II will be viewed within the context of the need to reduce public expenditures. In addition to determining just how long the grants program will continue, how it will be phased out, and what precise levels of funding should be, Congress of course will have to take on the always highly political step of choosing how the federal funds will be allocated or allotted to individual states. Another issue that is likely to arise in the reauthorization effort this year is a proposal to extend national Pollutant Discharge Elimination System (NPDES) permits from 5 to 10 years, with a reopener. As in the last Congress, the issue of nonpoint source pollution control is likely again to be considered as part of the reauthorization effort. Also intense will be the debate on interstate dispute resolution issues and the related issue of preserving other state rights or federal common law. (Baker-IVI)
W85-05833

6F. Nonstructural Alternatives

DISTRIBUTION OF ECONOMIC RENTS WHEN IRRIGATED FARMLAND IS LEASED: THE CASE OF THE IMPERIAL VALLEY, CALIFORNIA,
California Univ., Davis. Dept. of Agricultural Economics.
B. D. Gardner, and R. G. Huffaker.
Available from the National Technical Information Service, Springfield, VA 22161. Final Report, September 30, 1983. 93 p, 7 Fig, 22 Tab, 21 Ref. Contract/Grant No. 1-07-81-V0201.

Descriptors: *Farms, *Leases, *Economic rent, Public policy, *Irrigation, Economic aspects.

A method of testing whether unrestricted leasing of farmland in federal water projects concentrates the distribution of economic rents is proposed. The Imperial Valley, California, was the reclamation area chosen for the study. A survey was taken from 25 tenants participating in 156 cash leases and 45 share leases. The economic rents which each tenant could likely expect were calculated from the survey data, amortized, and compared to the annual rental rates actually paid to landowners (in the case of cash leases), or to the annual expected share rents each tenant was calculated to anticipate paying landowners (in the case of share leases). The percentages of expected rents paid by tenants to landowners, calculated from the cash and share lease studies, do not support the hypothesis that unrestricted leasing in the sample reclamation area is concentrating economic rents in the hands of the larger tenants, and tenants holding family leases. The percentages of expected rents paid by tenants to landowners, calculated from the cash and share leases studied, show the lease market in the study reclamation area to be a fairly efficient and competitive market. The data suggest that most of the economic benefits generated by water subsidies are going to landowners, not tenants. It does not appear that the rents are being disproportionately captured by the larger tenants. There is no correlation in the percentage of total expected rents paid by tenants and their scales of operation. Tenants holding family leases pay a slightly lower than average portion of their expected rents, with 85 percent going to landowners in family cash leases and 74 percent in family share leases.
W85-05330

6G. Ecologic Impact Of Water Development

ANATOMY OF THE GORDON-FRANKLIN (TASMANIA) DAM CONTROVERSY; SOCIO-ECONOMIC, POLITICAL AND ENVIRONMENTAL IMPLICATIONS - A VIEWPOINT,
Tasmania Univ., Hobart (Australia). Environmental Studies.
For primary bibliographic entry see Field 6B.
W85-05034

METALS AND CHLORINATED HYDROCARBONS IN SURFICIAL SEDIMENTS OF THREE NILE DELTA LAKES, EGYPT,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, S. R. McComas, and S. J. Eisenreich.
Water, Air, and Soil Pollution, Vol. 24, No. 1, p 27-39, January, 1985. 4 Fig, 5 Tab, 34 Ref.

Descriptors: *Lake sediments, *Chlorinated hydrocarbons, *Metals, *Egypt, *Nile Delta, Lake Mariut, Nozha hydrodome, Lake Manzalah, Aswan High Dam, Sediments, Pollutant identification, Water analysis, Water resources development, Environmental effects, DDT.

After construction was completed on the Aswan High Dam in 1964, both the Nile's flow and sediment load to the Delta region were reduced. Because lake sediments accumulate both natural and anthropogenic components, baseline geochemical information from surficial sediments can serve as a benchmark for evaluating sediment enrichment in the future and can also provide insight into the present environmental quality of the Delta lakes. Chlorinated hydrocarbon concentrations and major and minor trace element status of lake sediments of three Nile Delta lakes were determined: Lake Mariut, Nozha hydrodrome, and Lake Manzalah. Sediment samples were collected from the Delta lakes about 5 yr after the Aswan High Dam gates closed. With a few exceptions, bulk sediment analyses indicate surficial sediments from three delta lakes were not highly enriched in polychlorinated biphenyls, or trace elements. Some exceptions were Cu in Lake Manzalah, and possibly Zn in Lake Mariut. Lake Manzalah had t-DDT concentrations that were higher than other water bodies. It appeared that the majority of the variability of the sediment geochemistry is accounted for by land-derived clays, authigenically derived CaCO3, and Fe chemistry which influenced trace metal distributions. (Baker-IVI)
W85-05037

CHANGES IN THE QUALITY OF NILE WATER IN EGYPT DURING THE TWENTY-FIVE YEARS, 1954-1979,
National Research Centre, Cairo (Egypt).
J. B. Khalil, and F. S. Hanna.
Irrigation Science, Vol. 5, No. 1, p 1-13, April, 1984. 1 Fig, 4 Tab, 15 Ref.

Descriptors: *Nile River, *Egypt, *Water quality, *Aswan Dam, *Giza, Salts, Agricultural runoff, Sulfates, Chlorides, Potassium, Sodium, Magnesium, Hydrogen ion concentration, Carbonates, Calcium.

The study describes the variation in the chemical constituents of the Nile water at Giza, through the twenty-five years from 1954 to 1979 i.e., before and after the construction of the High Dam at Aswan. The total soluble salt content increased significantly by 29% after the construction of the High Dam, mainly due to the seepage of drainage water from the cultivated land of the Nile Valley. The SO4(-), Cl(-), K(+), Na(+) and Mg(2+) content increased significantly during the period of study, while the increase in pH values, HCO3(-) and Ca(2+) contents was significant. The suspend-

ed matter content decreased significantly by 94% from 1964 to 1979 due to the effect of the High Dam. The increase in silica content was significant while the decrease in oxygen content was not significant. No obvious variations were detected in chloride content, total alkalinity and total hardness during the study period. According to the ionic coefficients ratios and the geochemical classification, Nile water currently can be evaluated for irrigation purposes as falling within the class excellent-good and highly satisfactory for domestic purposes. (Author's abstract)
W85-05162

EFFECT OF FURROW IRRIGATION EROSION ON CROP PRODUCTIVITY,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
D. L. Carter, R. D. Berg, and B. J. Sanders.
Soil Science Society of America Journal, Vol. 49, No. 1, p 207-211, January-February, 1985. 2 Fig, 5 Tab, 4 Ref.

Descriptors: *Soil erosion, *Irrigation effects, *Crop yield, *Furrow irrigation, Tillage, Sedimentation, Erosion, Topsoil, Hardpan.

The effects of furrow irrigation erosion on crop yield have been quantified. Topsoil depth and crop yields were measured on 10 fields. Severe erosion on the upper ends of fields combined with tillage has mixed light-colored subsoil with topsoil and caused these areas to become whitish in color. The average portion of whitish soil was 30% on the 14 farmer operated fields studied. This percentage reflects the degree of erosion over the long term. The length of the whitish soil area does not seem related to the field length. Seventy percent of the furrow irrigated fields in the study area now have whitish soil areas. Those that do not, have slopes less than about 0.7%. Significant yield reductions were noted for all crops on all whitish soil areas studied. Significant yield loses resulting from furrow irrigation erosion are occurring on 21% of the farmed area after 78 years of irrigation. Observations, limited measurements based on reference points, and soil depth measurements downslope indicate that a loss of 20-30 cm over 78 yr of irrigation is common, and in some situations losses are greater. The depth to the hardpan indicates that significant amounts of sediment have been deposited on the middle and lower thirds of fields where the third and fourth transects were made. Topsoil depth clearly had a major impact on crop yields in the study area. The original 38 cm of topsoil was not sufficient for maximum yields in the area. This yield loss cannot be overcome by any method presently known, except possibly the returning of topsoil to eroded areas. (Baker-IVI)
W85-05192

MAMMAL SURVEILLANCE SYSTEM,
Bureau of Reclamation, Denver, CO. Power and Instrumentation Branch.
E. Campbell, and R. Bruce.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-82-16. March 1983. 40 p, 29 Fig, 2 Append.

Descriptors: *Infrared photography, *Concrete-lined canals, *Animal behavior, *Escape structures, Infrared imagery, Canals, Electronic equipment, Photography, Sensors, Remote sensing, Mammals, Deer, Surveillance systems.

In response to a need that has developed to monitor animal behavior in using escape structures in concrete-lined canals, a versatile motion sensing device has been devised. The device uses an advanced infrared detector, novel amplifier systems, and extensive logic to trigger three cameras and strobes as needed to photograph deer in four stages of departure from the canal.
W85-05311

ECOLOGICAL COMPARISON OF 6 BOG SITES IN ANNE ARUNDEL COUNTY, MARYLAND,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
D. Whigham.
Draft Final Report, August 1981, 141 p, 82 Fig, 21 Tab, 9 Ref, Append. Contract/Grant No. C20-81-430.

Descriptors: *Wetlands, *Bogs, *Vegetations, *Substrates, *Plant tissues, *Water quality, *Watershed management, Floristics, Environmental impact statement, Ecological effects, Environmental effects, *Maryland.

An ecological study of 6 wetlands was conducted in Anne Arundel County, at the request of State and County officials to assure that no major impacts would result from development. Primary emphasis of the study was an analysis of vegetation, substrate, plant tissue, and water quality data to determine relationships between and among bogs and adjacent wetland control forests. There appeared to be no unique topographic or geomorphic feature differentiating these bogs, except that all but one developed in areas that previously supported bottomland hardwood foresets. The remaining site, Round Bay Bog developed with the right-of-way corridor of a transmission line. However, clear patterns existed with Cypress Creek and Round Bay Bogs being the most distinct, in terms of floristics, substrate parameters, and plant tissue nutrient concentrations. The other sites (North Grey's, South Grey's, Angel's and Eagle Hill) were rather similar. The purposes of this study were 1) to determine what features could be used to characterize these bogs in comparison to nearby topographically similar yet floristically dissimilar wetlands, and 2) to delineate, if possible, biological and/or chemical parameters that could be used to monitor potential changes that might occur as a result of watershed development. Recommendations are given for each site.
W85-05334

TIDAL POWER: REPERCUSSIONS ON THE AQUATIC ENVIRONMENT (ENERGIE MAREMOTRICE: ASPECTS LIES A L'ENVIRONNEMENT AQUATIQUE),
Museum National d'Histoire Naturelle, Paris (France).
C. Retiere.
Houille Blanche, No. 8, p 583-589, August, 1984. 6 Ref.

Descriptors: *Tidal powerplants, *Environmental effects, *Estuarine environment, *Rance, *France, Ecosystems, Dam effects, Salinity, Water level fluctuations.

A tidal power plant cannot be envisaged without taking into account the impact of such a construction on the marine environment. The Rance basin project has made it possible to demonstrate the way in the estuary's ecosystem had adapted to the new environmental conditions imposed by operation of the plant (water level fluctuations, salinity, etc). The new state of equilibrium takes about ten years to establish itself. It depends on stability of operation in the plant. The dam itself does not hinder the development of profuse and varied forms of life in the estuary. The lessons learned here have been used to assess the possible impact of a tidal power plant such as that of the Cotentin-Centre project, for example. (Author's abstract)
W85-05545

LIMNOLOGY OF SUVIANA-BRASIMONE MAN-MADE LAKES: INFLUENCE OF PUMPED STORAGE OPERATIONS ON PHYSICAL, CHEMICAL AND BIOLOGICAL CHARACTERISTICS,
Bologna Univ. (Italy). Ist. di Zoologia.
G. Salmoiraghi.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1550-1557. December, 1984. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Lakes, *Limnology, *Pumped storage, *Lake Suviana, *Lake Brasimone, *Italy, Reservoirs, Hydroelectric plants, Phytoplankton, Nitrogen, Phosphorus, Temperature effects, Turbidity, Thermal stratification, Environmental effects.

Lake Suviana lies in the Tusco-Emilian Appenines, at 470 m above sea level, has a maximum capacity of 46,500,000 cu m and is 70 m deep. Lake Brasimone is higher up with a volume of 6,600,000 cu m and a depth of 29 m. A hydraulic connection between the two reservoirs was created in 1975 by means of a double penstock, a hydroelectric generating and pumping plant which exploits the difference in their altitudes. Thermoclines have never been noted for either lake, but for Suviana only, it has been possible to perceive a clear thermal gradient in late summer at depths below the outlet. Thermal curves in Lake Brasimone show temperature equality throughout the year, caused by the generating and pumping system which each day brings about an average exchange of over 25% of the water, thus causing its complete homogenization. In late summer and at the beginning of autumn a sharp reduction in dissolved oxygen is noted in Lake Suviana below the outlet depth, due to degradation and mineralization processes of the organic substance. In Brasimone, even in summer there is an almost orthograde distribution of dissolved oxygen with concentrations close to 100% saturation. The highest concentrations of inorganic nitrogen were found in winter and decreased gradually as the number of phytoplankton increased in each lake. The reducing environment formed in Lake Suviana in summer below the outlet causes the inorganic P compounds to become soluble again and the highest concentrations were recorded on these occasions, though lower than 0.1 mg/l. The mean P concentrations in Brasimone are always lower than those in Suviana. The phytoplankton population present in the euphotic zone of both lakes is structurally simple. The seasonal succession of chlorophyll a present in the euphotic layer of Suviana reservoir traces the temporal course of the densities and biomasses. The studies seem to point clearly to the amount of influence attributable to the activity of the generating and pumping plant on the limnology of the reservoirs and the importance of following and controlling the impact of these installations on lake ecosystems. (Baker-IVI)
W85-05641

INFLUENCE OF RECENTLY DROWNED TERRESTRIAL VEGETATION ON THE QUALITY OF WATER STORED IN IMPOUNDING RESERVOIRS,
Societe Degremont, Rueil-Malmaison (France).
For primary bibliographic entry see Field 5G.
W85-05646

SHORT TERM RESPONSE OF A NORTHERN LOTIC ECOSYSTEM TO A GREAT REDUCTION IN FLOW (REPONSE, A COURT TERME, D'UN ECOSYSTEME LOTIQUE NORDIQUE A UNE FORTE REDUCTION DE DEBIT),
Laval Univ., Quebec. Dept. de Biologie.
G. Moreau, and D. Planas.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1776-1785, December, 1984. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Flow, *Diversion, *Ecological effects, *Petite Opinaca River, *Quebec, Phytoplankton, Zooplankton, Turbidity, Light penetration, Primary productivity, Sedimentation, Fish.

The utilization of streams for electric energy generation produces a number of modifications in the aquatic environment, including the creation of reservoirs, modification of hydrologic regimes by barrages, and diversion of rivers. The Opinaca River and its tributary, the Petite Opinaca River, are in the James Bay area, Quebec. The average annual flow under natural conditions was 31 cu m/s for the Petite Opinaca and 202 cu m/s for the Opinaca River. Diversions reduced the flow to 5 and 15 cu m/s, respectively (flow reductions of 84 and 92%). The reductions in flow were accompanied by a reduction in velocity. The physico-chemical properties of the water, primary productivity, zooplankton, benthos and fish were studied in the Petite Opinaca before and after the reduction in flow. The reduction in flow in the upstream section resulted in an increase in the residence time and a great reduction in turbulence, which favor sedimentation of suspended particulates and the

evelopment of planktonic organisms. The increase in light penetration brought about an increase in the phytoplankton primary production, hich resulted in an increase in the numbers and omass of zooplankton, and in particular the clacerans and copepods. The increase in zooplankn favored the planktonivore fish species and the venile stages of a number of other fish species. lodification of habitats was favorable for some ecies and unfavorable for others. In the downream section, because of the absence of pools and e presence of a good channel, turbulence was not duced. Microfiltering organisms were favored by e conditions. (Moore-IVI)
/85-05658

MPORTANCE OF STREAMSIDE FORESTS O LARGE RIVERS: THE ISOLATION OF HE WILLAMETTE RIVER, OREGON, U.S.A., ROM ITS FLOODPLAIN BY SNAGGING AND TREAMSIDE FOREST REMOVAL,
acific Northwest Forest and Range Experiment tation, Corvallis, OR. Forestry Sciences Lab.
R. Sedell, and J. L. Froggatt.
'erhandlung Internationale Vereinigung Limnolo-ie, Vol. 22, No. 3, p 1828-1834, December, 1984. 2 ig, 1 Tab, 19 Ref. NSF grant DEB-8112455.

)escriptors: *Willamette River, *Oregon, *Flood lains, *Snags, *Riparian vegetation, Forest water-ieds, Land use, Channels, Dams, Rivers, Riparian ater loss, Channel morphology.

'he pristine and present streamside forest, channel eomorphology, and role of downed trees are decribed in the Willamette River, Oregon. From this ase history a modification of the river continuum oncept is presented. The Willamette Valley is one f the older settled regions of the American West. 'he pre-settlement stream had banks 1.5 to 2.6 m bove the low water line with a floodplain 1.6 to .2 km wide. A dense woodland covered most of he floodplain. By 1872 the channels and sloughs of he Upper Willamette were being closed off and he water confined to one channel. These channels vere closed off using nearby snags from the chanel and cottonwoods growing along the river. Wing dams were constructed with firs and willows nd other smaller trees cut from the banks. From 879 to 1950 over 65,000 snags and streamside rees were pulled and cut up, an average of 550 nags per kilometer. The 25 km between Harrisburg and the McKenzie River confluence had over 50 km of shoreline in 1854, reduced to 64 km in 967. This represents a four fold decrease in surace water volume in this section of the Willamette River, as well as a four fold reduction in organic nputs; both leaf litter and wood. The loss of horeline, fewer and smaller snags and reduced width of the riparian forest was an incredible loss o the Willamette River. Channel structural feaures, particulate organic inputs from litter fall, and retention capacity for filtering particulates from lood flows and entraining partially decomposed llochthonous organic materials were greatly reduced. Eleven major dams have been built since 1946, after the river was essentially confined to a single channel. The agricultural and navigational demands resulted in the major channel changes and loss of downed-tree inputs before the hydrologic regime was regulated. (Baker-IVI)
W85-05663

STREAM REGULATION OF THE UPPER COLORADO RIVER: CHANNEL CONFIGURATION AND THERMAL HETEROGENEITY,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
J. V. Ward.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 1862-1866, December, 1984. 3 Fig, 11 Ref.

Descriptors: *Stream regulation, *Environmental effects, *Species diversity, *Colorado River, *Lake Granby, Dam effects, Channels, Regulation, Temperature effects, Rivers, Population dynamics, Diversion, Rhithron, Trout, Invertebrates, Streamflow, Refugia.

Some effects of a transmountain diversion scheme on a regulated rhithron segment of the Colorado River near its origin in the Rocky Mountains were examined. Special attention was given to the macroinvertebrate community which tends to integrate the unique combination of physical and chemical variables at a given site, Lake Granby, a deep release storage reservoir, which was constructed in the 1940's. Although temperature and certain other factors are clearly altered by stream regulation, environmental conditions are generally suitable for lotic organisms and there is a productive trout fishery in the stream reach below the dam. Woody riparian vegetation consists of willows and alder. Rubble is the dominant substrate. Dissolved oxygen levels are at or near saturation with values ranging from 8.4 to 11.8 mg/l. The macroinvertebrate community of the Colorado River below Granby Dam was characterized by high density and biomass values, altered community structure, and reduced Shannon diversity compared with unregulated mountain streams. Unregulated rhithron sites exhibited a more even distribution of major zoobenthic groups than the Colorado River where ephemeropterans and dipterans collectively comprised 97% of the numbers and 82% of the biomass. Species diversity was depressed in the Colorado River compared to the range of values exhibited by the unregulated rhithron locations. It is postulated that the altered flow regime below Granby Dam has resulted in a channel configuration that fortuitously provides thermal refugia for species that would not otherwise be present. The putative relationship between channel configuration and thermal heterogeneity may account for otherwise inexplicable differences in community sructure between seemingly comparable regulated streams. The availability of temperature microhabitats should be considered when designing ecological studies of regulated streams and when interpreting the results of such investigations. (Baker-IVI)
W85-05666

SESTON TRANSPORT IN STREAMS AT COWEETA HYDROLOGIC LABORATORY, NORTH CAROLINA, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2J.
W85-05671

MANAGEMENT OF DITCHES, THE EFFECT OF CLEANING OF DITCHES ON THE WATER COENOSES,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Landscape Ecology and Nature Management.
B. Beltman.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 3, p 2022-2028, December, 1984. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Ditches, *Aquatic weed control, *Environmental effects, *Netherlands, Drainage, Agriculture, Drainage ditches, Aquatic life.

The ditches in the Dutch landscape, dug to improve drainage and make land suitable for agriculture, are shallow and seldom shaded. Due to the luxuriant growth of water plants, ditches can become covered over and blocked with vegetation, which hinders their drainage function. To prevent this the farmers and local water boards clean their ditches in autumn by removing most of of the plants and a part of the sapropelium from the ditches and putting it onto the banks. The cleaning is often done using manual equipment, but mechanized methods are becoming more common. The ditch-scoop and the mowing basket are most frequently used. The method of cleaning the ditches and the period in which ditches are cleaned influence the composition of macrofauna and of water, bank zone and bank plants. The mowing basket favors the growth of floating water plants, while the ditch scoop favors the submerged water plants and the filamentous algae. Also at the level of the plant species themselves the methods of cleaning have a remarkable effect. The different cleaning methods have an effect on the number of species and specimens in the macrofauna. Abiotic differences like seepage have their influence on the composition of the macrofauna. Influences from differences in the physical chemical composition of the water could not be demonstrated. (Baker-IVI)
W85-05682

ASSESSMENT OF INTERGRAVEL CONDITIONS INFLUENCING EGG AND ALEVIN SURVIVAL DURING SALMONID REDD DEWATERING,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
C. D. Becker, and D. A. Neitzel.
Environmental Biology of Fishes, Vol. 12, No. 1, p 33-46, January 1985. 4 Fig, 64 Ref. DOE contract DE-AC06-76RL0 1830.

Descriptors: *Salmonids, *Fish eggs, *Embryos, *Dewatering, *Mortality, *Water level fluctuations, Reservoir operation, Stream flow, Immature growth stages, Environmental effects.

In the Pacific Northwest, water-use conflicts often involve changes in stream flows that encroach upon the ecological requirements of salmonids. Extensive water use may alter stream flows so that areas used by salmonids for spawning are dewatered, thus exposing intergravel development phases to suddenly changed physical and chemical conditions. Environmental alteration may result in considerable mortality, particularly of the more vulnerable post-hatch phases. Review of five documented case histories of redd dewatering by dam operation or drought indicates that the primary factors that influence the survival of salmonid eggs, embryos and alevins are the following: species characteristics; alevin movement; dissolved oxygen; gravel composition; temperature; moisture retention; and residual flow. In field situations, typically compex ecological relationships prevail, and most ecological conditions will depend on each other in one way or another. Whenever spawning areas are dewatered at a time when intergravel development phases of salmonids are present, on-site studies should be made to quantify physical and chemical phenomena in the gravel, as well as to determine survival rates. (Moore-IVI)
W85-05711

ALTO SINU HYDROELECTRIC PROJECT IN COLOMBIA: POSSIBLE CONSEQUENCES FOR THE ENVIRONMENT,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
For primary bibliographic entry see Field 2H.
W85-05718

WATER QUALITY AND WATERSHED LAND USED OF JOHNSON SAUK TRAIL LAKE,
Illinois State Water Survey Div., Peoria. Water Quality Section.
R. K. Raman, and R. L. Evans.
Transactions of Illinois Academy of Sciences, Vol. 77, No. 3/4, p 155-170, 1984. 8 Fig, 6 Tab.

Descriptors: *Water quality, *Land use, *Johnson Sauk Trail Lake, *Illinois, Watersheds, Phosphorus, Eutrophic lakes, Cycling nutrients, Macrophytes, Pesticides, Heavy metals, Organic compounds.

A study of Johnson Sauk Trail Lake, Henry County, was conducted in 1981 to delineate existing lake conditions, to examine causes of degradation, if any, and to identify and quantify the sources of nutrients and any pollutants flowing into the lake. The lake watershed, in general, is in excellent condition with excellent ground cover and very little land disturbance. The lake water quality characteristics were found to be typical of midwestern lakes, with high alkalinity, conductivity, and dissolved solids. There was an abundance of phosphorus in the lake system all the time. The main lake tributaries were not found to convey unusual amounts of suspended sediment loads. Fish flesh analyses revealed levels of pesticides, heavy metals, and organochemicals either below detectable limits or below regulatory limits. A number of water quality impairments were found to persist in the lake, including hypolimnetic oxygen depletion during summer months, algal blooms, and dense

macrophyte growths in the littoral zone. Internal regeneration of nutrients was identified as the major source of nutrients to the lake. The lake is eutrophic by all the measures and indices suggested in the literature. (Author's abstract)
W85-05722

PREDICTED EFFECTS OF INCREASING SALINITY ON THE CRUSTACEAN ZOOPLANKTON COMMUNITY OF PYRAMID LAKE, NEVADA,
Colorado Cooperative Fishery Research Unit, Fort Collins.
D. L. Galat, and R. Robinson.
Hydrobiologia, Vol. 105, p 115-131, November, 1983. 9 Fig, 4 Tab, 48 Ref. Bureau of Indian Affairs contracts 14-16-0008-974 and K51C14201130.

Descriptors: *Salinity, *Crustaceans, *Zooplankton, *Pyramid Lake, *Nevada, Walker Lake, Water diversion, Bioassay, Species diversity, Saline lakes, Ecological effects.

Because of major upstream transbasin water diversions, the salinity of Pyramid Lake, Nevada has increased 32% from about 3.75 0/00 in 1933 to nearly 5.50 0/00 in 1980. It has been hypothesized that further increases of 1.5 to 2 times (1.5X to 2X) its present salinity would significantly reduce species richness and alter population structures of the existing crustacean zooplankton community. The present zooplankton community of Walker Lake (2X) was compared with that existing in Pyramid Lake (1X). Ceriodaphnia quadrangula and Diaphanosoma leuchtenbergianum, both collected from Pyramid Lake, were lacking in Walker Lake. Populations of Cyclops vernalis were significantly lower and those of Diaptomus sicilis and Moina hutchinsoni were significantly higher in Walker Lake than in Pyramid Lake. Densities of Ceriodaphnia and Cyclops were low in microcosms at salinities > 1X. Diaphansoma could not be maintained in microcosms, regardless of salinity. Numbers of Diaptomus and Moina in microcosms were proportional to salinity level. Short-term LC50 salinities (0/00) were as follows: Diaphanosoma, 6.5; Ceriodaphnia, 7.1; Diaptomus, 13.3; Cyclops, 14.8; and Moina, 17.8. Multiple-generation, chronic bioassays were run only on Cyclops and Diaptomus. Three generations of Cyclops were produced at salinities of 4.0 to 8.5 0/00, but not at 9.8 0/00 or higher. Diaptomus was unable to complete three generations at salinities > or = 9.6 0/00. If the salinity of Pyramid Lake increases 1.5 to 2X, crustacean zooplankton diversity will probably decline as the community shifts towards dominance by a few species resistant to high salinity. (Moore-IVI)
W85-05754

VAST DIVERSION OF SOVIET RIVER,
P. P. Micklin.
Environment, Vol. 27, No.2, p 12-20, 40-45, March, 1985. 4 Fig, 1 Tab, 78 Ref.

Descriptors: *Water resources development, *Diversions, *Siberia, *USSR, *Environmental effects, Water transfer, Water management.

The Soviet Union is on the verge of constructing a water management scheme that is unprecedented in its scale. It is planning to transfer large quantities of river water now flowing into northern drainage basins and divert them into southern drainage basins. The goal is to complete the undertaking by 1990, when diversion of 5.8 cu km of water per year is to begin. The rationale for the water transfers is reviewed. The characteristics of Soviet river diversion projects are tabulated. Specific attention is given to the European diversions, the Siberian transfers, and the impacts these diversions will have on the environment, including concern over possible effects on the Arctic ice cover. (Baker-IVI)
W85-05767

7. RESOURCES DATA

7A. Network Design

PROPOSAL TO CONSTRUCT A COORDINATING MATRIX FOR COMPARATIVE HYDROLOGY,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
G. Kovacs.
Hydrological Sciences Journal, Vol. 29, No. 4, 435-443, December, 1984. 3 Fig.

Descriptors: *Hydrologic models, Model studies, Hydrological regime, Morphology, Climatic data, Hydrologic balance.

When the development of hydrological sciences became linked to a large international program, the limitations to the application of conventional methods in areas with different characteristics were immediately recognized. The establishment of a multi-dimensional matrix which summarizes the various factors reflecting the different ratios of the water balance components and indicating the special processes to be considered when the hydrology of a given region is being investigated is seen to be a requirement. Attention is given to factors which modify the hydrological regime, the effect of morphology on hydrological processes, the influence of climatic conditions on hydrology, and the proposed form of the coordinating matrix (Baker-IVI)
W85-05007

MULTICRITERION NETWORK DESIGN USING GEOSTATISTICS,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
For primary bibliographic entry see Field 2F.
W85-05499

NOTE ON SELECTING AN OPTIMUM RAIN-GAUGE SUBSET,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2B.
W85-05541

7B. Data Acquisition

PORTABLE MONITOR FOR MEASUREMENT OF DISSOLVED SULFIDE BASED ON THE GLASS/SULFIDE-SELECTIVE ELECTRODE COUPLE,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
J. Gulens.
Water Research, Vol. 19, No. 2, p 201-204, 1985. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Monitoring, *Water analysis, *Glass/sulfide electrode, *Sulfides, Electrodes, Groundwater monitoring, Water quality control, Dissolved solids.

A portable monitor has been used to measure dissolved sulfide in uncontaminated and contaminated ground waters, and there is good agreement between the monitor response and the results of analyses of grab samples. The response of the monitor is based on the potential of a glass-sulfide selective electrode couple measured in acidic solutions. This approach appears to have overcome many of the problems associated with the conventional potentiometric determination of sulfide. A particular advantage of the monitor is that it uses the actual sample for calibration in the field. Thus, shifts in the calibration curve arising from changes in the composition of the ground water can be detected and accounted for. Also, the ability to check the accuracy of the monitor during measurement of a sample by the method of standard addition allows one to verify that such shifts are real and due to some chemical interaction between the solution and electrode surface and not due to some instrument instability or failure. Advantages of the glass/sulfide electrode pair are also discuss
(Baker-IVI)
W85-04975

SIMPLE CULTIVATION UNIT FOR T
EVALUATION OF ALGAL GROWTH POTE
TIAL AND TOXICITY OF WATER,
Ceskoslovenska Akademie Ved, Trebon. Dept.
Hydrobotany.
J. Lukavsky.
Water Research, Vol. 19, No. 2, p 269-270, 198
Fig, 3 Ref.

Descriptors: *Bioassays, *Algal growth potent
*Toxicity, Algae, Growth, Laboratory equipme
Water pollution effects.

A cultivation unit was designed for testing al
growth potential (AGP) and toxicity of waters
of soil extracts (for evaluation of soil fertility);
system may also be used for testing and screen
of biologically active substances, heavy met
pesticides, and biostimulatory compounds. T
cultivation unit is illuminated by an incandesc
lamp which is heat-filtered by a container wit
cm of water. The cultivation area is a covered
sealed plastic box to which CO2 is suppl
through a hole; concentration of CO2 is monito
with an indicator in a small polyethylene bag ha
ing inside the cultivation area. Gauze satura
with water maintains a high humidity level in
box. Microtitration plates or Petri dishes cont
ing solid media are placed in the cultivation a
with their lids upward. The alga Chlorella kess
may be used for bioassays. Consumption of C
by photosynthesis of the colonies is very small
addition of CO2 every second day is suffici
providing that the sealing of the box is go
(Collier-IVI)
W85-04983

SATELLITE PASSIVE MICROWAVE RA
RATE MEASUREMENT OVER CROPLAN
DURING SPRING, SUMMER AND FALL,
Wisconsin Univ.-Madison. Space Science and
gineering Center.
For primary bibliographic entry see Field 2B.
W85-04984

USE OF AERIAL PHOTOGRAMMETRY F
TRADITIONAL SURVEYS OF FLUCTU
TIONS IN GLACIAL SPITS (UTILISATION
LA PHOTOGRAMMETRIE AERIENNE PO
LES RELEVES TRADITIONNELS DE FLUCT
ATIONS DES LANGUES GLACIARES),
Centre National de Machinisme Agricole du Ge
Rural, des Eaux et des Forets, Saint-Mar
d'Heres (France). Div. Glaciologie.
For primary bibliographic entry see Field 2C.
W85-05020

AUTOMATIC MONITORING OF WAT
QUALITY,
T. Kohonen.
Vesientutkimuslaitoksen Julkaisuja, No. 49, p
53, 1982. 7 Fig, 4 Tab, 23 Ref.

Descriptors: *Automation, *Water quality, *Mo
toring, *Finland, Computers, Conductivity, H
drogen ion concentration, Dissolved oxygen, T
bidity, Chlorides, Thermal pollution, Water po
tion.

Since the early nineteen seventies, the Finnish
tional Board of Waters has been actively engag
in the development of automatic water qua
monitoring with the purpose of detecting imm
ately the discharge of pollutants into waterwa
Eleven automatic water quality monitoring stati
have been used, of which five are part of a co
puter controlled system in the rivers Kymijoki
Kokemaenjoki and the others are mobile static
The parameters measured are temperature, p
conductivity, dissolved oxygen and turbidity,
at five stations also chloride. The major causes
disturbances were associated with water intake
malfunction of microprocessors and the cent
computer. Effective operation times varied

tween 30 and 100% of the total measuring time. Automatic monitoring has in several cases revealed previously undetected variations in water quality. Of the 5-6 measurement parameters used, at least one always reacted to changes in water quality. The primary data obtained has been utilized with the aid of statistical methods in an attempt to determine the necessary sampling frequency for a given confidence of calculated means. (Collier-IVI)
W85-05063

USE OF SIMPLE KINETIC MODELS TO HELP DESIGN ENVIRONMENTAL MONITORING SYSTEMS,
EG and G Idaho, Inc., Idaho Falls.
For primary bibliographic entry see Field 5A.
W85-05102

QUICK METHOD OF FIELD OBSERVATIONS OF WASTEWATER SPREADING IN LAKES,
For primary bibliographic entry see Field 5A.
W85-05161

MEASUREMENT OF SOIL WATER CONTENT USING TIME-DOMAIN REFLECTROMETRY (TDR): A FIELD EVALUATION,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
For primary bibliographic entry see Field 2G.
W85-05180

ELECTRONIC DISCRIMINATOR TO ELIMINATE THE PROBLEM OF HORIZONTAL RAINDROP DRIFT,
Missouri Univ.-Columbia. Dept. of Agronomy.
C. J. Gantzer, E. E. Alberts, and W. H. Bennett.
Soil Science Society of American Journal, Vol. 49, No. 1, p 211-215, January-February, 1985. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Rain, *Photoelectric detectors, *Discriminators, Measuring instruments, Erosion, Rainfall simulator, Soil splash.

A simple electronic apparatus is described which has been designed to eliminate the problem of horizontal waterdrop drift during freefall. Such drift causes difficulty in collecting uniform soil splash samples from single-drop detachment studies. The electronic discriminator can be used easily with any single drop rainfall tower. The main detector of the discriminator consists of two optical light source-sensors positioned at right angles in a horizontal plane. These sensors detect and select for use only those drops falling within a 6.4 mm square target window. The discriminator can be built for about $400, including labor and materials. In one experiment to test the performance of the discriminator drop masses were analyzed which had been collected both with and without use of the discriminator and compared with drops collected directly from the drop former. No significant difference in mass between drops collected with the device and those collected directly from the drop former was found. A significant decrease in drop mass was found without use of the device. The discriminator also decreased drop mass variance about six times. In a second experiment soil splash was measured from uniformly packed cores of Norbourne fine sandy loam. An average splash increase of about 46% was noted when using the device vs not using it, insuring against biasing of raindrop kinetic energy vs soil splash relationships. (Baker-IVI)
W85-05193

GUIDE TO THE SELECTION OF MATERIALS FOR MONITORING WELL WELL CONSTRUCTION AND GROUND-WATER SAMPLING,
Illinois State Water Survey Div., Champaign.
M. J. Barcelona, J. P. Gibb, and R. A. Miller.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-141779. Report EPA-600/2-84-024, January 1984, 87 p. 5 Fig, 18 Tab, 160 Ref. Contract/Grant No. CR-809966.

Descriptors: *Hydrology, *Groundwater, *Aquifers, *Wells, Legislation, *Cost-benefit analysis, Sampling, Pollutant identification, *Monitoring, Groundwater management, Pumps.

Existing guidance documents for effective groundwater monitoring efforts were updated. The areas of primary concern were the potential sources of errors in chemical analyses of subsurface samples caused by well construction and sampling materials, techniques or procedures. A critical review of the literature was conducted on various aspects of monitorng natural waters, materials' performance data and unpublished information on the success of various ground-water monitoring techniques. The costs and benefits of recommended monitoring design criteria are given in detail.
W85-05350

REMOTE SEMIAUTOMATIC INSTRUMENTATION FOR INTERMITTENT STREAMFLOW MEASUREMENT AND SUSPENDED SEDIMENT SAMPLING,
Alberta Univ., Edmonton. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W85-05461

USE OF SATELLITE DATA FOR MONITORING OIL SPILLS IN CANADA,
INTERA Environmental Consultants Ltd., Ottawa (Ontario).
T. T. Alfoldi, and N. A. Prout.
EPS 3-EC-82-5, December 1982. 64 p, 19 Fig, 11 Tab, 3 Append, 31 Ref.

Descriptors: *Satellite technology, *Oil slicks, *Oil spills, *Remote sensing, *Infrared imagery, *Monitoring, *Data acquisition, *Monitoring, *Data collections, Spectral analysis, Telemetry, Radiometry, Oil pollution.

Satellite remote sensing of marine oil spills using the visible and infrared bands is reviewed. The Landsat satellite series features return beam vidicon cameras, and multispectral scanners. The NOAA satellite series was launched primarily to gather meteorological data for the U.S. and Canada. The AVHRR sensor aboard the TIROS-N/NOAA satellites is of primary interest to oil spill studies due to its 1 km resolution ability. On the GOES satellites, the Visible and Infrared Spin Scan Radiometer (VISSR) imagery is of interest in the monitoring of ocean oil spills. Future satellite systems will include Landsat D and D' which will feature a thematic mapper and multispectral scanner, the French remote sensing satellite SPOT featuring a matched pair of sensors, and the NOAA satellites. The technical considerations involving the ability of satellites to detect marine oil slicks falls into four basic categories: temporal, spatial, spectral, and radiometric. Methods for the acquisition and use of these satellite data in a spill emergency are detailed. Past experience in identifying oil spills has led to the conclusion that satellite systems are not configured to provide operational oil spill monitoring.
W85-05578

NOTE ON TURBULENT PERTURBATIONS OF SALINITY IN A PARTIALLY MIXED ESTUARY,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W85-05689

COMPARISON OF DAILY AND WEEKLY PRECIPITATION SAMPLING EFFICIENCES USING AUTOMATIC COLLECTORS,
Geological Survey, Lakewood, CO.
L. J. Schroder, R. A. Linthurst, J. E. Ellson, and S. F. Vozzo.
Water, Air, and Soil Pollution, Vol. 24, No. 2, p 177-187, February, 1985. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Precipitation, *Sampling, *Automation, Rain gages, Evaporation, Hydrogen ion concentration, Specific conductance, Samplers, Raleigh, North Carolina.

Precipitation samples were collected for approximately 90 daily and 50 weekly sampling periods at Finley Farm, near Raleigh, North Carolina from August 1981 through October 1982. Ten wet-deposition samplers (Aerochem Metrics Model 301) were used; 4 samples were operated for daily sampling and 6 samplers were operated for weekly-sampling periods. This design was used to determine if: (1) collection efficiencies of precipitation are affected by small distances between the Universal (Belfort) precipitation gage and collector; (2) measurable evaporation loss occurs and (3) pH and specific conductance of precipitation vary significantly within small distances. Average collection efficiencies were 97% for weekly sampling periods compared with the rain gage. Collection efficiencies were examined by seasons and precipitation volume. Neither factor significantly affected collection efficiency. No evaporation loss was found by comparing daily sampling to weekly sampling at the collection site, which was classified as a subtropical climate. Correlation coefficients for pH and specific conductance of daily samples and weekly samples ranged from 0.83 to 0.99. (Author's abstract)
W85-05694

VARIATION IN PH DURING SUMMER STORMS NEAR THE CONTINENTAL DIVIDE IN CENTRAL COLORADO, U.S.A.,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W85-05766

WET DEPOSITION MONITORING - EFFECT OF SAMPLING PERIOD,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 5A.
W85-05773

GRAN'S TITRATIONS: INHERENT ERRORS IN MEASURING THE ACIDITY OF PRECIPITATION,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5A.
W85-05774

COLLECTION OF FOG DRIP,
San Jose State Univ., CA. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W85-05802

7C. Evaluation, Processing and Publication

WGEN: A MODEL FOR GENERATING DAILY WEATHER VARIABLES,
Agricultural Research Service, Washington, DC.
C. W. Richardson, and D. A. Wright.
Report ARS-8, August 1984. 83 p, 3 Fig, 12 Tab, 13 Ref, 4 App.

Descriptors: *Weather forecasting, *Simulation, *Computer models, *Markov process, *WGEN, *Weather Generator, Temperature, Solar radiation, Synthetic weather data.

Daily weather data are required for many applications. Weather data are frequently needed to aid in the design of hydraulic structures; to evaluate the effects of watershed changes on hydrology, water quality or erosion; or to assess alternative crop or range management strategies. Mathematical models of the physical processes involved are often used to make these evaluations. Further, it is desirable to have the capability of generating synthetic weather data with the same statistical characteristics as the actual weather at the location. This paper presents a computer simulation model called WGEN (Weather Generator) that provides daily values for precipitation, maximum temperature, minimum temperature, and solar radiation. The model accounts for the persistence of each vari-

able, the dependence among the variables, and the seasonal characteristics of each variable. Its parameters are defined for locations in the United States, enabling use of the model in the 48 contiguous States without reference to actual data. Examples of model applications are given, and weather data generated by the model are compared with actual data.
W85-05129

8. ENGINEERING WORKS

8A. Structures

PROSPECTS OF USING AUTOMATED MANAGEMENT SYSTEMS IN EARTH-DAM CONSTRUCTION,
N. G. Savchenkov, S. Ya. Laschchenov, V. V. Vil'vovskii, and R. G. Erchikovskii.
Hydrotechnical Construction, Vol. 178, No. 5, p 195-199, May, 1984. 1 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, May 1984.

Descriptors: *USSR, *Dam construction, *Earth dams, *Automated management systems, Computers, Construction, Planning, Decision making.

The need for modern computers to manage dam construction activities in the Soviet Union is discussed. The functions, structure, and stages of introducing such an automated system are noted. The system consists of a specialized wired-program computer and dump-truck identification, weighing, and display apparatus. Structurally the system consists of a central control point housing the computer, printers, radio equipment, loudspeaker and selective calling systems, TV, and three identification-weighing points consisting of scales, secondary weighing apparatus, and other devices. The experience of using the automated system at the Nurek hydrostation makes it possible to critically evaluate the presently existing methods of controlling and managing dam construction processes and on the basis of this to give suggestions on the creation of a new, more functionally extensive automated management system. (Baker-IVI)
W85-05022

SELECTION AND SUBSTANTIATION OF EFFECTIVE DRAINAGE PROTECTION OF THE GATE WORKS OF THE DIVERSION TUNNELS OF THE ROGUN HYDROELECTRIC STATION,
R. Kh. Bukhairov, A. I. Yugai, and V. F. Ilyushin.
Hydrotechnical Construction, Vol. 18, No. 5, p 234-240, May, 1984. 3 Fig, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 36-40, May, 1984.

Descriptors: *Drainage, *Dam construction, *Underground structures, Diversion structures, Rogun hydroelectric station, Tunnels, Seepage, Permeability, Gates, Hydroelectric plants.

The underground structures of the Rogun hydroelectric station include the powerhouse complex (PHC), combined shaft and tunnel service spillways, diversion tunnels, grouting tunnels and shafts, transportation tunnels, and other underground workings. The low permeability and high tectonic compressive stresses in the rock mass made it possible to locate the chamber-type underground structures for the upper pool under the reservoir bed. A well drainage curtain located on the upstream side of the grouting zone was used as the main measure on protecting the underground chambers from seepage. In the Rogun hydroelectric station, in the absence of drainage the linings of the gate hoisting chambers of the diversion tunnels will experience a pressure up to 2.50 MPa. With operation of just the main drainage system of the PHC this pressure decreases to 1.80 MPa; with the combined operation of the drainage systems of the PHC and gate works of the diversion tunnels the seepage pressure on the linings of the latter decreases to 0.08-0.32MPa; with the operation of the local borehole drainage of the hoisting chambers, the pressure near the boreholes decreases to 0.01 MPa. With the combined operation, the main drainage systems of the PHC receives 12,300 cu m/day of water and the drainage system of the gate works 7650 cu m/day. Operation of the borehole drainage increases the seepage flow to the chambers by about 300 cu m/day. (Baker-IVI)
W85-05027

HEAVY SNOW LOADS PLAGUE RESERVOIR ROOF,
Culp/Wesner/Culp, Cameron Park, CA.
R. L. Culp, R. G. Baer, G. Plasterer, and P. English.
Public Works, Vol. 115, No. 8, p 80-82, August, 1984. 5 Fig.

Descriptors: *Reservoir covers, *Snow, *Stateline Reservoir, *California, Engineering, Storage reservoirs, Reservoirs.

Stateline Reservoir is a public water supply reservoir with a capacity of about 1.6 MG. In March 1983, a major portion of the reservoir roof collapsed due to the weight of snow on it. Various solutions to the problem were considered including reconstruction, partial reconstruction, new construction, use of a floating cover, air supported cover, geodesic dome, or the building of a new facility. The floating cover was finally accepted and installed by October 1983. The cover fully protects the water stored in the reservoir against airborne contamination and complies with structural and safety needs. During 1983-84, when once again severe snows were experienced, it gave evidence of being an acceptable solution. (Baker-IVI)
W85-05482

STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA,
WRC Engineering, Inc., Denver, CO.
For primary bibliographic entry see Field 4A.
W85-05484

WORK RESUMED ON WATER TUNNEL.
Public Works, Vol. 115, No. 7, p 184-190, September, 1984. 2 Fig.

Descriptors: *Tunnels, *Construction, *New York City, *New York, Water conveyance, Tunnel construction.

A $120 million contract for the final section of Stage 1 of New York City's Third Water Tunnel calls for excavation of a 24 ft tunnel 8,240 ft long through bedrock some 500 to 700 ft below the surface of Manhattan, then concrete lining the mined out portion and lining a previously mined 9,000 ft section. Stage 1 is only the first in a planned four stage tunnel system that will comprise the whole of Water Tunnel No. 3. The need for the four stages are an increase of the delivery capacity and pressure to meet a growing demand in the easterly and southerly areas of the city, which are furthest from the existing tunnels; a need to reduce high flows in the existing tunnels; and a need for inspection and performing any rehabilitation of the existing tunnels. (Baker-IVI)
W85-05485

PROGRAM MANAGEMENT KEEPS ANCHORAGE WATER PROJECT ON SCHEDULE,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 6A.
W85-05486

TWENTY YEARS AFTER: AN EXPERIMENT IN TIDAL POWER (VINGT ANS APRES LA RANCE, UNE EXPERIENCE MAREMOTRICE),
Groupe Mixte Exploitation Bretagne Electricite de France.
P. Hillairet.
Houille Blanche, No. 8, p 571-582, August 1984. 7 Ref.

Descriptors: *Tidal powerplants, *Rance, *France, Powerplants, Hydraulic machinery, Tidal energy, Civil engineering.

This experiment is still unique of its kind because Rance (France), the only tidal power station in the world in regular operation, can no longer be considered as just a prototype. The materials utilized, the bold design of this hydraulic power plant and harnessing of tidal energy in general have preoccupied pioneers and engineers alike over the years. But what is the situation now, after twenty years. Civil engineering works and electrical and mechanical equipment have stood the test of time and fulfilled the expectations placed in them, because they now provide electric power at a very competitive price on a regular commercial basis. The article outlines the problems encountered over these twenty years of operation. (Author's abstract)
W85-05544

FROM THE ATLANTIC TO THE GREAT LAKES: A HISTORY OF THE U.S. ARMY CORPS OF ENGINEERS AND THE ST. LAWRENCE SEAWAY,
George Washington Univ., Washington, DC.
W. H. Becker.
Office of the Chief of Engineers (Army), Washington, DC. EP 870-1-20, October 1984. 179 p.

Descriptors: *History, *St. Lawrence Seaway, *Navigation canals, *Corps of Engineers, Great Lakes, International waters, Construction costs, Political aspects, Engineering.

The Corps of Engineers played a major part in the planning, design, and construction of the St. Lawrence Seaway, and international power and navigation project. Improvements for navigation required building two American and four Canadian locks, constructing ship channels in the International Rapids and the Lacine (Montreal) sections of the river, and extensive dredging in the St. Lawrence. The power works, a joint effort of New York State and Ontario, called for a powerhouse across the north channel of the St. Lawrence River and the construction of a powerhouse spillway dam, the Long Sault Dam. A control dam crossed the river in the vicinity of Iroquois Point to regulate the outflow of Lake Ontario. These navigation and power improvements required an extensive system of dikes and the relocation of towns, roads, railroads, bridges, and power lines. By the time the Seaway officially opened on 26 June 1959, the United States had spent $131 million, Canada $340 million, and New York and Ontario each $300 million. The scope of the Corps' role in the project was determined in part by its long involvement in the development of the St. Lawrence; in part by events and political relationships and controversies in the United States and Canada; and in part by the engineering issues involved in, and the organizational structure devised for, the successful completion of the project. Based on extensive research in the published and archival sources of the Corps, Congress, and the Bureau of the Budget, this study covers each of these determinants, then provides an assessment of the effectiveness of the Seaway.
W85-05576

HYDRO ENERGY IN CZECHOSLOVAKIA,
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering and Architecture.
L. Votruba.
International Water Power and Dam Construction, Vol. 37, No. 3, p 13-16, March, 1985. 3 Fig, 2 Tab, 2 Ref.

Descriptors: *Hydroelectric power, *Czechoslovakia, Pumped storage, Reviews, Energy, Hydroelectric plants.

The hydro energy situation in Czechoslovakia is a typical example of power generation and supply in a highly developed country with rich deposits of fossil fuel, but with hydropower resources that are limited by relatively low flow rates and relatively low heads. Therefore the main role of hydroelectric stations is to cover peak loads rapidly. Pumped-storage plants are of great importance because by balancing the daily and weekly load curves effectively, they create favorable conditions for the operation of thermal and nuclear powerplants. As is the case in some other countries, the operation of most small hydro stations ceased in

ast decades. With the development of the system f power generation and supply, rationalized esign of sets, and automatic control, small hydro lants have again become a useful supplement for he electrification system. Water schemes and dams uilt for other main purposes are also being used or hydropower. All this has lead to a great effort eing aimed at the exploitation of all sources of ydro energy that are both economical and techni- ally feasible. (Baker-IVI)
W85-05816

ROMANIA GIVES PRIORITY TO EMBANKMENT DAMS,
National Committee on Large Dams, Bucharest (Romania).
V. Focsa, and D. Mihail.
International Water Power and Dam Construction, Vol. 37, No. 3, p 16-19, March, 1985. 8 Fig, 2 Tab.

Descriptors: *Dam construction, *Romania, *Embankments, *Earth dams, *Rockfill dams, Hydroelectric plants, Policy making, Water resources development.

An overview is presented of policies in the energy sector in Romania which are concerned with the development of all available hydroelectric resources and the construction of a number of large dams. The particular focus of the review is on the construction of high embankment dams for hydropower. Between 1953 and 1982, 101 large dams were constructed in Romania. These were built for multipurpose schemes with hydropower as one of the principal functions. Ten are between 60 and 100 m high and five are higher than 100 m. The type of dam in each case was established according to the geological and topographical conditions at the site as well as economic criteria. Of the concrete dams, four are of the gravity type, one of which is 127 m high. There are also 14 arch dams and four buttress dams. Embankment structures, however, represent the majority of Romanian dams. The characteristics of major earth and rockfill dams in Romania are tabulated. These were constructed mainly for reservoirs associated with low-head hydro plants. Stability analysis of the fill dams is based on extensive foundation and soil investigations, as well as laboratory tests, and has required modern design methods such as the slices method, model tests, and the finite element method which is applied to the embankment and its foundation, and used to test for liquefaction under dynamic earthquake stresses. Upstream concrete facings have generally been used for embankments less than 100 m high, and impervious cores for the higher ones. Bituminous concrete facings and thin membranes have also been used. (Baker-IVI)
W85-05817

SRI LANKA'S KOTMALE HYDRO PROJECT,
Halcrow (William) and Partners, Colombo (Sri Lanka).
E. M. Gosschalk, and A. D. Longman.
International Water Power and Dam Construction, Vol. 37, No. 3, p 21-26, March, 1985. 6 Fig, 2 Tab.

Descriptors: *Mahaweli Ganga Development, *Sri Lanka, *Kotmale Hydroproject, *Powerplants, Construction, Hydroelectric plants, Dams, Tunnels, Spillways.

The Kotmale hydropower project is a major component of the massive Mahaweli Ganga development. Adverse geological conditions at the originally planned dam site necessitated a change in the dam's location, and a comprehensive account of the investigations and project design is presented here, together with details of the main features of the scheme. The Kotmale Oya originates in the south central massif at an elevation of about 2100 m. The dam is 87 m high above river bed level, and has a crest length of 600 m. The intake to the low pressure tunnel carrying water to the power station is on the right bank immediately upstream of the dam with its sill at elevation 654 m. The first part of the tunnel system carrying the flow from the reservoir to the power station is a 6.4 m equivalent diameter concrete lined horseshoe-shaped low pressure tunnel. Upstream and downstream surge chambers are provided to reduce the transient pressures tranmitted into the headrace and tailrace tunnels, and to limit the water acceleration time. The power station which houses the generating plant is an underground cavern 67 m long by 20 m wide by 38 m high. The outfall from the tailrace tunnel will be on a flood channel of the Mahaweli Ganga immediately upstream of the confluence with the Atabaga Oya. (Baker-IVI)
W85-05818

SALLENTE DAM SPILLWAY,
Informes y Projectos S.A., Madrid (Spain).
M. S. Tovar,
International Water Power and Dam Construction, Vol. 37, No. 3, p 33-36, March, 1985. 7 Fig, 6 Ref.

Descriptors: *Sallente Dam, *Spain, *Spillways, Design criteria, Hydraulics, Flow, Model studies, Avalanches, Flip bucket.

Salente dam in Spain has an uncontrolled side spillway with a channel discharge tunnel. Some modifications to the structure had to be carried out following scale model tests, and these are described in this article. The spillway was designed to prevent damage, obstruction and difficulties in the event of avalanches of snow, which frequently occur at this site. The preliminary design has worked correctly for the 1000 year flood. For higher flows operation was affected by the inlet tunnel which produced disturbance and premature flooding. To improve these conditions, the inlet section was widened, easing the inlet's forms, and a center splitter wall was designed. The transition between the vertical and inclined walls of the side channel was eliminated, and its satisfactory hydraulic operation has been proved. The form of the flip bucket, which can modify the direction of the flow, was designed using plane surfaces, rather than the classical solution of cylindrical surfaces; this will facilitate construction. (Baker-IVI)
W85-05820

EXPERIMENTAL INVESTIGATIONS OF THE WORK OF FOUNDATION ELEMENTS OF HYDRAULIC STRUCTURES,
V. S. Adlersberg.
Hydrotechnical Construction, Vol. 18, No. 7, p 297-302, July, 1984. 7 Fig, 3 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 17-21, July, 1984.

Descriptors: *Hydraulic structures, *Foundations, *Strength, Stress analysis, Dam construction.

Reconstruction and modernization of existing hydraulic structures is inseparably related to the problem of strengthening structural elements. After strengthening, the element should absorb additional loads. When constructing the foundation slabs of hydraulic structures in two phases it is necessary to take into account that the work of the two foundation slabs with the same geometry and same external load can be substantially different if the first of them is constructed and loaded at once and the second was additonally loaded after increasing its geometry. In all foundations being constructed anew it appears possible to substantially reduce the bending moments by redistributing the reaction pressures on the under surface. (Baker-IVI)
W85-05821

8B. Hydraulics

SCOUR CONTROL AT OUTLOOK BRIDGE - A CASE STUDY,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W85-05454

CHARTS FOR WATER HAMMER IN LOW HEAD PUMP DISCHARGE LINES RESULTING FROM WATER COLUMN SEPARATION AND CHECK VALVE CLOSURE,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
E. Ruus, B. Karney, and F. A. El-Fitiany.
Canadian Journal of Civil Engineering, Vol. 11, No. 4, p 717-724, December, 1984. 22 Fig, 1 Tab, 8 Ref.

Descriptors: *Pumps, *Pipelines, *Water hammer, *Water column separation, Water distribution, Check valves, Head, Valves.

Water column separation is likely to occur when pumps fail in an unprotected low head installation that has a long pipeline carrying water at high velocity. A systematic study was made combining the effects of water column separation and check valve closure on the maximum pressure head rise, both initiated by power failure. Water column separation occurring in a high point can yield a dangerous pressure head rise in the pipeline. The vertical elevation of the high point has the primary influence on water column separation and on the resulting maximum pressure head rise. Sharp pressure head peaks occured at nearly all high point locations studied. Pressure head rises higher than nine times the initial steady state pumping head can occur in some cases. Very little or no water column separation occurs in the high points considered when low pipeline constant values are combined with high inertia constant values. Water column separation does not always signal a danger for the pipeline. In many cases, column separation only marginally increases the pressure head rise above that produced by check valve closure. The hissing and thumping noise that may occur may be objectionable. Large friction in general reduces the pressure head rise caused by water columnn separation and sometimes eliminates the separation. Low head installations are more susceptible to water column separation than high head installations. (Baker-IVI)
W85-05455

INTERPOLATION OF THE COLEBROOK FORMULA FOR APPLYING THE HARDY CROSS METHOD TO WATER DISTRIBUTION SYSTEMS (INTERPOLATION DE LA FORMULE DE COLEBROOK POUR L'APPLICATION DE LA METHODE DE HARDY CROSS AUX RESEAUX DE DISTRIBUTION D'EAU),
Bologna Univ. (Italy).
G. Rossi.
Houille Blanche, No. 8, p 553-556, August, 1984. 2 Tab.

Descriptors: *Water conveyance, *Friction, *Pressure pipelines, Mathematical equations, Head loss, Hydraulic roughness, Turbulence.

It is first shown that the Colebrook formula for calculating the friction coefficient in uniform movement of a turbulent liquid, in a pressure pipeline, is not easily adaptable to the Hardy Cross method. Attempts were therefore made to find, by interpolation, an equation which would give a good approximation of friction coefficient figures for water at 12 C within the speed, diameter and roughness parameters of interest in water distribution systems, and at the same time would provide monomial expressions of head losses easily applicable with the Hardy Cross method for specific roughness values. (Author's abstract)
W85-05542

FREE JET SCOUR BELOW DAMS AND FLIP BUCKETS,
Gibb (Alexander) and Partners, London (England).
P. J. Mason, and K. Arumugam.
Journal of of Hydraulic Engineering, Vol. 111, No. 2, p 220-235, February, 1985. 4 Fig, 3 Tab, 32 Ref, 1 Append.

Descriptors: *Free jet scour, *Scour, *Dams, *Flip buckets, *Mathematical formulas, Particle size, Chutes, Flumes, Jets.

Formulas proposed to date for calculating ultimate scour depth under jets, such as issue from free dam overfalls and flip buckets, were examined. The accuracies of the formulas were evaluated by using each to process sets of scour data from prototypes and models of such prototypes. Scour depth is as

adequately calculable using only unit flow q and head drop H as using more complex considerations, but those formulas most applicable for model purposes are not those best for prototypes. Where bed particle size d was also considered, the use of the mean particle size dm was more appropriate than the d90 size. Chute friction loss allowances and jet impact angle were also examined in terms of improved accuracy; the relevance of Froude law scaling for this type of scour was verified. A novel formula for predicting ultimate scour depth, which includes an allowance for tailwater depth h, gives improved accuracy for both models and prototypes. (Author's abstract)
W85-05781

DRAG COEFFICIENT ON PYRAMIDAL BAFFLE BLOCKS,
Societe Generale pour l'Industrie Ingenieurs-Conseils, Geneva (Switzerland).
M. Gerodetti.
International Water Power and Dam Construction, Vol. 37, No. 3, p 26-28, March, 1985. 7 Fig, 5 Ref.

Descriptors: *Baffles, *Drag, *Hydraulic jump, Hydraulics, Velocity, Supercritical flow, Scale models, Hydraulic models.

Forces on pyramidal baffle blocks at the downstream end of outlets under spraying supercritical flow conditions depend on a number of factors, for example, water velocity and height of baffles. Some experimental results are presented. The experiments were carried out for complete testing of a dam's hydraulic structures on a 1:50 scale model. For the project in question, pyramidal baffle blocks were placed at the downstream end of the five bottom outlets, which in the model were 150 mm wide and 80 mm high. The flow was measured by an orifice meter in the supply pipe and the depth of the supercritical flow was adjusted by a curved sluice gate. The tailwater level was adjusted according to the natural conditions and did not vary during the tests. The drag force on an individual baffle block was measured with the help of a specially fabricated drag frame. The drag forces were compared with one another and analyzed to correlate the relationship between different parameters. (Baker-IVI)
W85-05819

CALCULATION OF SEEPAGE FROM A RESERVOIR BY THE MATHEMATICAL MODELING METHOD,
For primary bibliographic entry see Field 2F.
W85-05822

NUMERICAL SIMULATION OF TURBULENT FLOWS,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
For primary bibliographic entry see Field 2E.
W85-05830

SECONDARY FLOW IN CURVED OPEN CHANNELS,
Universidad Central de Venezuela, Caracas. Inst. de Mecanica de Fluidos.
For primary bibliographic entry see Field 2E.
W85-05831

8C. Hydraulic Machinery

RESERVOIR RELEASE IMPROVEMENT,
Tennessee Valley Authority, Chattanooga. Div. of Water Resources.
For primary bibliographic entry see Field 5G.
W85-05298

EVALUATION OF WATER BLEEDER CONTOLS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
D. W. Smith, and A. Yee.
Environmental Protection Service, Technology Development Report EPS 4-WP-83-1, March 1983. 60 p, 24 Fig, 10 Tab, 64 Ref, 1 Append.

Descriptors: *Water bleeding, *Freezing, *Pipelines, *Hydraulic equipment, *Subarctic zone, Water conveyance, Water distribution, Pipes, Conveyance structures, Water mains, Economic evaluation, Canadian distribution systems, Bleeder control devices.

Alternative service line bleeder controls that could be used with existing bleeder systems were evaluated for their ability to prevent pipe freezing in northern piped distribution systems. Laboratory scale tests were conducted on five bleeder control devices: a temperature controller, a timer, a gravity flow drainage tank, and orifice plate, and a storage pressure tank. The orifice plate and the variable set timer gave technically acceptable results and are recommended for further development. The orifice plate can regulate continuous bleeder flows to a specified minimum, relieving the bleeder operator of the responsibility of setting flow. The timer showed the greatest potential for saving water because it allowed only intermittent bleeding. The timer also proved to be the more economic of the two alternatives based on a 20-year expected life present worth comparison. (See also W70-01088, W71-06625, and W74-10161)
W85-05301

HYDRAULIC MODEL STUDIES ON BULB TURBINE INTAKES,
Bureau of Reclamation, Denver, CO. Hydraulics Branch.
C. A. Pugh.
Available from the National Technical Information Service, Springfield, VA 22161. Bureau of Reclamation Report REC-ERC-82-14. March 1983. 18 p, 28 Fig, 4 Ref.

Descriptors: *Hydraulic models, *Hydraulic equipment, *Intakes, *Turbines, *Cost savings, *Pressure head, *Hydraulic machinery, Flow velocity, Velocity distribution, Model studies, Construction costs, Rim generator turbine intakes, Bulb turbine intakes, Value engineering.

Intakes for bulb and rim generator turbines are very large in relation to their runner diameters. Because the water velocity is low in the intake area, the losses are small. The effect is described that simplifying the intake design has on energy losses and flow distribution. Various models were employed to test the effect of alterations intake size and shape, and the effects of a bulkhead slot, a pier in the intake, a draft tube, and different approach channel configurations. Using straight surfaces in place of curved bellmouth entrances and shortening the length of the intake could significantly reduce construction costs. In addition, reducing the intake size would reduce the size of trashracks, gates, and associated operating equipment.
W85-05307

PROCEEDINGS OF THE AMERICAN POWER CONFERENCE, CHICAGO, IL, APRIL 18-20, 1983.
Illinois Institute of Technology, Chicago, IL, 1983. Vol 45, 1120 p.

Descriptors: *Powerplants, *Conferences, Water use, Hydroelectric plants.

This proceedings volume contains 168 papers on the generation, transmission, distribution and utilization of power. The papers are arranged in the following categories: mechanical, electrical, nuclear, civil engineering, industrial, water technology, and hydroelectric.
W85-05323

LONG-DISTANCE, HIGH-PRESSURE WATER SUPPLY SYSTEM FOR BONANZA POWER PLANT,
Burns and McDonnell, Kansas City, MO.
R. D. Vering, D. J. Langford, D. J. Miller, and K. M. Neuschwander.
In: Proceedings of the American Power Conference, Chicago, IL, April 18-20, 1983. Illinois Institute of Technology, Chicago, 1983. Vol 45, p 880-884, 2 Fig, 1 Ref.

Descriptors: *Powerplants, *Water conveyance, Pumps, Pipelines, Wells, Diversion Structures, Alluvial aquifers, Computers.

Construction of the water supply system for the Bonanza Power Plant is nearly complete. All systems are scheduled to be fully operational by June of 1983. The special corrosion and water hammer protection considerations incorporated into the system should result in a long life, trouble free pipeline. Several innovative features were included in the design of the Bonanza Power Plant. Field tests have proven the Ranney collector wells to be an effective method of water diversion from shallow alluvial aquifers. Mechanical joint, pretensioned concrete pipe has proven to be a cost-effective, water-tight pipe material for high-pressure, long-distance water pipelines in its first know application in this service. The use of polyethylene encasement effectively shields concrete pipe from impressed currents and allows interference corrosion problems to be solved with resistance bonds. The use of identical pumps for interchangeability allows maximum operation flexibility and reduces maintenance, spare part and capital costs. Pump stations 20 miles from the plant site are controlled with minimal operator input from a plant site control room by utilizing a supervisory communicaitons system and a programmable controller. Multiplexing the control signals significantly reduces communication system cost, and the programmable controller provides maximum flexibility in system control modification.
W85-05328

ANALYSIS AND COMPUTERIZED MODEL OF THE AUTOMATIC HYDRAULIC RAM PUMP,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller, and P. Kahangire.
Canadian Journal of Civil Engineering, Vol. 11, No. 4, p 743-750, December, 1984. 10 Fig, 7 Ref.

Descriptors: *Pumps, *Hydraulic ram pump, *Computer models, Model studies, Pumping, Hydraulic machinery, Water hammer, Automation, Head loss.

The automatic hydraulic ram pump is a unique device that uses energy from a falling quantity of water as the driving power to pump some of the water to a head much higher than the source. The operating characteristics of the hydram system were studied analytically, with some parameters being determined experimentally. The system efficiency, pumping capacity, pump power, and cycle duration were derived with a simple computerized model. The velocity to initiate waste valve closure is identified as the most important parameter controlling hydram operation and is affected by waste valve design and adjustment, supply head, and drive pipe length. With parameters such as velocity of water in the drive pipe when the waste valve begins to close, dimensionless drag force coefficient, total head loss factor of both the drive pipe and waste valve, total head loss factor of both drive pipe and delivery valve, frictional head loss factor of the drive pipe alone, and steady state flow velocity in the drive pipe, determined under steady flow conditions, the performance of the hydram can be predicted within acceptable errors using a simple computerized model. The simple analysis presented gives results in close agreement with the measured pump performance. (Baker-IVI)
W85-05456

DEVELOPMENT OF AXIAL FLOW MACHINES FOR USE IN TIDAL POWER PLANTS (EVOLUTION DES GROUPES AXIAUX POUR L'EQUIPEMENT DES INSTALLATIONS MAREMOTRICES),
J. Bosc, and L. Megnint.
Houille Blanche, No. 8, p 591-595, August, 1984. 2 Fig, 2 Ref.

Descriptors: *Tidal powerplants, *Axial flow, *Hydraulic equipment, Turbines, Powerplants, Electrical equipment, Hydraulic machinery

Typical tidal power plant sites have a drop in water level of between 0 to 13 to 14 meters. The choice of operating equipment for small differences in water level has a crucial influence on plant productivity; the electrical and mechanical design of such equipment must therefore be properly adapted to these conditions. Based on pilot projects which have proved successful for the Rance and rivers with small differences in gradient, two technical possibilities are worth examination: the use of speed multiplicators; the use of variable speed groups which employ static frequency convertors at full or partial operating capacity. (Author's abstract)
W85-05546

DEVELOPMENT OF AN AUTOMATED PLUGGING FACTOR MONITOR,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 3A.
W85-05597

MISCELLANEOUS POWER O AND M INSTRUCTIONS.
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
Power O and M Bulletin No. 27, July 1982. 15 Fig.

Descriptors: *Generators, *Electric powerplants, *Electrical equipment, *Insulation, *Maintenance, *Pipes, *Coatings, *Hydraulic equipment, Electric power production, Electrical transmission, Electrical insulators, Chlorine, Protection, Turbines, Hydraulic machinery.

This bulletin contains a number of unrelated topics of instruction or information not included in other bulletins. Any section may be revised or cancelled if the material is absorbed by another bulletin, and sections may be added. This bulletin contains data from Maintenance Instruction Sheet Nos. 25, 46, 47, and 60, and supersedes them. Topics covered by the thirteen items are: standard transmission line structure numbering system, and standard switch numbering system; generator thrust-bearing insulation, and oil film resistance; load division and circulating current in parallel-operated transformers; test equipment available for loan from the Engineering and Research Center; limitations in manual and automatic synchronizing; an electrical method of moving an alternator rotor; commutator and collector ring performance; fiber optic arc detector; protective coatings for water passage surfaces of turbine scrollcases, turbine parts, and draft tubes; high pressure systems; acceptable generator power transients during switching; and chlorine gas system safety program.
W85-05599

USE OF EQUALIZING RACKS IN THE OUTLET SECTIONS OF DRAFT TUBES OF HYDROELECTRIC AND PUMPED-STORAGE STATIONS,
I. E. Mikhailov, M. F. Gubin, and V. G. Kudrevatykh.
Hydrotechnical Construction, Vol. 18, No. 7, p 308-312, July, 1984. 3 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 25-29, July, 1984.

Descriptors: *Pumped storage, *Hydroelectric plants, *Equalizing racks, Flow, Energy, Equalizing basins, Equalizing reservoirs, Draft tubes.

The flow under a runner, especially when operating in nonoptimal turbine regimes, has considerable nonuniformity. The nonuniformity of the flow can be reduced either by eliminating nonoptimal operating regime of the turbine or by installing a flow converter in the outlet section of the draft tube. A plane equalizing rack installed in the grooves of the guard gate can be used as the flow converter equalizing the velocity distribution in the cross sections of the draft tube of a hydroelectric station. Investigations and calculations showed that the installation of equalizing racks in the outlet sections of draft tubes increases the operating efficiency of hydraulic machines and is expedient both in energy and economic respects. To determine the actual positive effect, an equalizing rack should be installed at one of the operating hydroelectric stations or pumped storage stations and the necessary on-site observations and measurements carried out. (Baker-IVI)
W85-05823

8D. Soil Mechanics

TEMPORAL VARIATION OF THE CHARACTERISTICS OF SANDS IN HYDRAULIC-FILL STRUCTURES OF THE RIGA HYDROELECTRIC STATION,
I. V. Dudler, V. V. Malakhanov, A. N. Yulin, A. V. Serkov, and A. Ya. Vinogradov.
Hydrotechnical Construction, Vol. 18, No. 5, p 200-206, May, 1984. 4 Fig, 5 Tab, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 9-13, May, 1984.

Descriptors: *Dam construction, *Sand, *Hydraulic fill dams, Hydroelectric plants, Construction, Design criteria, Riga hydroelectric station, Dams, Levees, Particle size.

When designing hydraulic-fill structures the temporal variations of the characteristics of hydraulic-fill sand caused by processes of infilling of their voids, consolidation, and development of structural bonds are practically disregarded. Increasing the rate of hydraulic filling, compression of the dam profile when necessary, and increasing the permissible rate of reservoir drawdown are processes which substantially increase the strength and dynamic stability of sands and reduce their compressibiliy and permeability. Investigations were made of the hydraulic-fill structures of the Riga hydroelectric station. An analysis of the data of operative construction control of the first years of hydraulic filling of the structure suggested the advisability of introducing a number of corrections in the hydraulic-fill specifications. A somewhat finer sand than was stipulated by the specifications was placed in the dams and levees of the Riga hydrostation. According to the specifications the content of particles smaller than 0.25 mm should have been 20-40%, whereas actually according to the operative control data it was 30-50%. Infilling occurred both during infiltration of water during hydraulic filling of the next layers and during fluctuation of the depression surface during drawdown of the reservoir. The change in the particle-size distribution of sands not only reduces their permeability but also noticeably affects the conditions of formation of the density and strength of the hydraulic fill sands. Consolidation of the hydraulic-fill sands with time leads to an increase of their dynamic stability. (Baker-IVI)
W85-05023

STABILITY OF A PEBBLE DAM WITH AN INJECTED CORE,
L. N. Rasskazov, and A. A. Belyakov.
Hydrotechnical Construction, Vol. 18, No. 5, p 226-233, May, 1984. 4 Fig, 1 Tab, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 26-32, May, 1984.

Descriptors: *Dam stability, *Injected cores, *Earth dams, *Rockfill dams, Dam construction, Canyons, Topography, Slopes, Soil compaction, Stability, Stress, Strain.

The performance of an earth dam is determined mainly by its state of stress and strain, which is substantially affected by the conditions of the three-dimensional behavior of the structure. An investigation of the stress-strain state of a dam can be based on the solution of two- and three-dimensional problems, the combined approach to the investigation consisting of the following: the behavior of the dam determined by its design, the behavior of the dam determined by the topography of the canyon in which it will be constructed, the behavior of the structure as a whole. When it is possible, it is expedient for investigating the behavior of earth dams to use the combined approach based on solving selected two- and three-dimensional problems in a definite way. The three-dimensional behavior of a 122.5 m high gravel dam in a canyon with a site coefficient Ksi about 1 is determined mainly by its interaction with the walls; the dam proved to be substantially underloaded. This can cause development of slide processes in the surface zones of the dam if there is insufficient compaction of the soil. The effect of a change in the slope of the downstream face on stability of the dam is small. Graphs of effect of soil placement density and slope of the downstream face on stability of the first-phase dam can be used when assigning the parameters of the dam design and soil placement density on the basis of known stability requirements. Since in the case of poor compaction of the soil a loss of stability occurs in the surface zones of the dam, near the crest and slopes, stringent requirements should be imposed on soil compaction precisely in these zones. It is also expedient to replace the gravel-pebble fill by fill having a greater strength under small stresses, as by rubble. (Baker-IVI)
W85-05026

FIELD OBSERVATIONS OF RIVER BED SCOUR ON THE PEACE RIVER NEAR FORT VERMILION, ALBERTA,
Research Council of Alberta, Edmonton. Hydrotechnical Section.
R. A. Harrington, and D. G. McLean.
Canadian Journal of Civil Engineering, Vol. 11, No. 4, p 782-797, December, 1984. 15 Fig, 5 Tab, 15 Ref.

Descriptors: *Scour, *Bridges, *Peace River, *Fort Vermilion, *Alberta, Hydraulics, Rivers, Sediment erosion, Mathematical equations, Flow discharge, Velocity.

Field measurements were made of general and local scour at a bridge crossing on the Peace River at Fort Vermilion, Alberta and comparisons of these measurements were made with results from commonly used design equations. The Peace River is the largest sand bed river in Alberta. It exhibits an irregular meandering pattern and is often split by large wooded islands, resulting in a considerable variation in width and depth along the river. Flow regulation provided by the W. A. C. Bennett Dam has significantly reduced summer peaks on the River. Therefore, the probability of obtaining discharge in the range that would be considered channel forming has been reduced. The data indicate that bedform dimensions increased with discharge and that the magnitude of the bedform height could be up to 20% of the general scour magnitudes. Most formulae for predicting general scour at the crossing site were in overall agreement with the measured data, although the Lacey equation is not appropriate, nor was it intended, for locations with a significant degree of contraction. In addition, the mean velocity method was excessively conservative. The local pier scour formulae all overestimated the local scour although this is partly due to the arresting action of the footing on scour development. This phenomenon is due to the site-specific characteristics of the Fort Vermilion crossing. (Baker-IVI)
W85-05457

LONGITUDINAL DISPERSION OF MATTER DUE TO THE SHEAR EFFECT OF STEADY AND OSCILLATORY CURRENTS,
Government Industrial Research Inst., Chugoku, Kure (Japan).
H. Yasuda.
Journal of Fluid Mechanics, Vol. 148, p 383-403, November, 1984. 18 Fig, 9 Ref.

Descriptors: *Dispersion, *Water currents, *Shear, *Oscillatory currents, Fluid mechanics, Boundary conditions, Variance, Mathematical studies.

The longitudinal dispersion in an oscillatory current forming a boundary layer given analytically has been analyzed previously. The earlier analytical method has been expanded to deal with longitudinal dispersion due to the shear effect, making a comparison between that in the steady current and that in the oscillatory current. The time-dependency of the vertically averaged dispersion coefficient has been elucidated analytically in both the steady

and oscillatory currents, regardless of the vertical profile of the current. The dispersion during the initial stage or its variation within one oscillatory period, which has strong vertical shear of the first-order moment, has required a new definition of the variance and the dispersion coefficient. Analysis of the dispersion during the initial stage needs a clear definition of the vertical average of the variance. The problem of the negative dispersion coefficient, which is obtained by the usual vertical average, through introduction of a new vertical average, can be understood. (Baker-IVI)
W85-05469

EXPERIENCE IN THE OPERATION OF HYDRAULIC STRUCTURES AND EQUIPMENT OF HYDROELECTRIC STATIONS,
Yu. A. Zhebelev, and Z. I. Solov'eva.
Hydrotechnical Construction, Vol. 18, No. 7, p 325-330, July, 1984. 3 Fig, 2 Tab, 2 Ref. Translated from Gidrotechnickeskoe Stroitel'stvo, No. 7, p 37-40, July, 1984.

Descriptors: *Earth dams, *Bratsk Hydroelectric Station, Drainage, Seepage, Hydroelectric plants, Settlement, Dam foundations.

The right bank earth dam at the Bratsk Hydroelectric Station is hydraulic fine sand fill and has a crest length of 2965 m, maximum height 36.6 m, crest width 21.7 m, and side slope ratios of the upstream and downstream slopes of 1:4.1:3 and 1:3.1:2.5, respectively. A general picture of settlement along the longitudinal lines of the surface as of May 1983 is given. Since the dam is hydraulic-fill, wetting of the dam with attainment of the normal pool level did not produce considerable consolidation. Settlement on the right bank dam is considerably less than on the left bank. The total settlement of the upstream slope during the period from 1966 through 1983 is from 19 to 85 mm. Settlement along the longitudinal lines formed in complete conformity with the total thickness of the dam body and loose foundation soils, the process of consolidation occurring both in the dam body and in the dam foundation. Settlement is continuing to increase in a particular stretch, apparently due to a decrease of the uplifting effect of groundwaters in connection with lowering of the levels during the period 1976-1982. The overall seepage regime is stable in time. The piezometric levels and discharges are staying within certain limits at the corresponding UPLs. The levels in the piezometers do not exceed the design lines of seepage. The exception is the discharge in collector drain No. 2, which showed a tendency toward an increase in connection with piping into the gallery at DM 46. The presence of two piping centers in the drainage gallery at DM 30 and DM 46 requires greater attention. The installation of flumes with a sand blanket is stopping piping into the gallery, but is not reducing the gradients of the head at the outlet, that is, it is localizing the processes but is not eliminating them. The effect of the constantly acting vibration loads on the dam is unclear. This process may lead to consolidation or liquifaction of the soils, which should be established by constant seismometric observations. (Baker-IVI)
W85-05825

8F. Concrete

FLY ASH AND FLY ASH CONCRETE,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
E. R. Dunstan.
REC-ERC-82-1, May 1984. 42 p, 32 Fig, 11 Tab, 45 Ref.

Descriptors: *Concrete technology, *Cements, *Fly ash, *Pozzolans, *Concrete testing, *Concretes, *Portland cements, *Concrete mixes, Strength, Testing procedures, Calcium sulfate, Minerals, Freeze-thaw tests.

Fly ash is a residue that results from the combustion of ground or powdered coal. Historically, fly ash has been referred to as a pozzolan and is used to reduce the amount of portland cement in concrete. However, in many Western States fly ashes have cementitious properties as well as pozzolanic properties, and they are capable of producing good strengths without portland cement. This study discusses test results of several ashes according to ASTM: C618, (Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete). Many changes are suggested. The replacement of 15 to 25% by mass of portland cement in concrete is examined. A few highly cementitious ashes were used to make concrete without portland cement. A new cement was developed that consists of over 90% fly ash and anhydrous CaS04. Test data for most concretes include: mix proportions, compressive strength, elasticity, drying shrinkage, sulfate resistance, and freeze-thaw durability. Other results included are adiabatic temperature rise, alkali-aggregate reaction, and modulus of rupture. (Author's abstract)
W85-05596

SELECTION OF PLACEMENT TECHNIQUES FOR WATER BOREHOLE CEMENTING,
British Geological Survey, London (England). Hydrogeology Research Group.
N. S. Robins.
Water Services, Vol. 89, No. 1068, p 64 and 68, February, 1985. 9 Ref.

Descriptors: *Boreholes, *Cements, Drilling, Drill holes, Engineering.

Borehole cementing is a specialized and highly technical field of drilling engineering. There are three main uses of borehole cements in the water industry: as a bridge plug, as a backfill medium during construction or abandonment; and as a seal in the annular space between the borehole wall and the casing. The cement slurry used must be capable of setting into a durable solid of sufficiently low permeability to restrict fluid flow and sufficient strength to support the borehole wall and casing. Placement of the cement is carried out by one of two methods - pressure placement or gravity placement. Gravity placement of cement can be carried out by most drilling contractors providing the depth range is only moderate. Pressure cementing is usually undertaken by a cement service company. (Baker-IVI)
W85-05815

8G. Materials

VIBRATION TESTS OF THE ANDIZHAN RESERVOIR BUTTRESS DAM,
G. E. Shablinskii, Yu. A. Simon, V. F. Zakharov, G. A. Shapiro, and F. L. Doronin.
Hydrotechnical Construction, Vol. 18, No. 5, p 207-211, May, 1984. 5 Fig, 1 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 13-16, May, 1984.

Descriptors: *Andizhan Reservoir Dam, *Buttress dams, *Vibration, *Testing procedures, Karadarya River, Earthquake engineering, Dam construction, Seismic properties, Concrete dams, Gravity dams.

The Andizhan Reservoir Buttress Dam was built on the Karadarya River in a region with intensity 9 seismicity. The height of the dam is 119.5 m; the slopes of the upstream and downstream faces, m = 0.5; the width of the sections is 25 m. After completing construction it was necessary to establish to what extent the investigations conducted on models and the calculation of the earthquake resistance of the dam reflected the actual work of the structure. Determination of the dynamic characteristics of the prototype structure, including a determination of the frequency and models of free vibrations, is necessary for solving this problem. Dynamic tests of concrete dams by the vibration machine make it possible to determine the dynamic characteristics of the structure with a high accuracy and on this basis to refine its calculation scheme. In dynamic calculations for concrete gravity dams it is necesary to take into account the three-dimensional character of behavior of the structure (interaction of the sections) and to estimate the forces occurring in the intersectional joints for checking the strength of the intersectional seals. (Baker-IVI)
W85-05024

USE OF CATHODIC PROTECTION OF BURIED AND SUBMERGED METALS IN CORROSION PREVENTION IN ELECTRIC POWER INSTALLATIONS.
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
Power O and M Bulletin No. 25, March 1983. 17 p, 6 Fig, 5 Ref, 1 Append.

Descriptors: *Corrosion, *Corrosion control, *Metals, *Anodes, *Cathodes, *Coatings, *Protection, *Electric powerplants, Metallurgy, Pipes, Gates, Electrodes, Insulation, Soil water, Electrolytes, Design criteria, Water tanks.

The protection of metallic structures against corrosion damage is considered beneficial from an operating standpoint as well as from the financial aspect for replacement of structural components and labor. The principles of galvanic and stray current corrosion are described. Water or soil water often provides the electrolyte required to complete the cell circuit between metallic anodes and cathodes. Protective coating and cathodic protection complement each other and afford the best protection against corrosion. Cathodic production uses an impressed or galvanic current to reduce or prevent corrosion of a metal in an electrolyte by making the metal to be protected the cathode of a corrosion cell. Sacrificial anodes, metallically connected to a corroding structure and suitably immersed in the electrolyte (water or moist soil), create a simple galvanic cell in which the structure is the cathode or protected surface. In this system detrimental corrosion is replaced by localized and controlled corrosion of an expendable and replaceable anode. Proper designing, spacing and installation of a sacrificial anode system are discussed. Impressed current (rectifier) systems are similar to sacrificial anode systems but rely on an artificial or introduced source of current. Insulated joints utilize isolation and sectionalization of metals to prevent a galvanic cell from being formed. Scenarios of several typical field corrosion problems and possible solutions are listed. Design data questionnaires for corrosivity determination of soils, waters or cathodic protection design are given.
W85-05598

8H. Rapid Excavation

EFFECT OF SHOCK WAVES DURING UNDERWATER BOREHOLE BLASTING,
R. A. Gil'manov.
Hydrotechnical Construction, Vol. 18, No. 5, p 221-225, May, 1984. 6 Fig, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 22-25, May, 1984.

Descriptors: *Blasting, *Shock waves, *Boreholes, *Underwater, Seismic properties, Construction, Pressure waves, Explosives.

The presently used method of estimating safe distances is based on investigations of the propagation of pressure waves from an explosion of exposed charges and does not take into account the characteristics of the formation and propagation of pressure waves from buried, mainly borehole, charges. As a result of an analysis it was determined that during underwater borehole blasting, initiated in the general case from the surface by a detonating fuse, the total water shock wave is formed by the detonation products of the explosive penetrating into the water (Sh wave), the seismic wave retracted in the water (Se wave), and the wave from the explosion of the DF. The seismic component of the water shock wave (WShW) on the oscillograms corresponds to the first arrivals, since the velocity of seismic body waves in rocks is higher than the propagation velocity of a shock wave in water. On the basis of calculating the energy of seismic waves of normal fragmentation explosions and their refraction at the rock water interface, relationships

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ere obtained for the seismic component of the
/ShW. (Baker-IVI)
/85-05025

I. Fisheries Engineering

ROUT FARMING IN WASHINGTON,
Vashington State Univ., Pullman. Coll. of Agri-
ulture.
. C. Harbell, and R. Carkner.
Cooperative Extension Bulletin No. EB756, March
981, 18 p. 16 Fig, 8 Tab, 9 Ref.

Descriptors: *Trout, *Fish farming, *Pond stock-
ng, Fish stocking, Ponds, Washington, Estimated
osts, Legal aspects, Leaky aquifers, Literature
eview, Economic aspects, Irrigation.

The basic principles that must be followed in the
esign, construction, and operation of trout farms
n ponds are described. The site must have suffi-
ient area and water supply. The water should be
etween 50 and 65 F, have a dissolved oxygen
ontent of at least 6 parts per million and above, be
ree of silt and pollutants, and be within pH 6.5 to 9 range. Various soil conditions and climates are discussed. Species selection and natural vs artificial feeding are also considered. Parasite, disease, and weed control can be maximized by proper design, construction, and operation of the pond. Finally, legal and economic aspects of the trout production are discussed.
W85-05337

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

RUSSIAN-ENGLISH/ENGLISH-RUSSIAN GLOSSARY: PLASTICS IN HYDROTECHNICAL CONSTRUCTION.
Bureau of Reclamation, Washington, DC.
Bureau of Reclamation, Washington, DC. 1984. 143 p.

Descriptors: *Plastics, *Construction, *Hydrotechnical, Glossary, Dictionary.

This glossary evolved from a joint US/USSR study on the use of Plastics in Hydrotechnical Construction of water resource development projects. The joint study was made possible by the US/USSR Agreement on Cooperation in the Fields of Science and Technology, first signed in 1972. Originally, glossaries were prepared in three parts: 1) Plastic Films and Soil Stabilizers, 2) Plastic Piping Systems for Irrigation and Drainage, and 3) Polymer Concrete. More than 700 terms presented here are associated with the engineering specialty of Plastics in Hydrotechnical Construction.
W85-05577

10E. Translations

RUSSIAN-ENGLISH/ENGLISH-RUSSIAN GLOSSARY: PLASTICS IN HYDROTECHNICAL CONSTRUCTION.
Bureau of Reclamation, Washington, DC.
For primary bibliographic entry see Field 10D.
W85-05577

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SELECTED WATER RESOURCES ABSTRACTS

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 18, NUMBER 11
NOVEMBER 1985

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

FRACTAL GROWTH OF VISCOUS FINGERS: QUANTITATIVE CHARACTERIZATION OF A FLUID INSTABILITY PHENOMENON,
Dowell Schlumberger Research and Development, Saint-Etienne (France).
For primary bibliographic entry see Field 1B.
W85-05854

1B. Aqueous Solutions and Suspensions

FRACTAL GROWTH OF VISCOUS FINGERS: QUANTITATIVE CHARACTERIZATION OF A FLUID INSTABILITY PHENOMENON,
Dowell Schlumberger Research and Development, Saint-Etienne (France).
J. Nittmann, G. Daccord, and H. E. Stanley.
Nature, Vol. 314, No. 6007, p 141-144, March 14-20, 1985. 7 Fig, 26 Ref.

Descriptors: *Water properties, *Fluid instability, *Viscosity, *Fractal geometry, Physical properties, Hele-Shaw cells.

When a low viscosity fluid like water is used to push a high viscosity fluid like oil, there arises a fluid instability phenomenon termed the 'viscous fingering instability' in which the low viscosity fluid forms characteristic fingers extending well into the high viscosity fluid. Water, dyed with methylene blue, was used to push a more viscous but miscible, non-newtonian fluid in a Hele-Shaw cell which is a pair of transparent plates separated by 0.5 mm. The viscous fluid used was an aqueous polymer solution of high relative molecular mass polysaccharide for which the mixing time is very slow compared with the time of the experiment. The resulting viscous finger instability was found to be a fractal growth phenomenon. Reproducible values of the fractal dimension d sub f were found and were interpreted using a modification of the diffusion limited aggregation model. The physical basis of the viscous fingering instability is analagous to that of other second-order phase transitions that obey the same sort of scale invariant symmetry found here for viscous fingers. (Collier-IVI)
W85-05854

2. WATER CYCLE

2A. General

INFLUENCES OF PRECIPITATION CHANGES AND DIRECT CO2 EFFECTS ON STREAMFLOW,
University of East Anglia, Norwich (England). Climatic Research Unit.
T. M. L. Wigley, and P. D. Jones.
Nature, Vol. 314, No. 6007, p 149-152, March, 1985. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Carbon dioxide, *Hydrologic cycle, *Precipitation, *Climatology, *Streamflow, Plant physiology, Evapotranspiration, Atmosphere.

Increasing atmospheric carbon dioxide concentrations are expected to cause major changes in the world's climate over the next 50-100 yr. The impact of such changes on water resources, through changing precipitation and evaporation, will, however, be complicated by the direct effects of increasing CO2 on vegetation. In controlled environment experiments, higher CO2 levels cause the stomata of plants to close down, decreasing their rate of transpiration and increasing their water use efficiency. Reduced evapotranspiration would make more water available as runoff and could tend to offset the effects of any CO2-induced reductions in precipitation or enhance the effects of precipitation increases. The relative sensitivity of runoff to changes in precipitation and changes in evapotranspiration was analyzed. For low runoff ratios, small changes in precipitation may cause large changes in runoff. The magnitude and direction of these changes is, however, strongly dependent on the magnitude of the direct CO2 effect on plant evapotranspiration. (Author's abstract)
W85-05855

CONCEPTUAL MODEL OF UNIT-MASS RESPONSE FUNCTION FOR NONPOINT SOURCE POLLUTANT RUNOFF,
Padua Univ. (Italy). Faculty of Engineering.
For primary bibliographic entry see Field 5B.
W85-05872

PREDICTING THE MEAN ANNUAL FLOOD FROM BASIN CHARACTERISTICS IN SCOTLAND,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W85-05902

REGIONAL FLOOD FREQUENCY ESTIMATION USING THE TWO-COMPONENT EXTREME VALUE DISTRIBUTION,
Universita di Reggio Calabria, Cosenza (Italy). Dipt. di Difesa del Suolo.
M. Fiorentino, P. Versace, and F. Rossi.
Hydrological Sciences Journal, Vol. 30, No. 1, p 51-64, March, 1985. 8 Fig, 9 Ref.

Descriptors: *Regional flood frequency, *Flood frequency, *Statistical analysis, *Model studies, Regional floods, Hydrologic models, Regionalization.

The two-component extreme value (TCEV) distributions, suggested for modelling Italian annual flood series (AFS), was shown to account both for the presence of flow outliers and for the high variability of the skewness of historical AFSs. Using such a model, the T-year flood was found to vary with log(T) much more rapidly for large values of T than is the case for small values of T. The presence of four parameters in the TCEV distribution introduces great uncertainty in estimating the T-year flood when the parameters are estimated from a single series. Regional analysis, which exploits basin similarities, is then needed, not only at ungauged sites but also at gauged ones. Combined regionalization techniques, by which all flood data over a region produce a single regional flood distribution, are described and their application to Italian data is shown. (Author's abstract)
W85-05903

HYDROLOGICAL REGIONALIZATION OF SWEDEN,
Oslo Univ. (Norway). Inst. of Geophysics.
L. Gottschalk.
Hydrological Sciences Journal, Vol. 30, No. 1, p 65-83, March, 1985. 6 Fig, 5 Tab, 28 Ref.

Descriptors: *Regionalization, *Sweden, *Hydrologic models, Statistical analysis, Principle component analysis, Runoff, Physiographic provinces.

Hydrological regionalization is an important tool for the analysis of the spatial pattern of variations in hydrological phenomena. Regionalization means areal classification, i.e. the ability to attach to some location a label or number which is hydrologically meaningful. With the use of statistical methods, hydrological regions are analogous to areal classes. Pairwise grouping as well as principal components were applied to Swedish river runoff data in order to analyze the patterns of variation and to delimit regions where hydrological behavior may be regarded as uniform. Pairwise grouping is the appropriate method to use on a national scale with heterogeneous hydrological regimes. Principal components (empirical orthogonal functions) demand homogeneity but within such regions describe very well the trends and variations. (Author's abstract)
W85-05904

HYDROLOGIC BEHAVIOUR OF A SMALL FORESTED CATCHMENT,
Melbourne Univ., Parkville (Australia). Forestry Section.
L. J. Bren, and A. K. Turner.
Journal of Hydrology, Vol. 76, No. 3/4, p 333-350, February, 1985. 15 Fig, 1 Tab, 12 Ref.

Descriptors: *Hydrologic models, *Catchments, *Forest hydrology, *Australia, Groundwater, Flow, Boussinesq equation, Mathematical equation, Streamflow, Springs, Storm seepage, Groundwater movement.

The variations in discharge along a reach of stream emanating from a spring at the head of a small steep forested catchment in southeastern Australia were measured over a 4 yr period. The outflow of the springhead catchment was considerably less variable than the outflow of the catchment flanks along the length of the stream. Following substantial periods of rainfall the peak discharges from the springhead were reached some days after the cessation of rain, while the peak discharges from the flank catchment were reached during or immediately after the period of rainfall. Diurnal variations in summer streamflows were not observed at the springhead, but were observed with an increasing amplitude as distance downstream from the springhead increased. Field studies and mathematical analysis indicated that neither overland flow nor channel interception of rainfall were important in generating the streamflow response to any but very small storms, and that groundwater movement within a phreatic aquifer was the dominant process at all times. The hydraulic gradient of the groundwater was considerably steeper than generally attributed to such systems. To aid in interpretation, numerical solutions of the Boussinesq equation were used cast in a coordinate system approximating that of the component catchments. These showed that the observations are explainable as the effect of catchment shape on groundwater outflow. A noted perturbation in recession hydrographs may be attributable to the presence of a symmetry boundary associated with the ridge. (Baker-IVI)
W85-06052

RESOLVING THIESSEN POLYGONS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. E. Croley, II, and H. C. Hartmann.
Journal of Hydrology, Vol. 76, No. 3/4, p 363-379, February, 1985. 5 Fig, 18 Ref.

Descriptors: *Lake Superior, *Forecasting, *Thiessen polygons, *Computers, Data processing, Flows, Meteorological data, Water level, Runoff.

An automatic computer forecast package for Lake Superior, North America has been developed that uses near real-time meteorological data to produce operational outlooks of basin runoff for improving lake level regulations. The data collection network changes frequently as stations are added or dropped or fail to report from time to time. Therefore, forecasts depend on semi-automatic updating of meteorological data, requiring efficient computations of Thiessen weights. Various methods of computing Thiessen weights either have large computational overheads or provide unacceptable approximations. A polygon-edge-definition algorithm is described which rapidly determines Thiessen weights by using a digital map. Since relatively few of the points in the digital map are actually looked at to determine polygon boundaries, the procedure is much faster than exhaustive search methods that compute the closest station for every point in the map. It is also more accurate than sampling methods that only approximate Theissen weights by computing the closest station for a limited number of sampled points. It also allows the use of efficient bit maps for single-basin applications. The edge-definition procedure is especially advantageous for high-resolution maps of watershed areas, even with extremely high density data observation networks. The method has far reaching applications including areal averages of meteorologic variables, lake-level estimation, groundwater level estimation, near real time accounting of network changes, computer map generation and

realtime graphics, and even industrial engineering applications in computer aided description of convex shapes. (Baker-IVI)
W85-06054

ASSESSMENT OF NON-STATIONARITY IN ANNUAL SERIES THROUGH EVOLUTIONARY SPECTRA,
Birmingham Univ. (England). Dept. of Civil Engineering.
N. T. Kottegoda.
Journal of Hydrology, Vol. 76, No. 3/4, p 381-402, February, 1985. 9 Fig, 1 Tab, 25 Ref.

Descriptors: *Non-stationarity, *Time series analysis, *Evaluation, *Streamflow forecasting, Hydrologic models, Auto-regressive moving average, Simulation, Stream flow, Precipitation.

Different forms of non-stationary behavior may be evident in the analysis of natural time series. Non-stationary series can be viewed as ones that are being disturbed by transient effects of one or more kinds with different causative factors. An index method of evaluating non-stationary behavior is proposed. Auto-regressive moving average (ARMA) models are initially fitted to annual hydrologic time series. Evolutionary spectra are estimated from overlapping sub-samples formed from a sequence of observations. Chi-squared variables are obtained over a high frequency band of the spectrum and standardized by means of the theoretical median value of chi-squared to form a K index. Empirical distribution for K are calculated from stationary series simulated using the same model structures and sequence lengths as in the historical sets. The time series of K formed from overlapping sections, in relation to its median value and extreme percentiles provides a measure of non-stationarity. Eleven annual flow, precipitation and a tree ring series from nothern Utah and the Nile flows at Aswan dam, Egypt, are investigated. The proposed method should help in estimating the time horizons over which stationarity is a reasonable assumption and the resilience which needs to be provided in planning future schemes. (Baker-IVI)
W85-06055

2B. Precipitation

INFLUENCES OF PRECIPITATION CHANGES AND DIRECT CO2 EFFECTS ON STREAMFLOW,
University of East Anglia, Norwich (England). Climatic Research Unit.
For primary bibliographic entry see Field 2A.
W85-05855

APPORTIONMENT OF RAINFALL IN CENTRAL HIMALAYAN FORESTS (INDIA),
Banaras Hindu Univ., Varanasi (India). Dept. of Botany.
P. C. Pathak, A. N. Pandey, and J. S. Singh.
Journal of Hydrology, Vol. 76, No. 3/4, p 319-332, February, 1985. 3 Fig, 4 Tab, 34 Ref.

Descriptors: *Rainfall, *Forest watersheds, *Interception, *Kumaun Himalaya, *India, Runoff, Infiltration, Overland flow, Stemflow, Throughfall, Canopy, Monsoons, Base flow.

The apportionment of rainfall into throughfall, stemflow and interception in certain forests of Kumaun Himalaya was assessed during the 1981 and 1982 monsoon seasons. The percentage of incident rainfall reaching the forest floor through the canopy ranged between 72% and 83%. The interspecies differences were significant. A larger shower size accompanied by higher intensity resulted in greater stand throughfall. Stand throughfall as percent of incident rainfall plateaued and became almost constant for larger rainshowers. A lower intensity during a larger shower reduced the throughfall in proportion to rainfall quantity. Observation also indicated that a greater quantity of throughfall arrived on the floor during a rainfall of moderate size and intensity, provided the canopy was saturated by the preceding rainfall event. The proportion of gross rainfall reaching the ground as stand throughfall was maximum (91.5%) on the pine mixed broadleaf forest site and least on the pine forest site (74.7%). No stemflow occurred when the shower size was less than 2.2 mm. Stand stemflow accounted for only a small percent of gross rainfall. Comparison of regression slopes in the given equations indicates that the pine-mixed broadleaf forest is different from all other forests. Canopy interception varied among species from 14.3% to 28% of gross rainfall. Rain water falling on the litter gradually increases the litter moisture level to field capacity and then to saturation. The litter layer in the present forests intercepted a greater percent of gross rainfall when the shower size was small. The litter layer did not intercept as much rainfall as did the canopy. Interception of rainfall by litter was greater in broadleaf forests compared to pine and pine-dominated forests. Overland flow did not normally occur if the shower size was less than 10 mm. Low surface runoff values in this study suggest that the slopes are highly infiltrating and water transmission is more baseflow dominated. (Baker-IVI)
W85-06051

ANNUAL AND MONTHLY PRECIPITATION GENERATION IN IDAHO,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. L. Hanson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1792-1797 and 1804, November-December, 1984. 3 Fig, 8 Tab, 9 Ref.

Descriptors: *Precipitation, *Idaho, *Statistical analysis, Monthly distribution, Annual distribution, Rainfall distribution.

Procedures were developed which can be used to generate synthetic annual and monthly precipitation series for locations in Idaho. Analyses of records from Idaho stations and stations adjoining Idaho indicate that the normal distribution is more representative of the annual series for locations in the intermountain region of the Pacific Northwest than the log-normal distribution that has been suggested for other areas of the United States. The normal distribution was used to generate annual series and the cube-root-normal distribution is used to generate monthly series. The monthly procedure includes a method for generating zero monthly amounts in the series. The uniform distribution was used to determine if a value in the series being generated is zero. As with the annual generating procedure, only the mean monthly amount is necessary because linear relationships are given to calculate the standard deviation from the mean precipitation amount. Mean and standard deviation of the cube-root transformed series were calculated so that the normal distribution can be used to generate synthetic monthly series. (Collier-IVI)
W85-06089

2D. Evaporation and Transpiration

MODIFICATION OF IRRIGATION REQUIREMENT OF WHEAT THROUGH MULCHING AND FOLIAR APPLICATION OF TRANSPIRATION SUPPRESSANTS,
Indian Agricultural Research Inst., New Delhi. Div. of Agronomy.
For primary bibliographic entry see Field 3F.
W85-05923

COMPARISON OF METHODS USED TO ESTIMATE EVAPOTRANSPIRATION FOR LEACHING CONTROL,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 7B.
W85-05926

DIURNAL CHANGES IN THE WATER RELATIONS AND TRANSPIRATION OF A SOYBEAN CROP SIMULATED DURING THE DEVELOPMENT OF WATER DEFICITS,
Gdansk Technical Univ. (Poland). Inst. of Hyrdotechnics.
For primary bibliographic entry see Field 2I.
W85-05932

QUANTITATIVE APPROACH TO THE PRUITT AND DOORENBOS VERSION OF THE PENMAN EQUATION,
Nebraska Univ. Panhandle State at Scottsbluff. A. Weiss.
Irrigation Science, Vol. 4, No. 4, p 267-275, December, 1983. 3 Fig, 1 Tab, 32 Ref. OWRT project A-064-NEB.

Descriptors: *Penman Equation, *Evapotranspiration, *Alfalfa, Wind, Humidity, Reference crop evapotranspiration, Mathematical equations.

Since its development, the Penman equation has been widely used to calculate reference crop evapotranspiration. The Pruitt and Doorenbos version of the Penman equation is calculated mainly from tables and is based on measurements made over a grass surface. The tabular procedures are quantified, and the approach is extended to measurements made over alfalfa. The latter was achieved by using a wind function that takes into account the height of the alfalfa and the use of mean rather than maximum relative humidity to calculate the correction factor used to take into account day and night weather conditions on calculated reference crop evapotranspiration. Calculated values of evapotranspiration overestimated measured values from alfalfa by 13%. A much better agreement was obtained between these general procedures and a Penman equation with a locally derived wind function from data collected with an automated weather station. The procudures can be extended to the calculation of daily reference crop evapotranspiration values rather than 10 or 30 day mean values. (Moore-IVI)
W85-05936

EVAPOTRANSPIRATION AND WATER USE EFFICIENCY OF TARO,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih, and G. H. Snyder.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1745-1748, November-December, 1984. 2 Fig, 1 Tab, 8 Ref. South Florida Water Management District grant 4-FCD-22.

Descriptors: *Evapotranspiration, *Water use efficiency, *Taro, *Crop production, *Everglades Agricultural Area, *Florida, Wetlands, Biomass, Subsidence.

Production of taro in the Everglades Agricultural Area would help in reducing organic soil subsidence because this crop can be kept flooded like rice. Objectives of this study were to study the ET requirement and water use efficiency for taro production and to establish relationships between ET and taro yield. Evapotranspiration (ET) and water use efficiency were determined from lysimeters installed within a taro field. The ET from taro varied from 2.0 to 6.5 mm/day. About 3000 to 4300 kg of water was required to produce 1 kg of dry biomass (DB), and the water required to produce 1 kg of tuber yield (TY) ranged from 1400 to 1900 kg. The relationship between DB and ET was found to be DB = -27.7 + 25.8(0.001)ET (r squared = 0.95) and the TY was related to ET as TY = -60.5 + 56.3(0.001)ET (r squared = 0.92) where the units of yields and ET are t/ha and mm respectively. Dry biomass is not only highly correlated to the ET but is also a better predictor for estimating the ET required for taro production than the tuber yield. (Collier-IVI)
W85-06081

2E. Streamflow and Runoff

BIFURCATIONS OF FINNISH WATERCOURSES (SUOMEN VESISTOJEN BIFURKAATIOT),
National Board of Waters, Helsinki (Finland). Hy

drological Office.
E. Kuusisto.
Terra, Vol. 96, No. 4, p 253-261, 1984. 8 Fig, 7 Ref.

Descriptors: *Streambeds, *Channels, *Bifurcation, *Finland, Basins, Lakes, Channel morphology.

About 40 lake and 25 river bifurcations in Finland are described in this article. According to their location, the bifurcations can be classified to external and internal bifurcations. An external bifurcation is located on the divide, either between two river basins or between two subbasins. An internal bifurcation occurs within a river basin or subbasin. The branches of an internal bifurcation have a junction downstream; if at least one branch has a tributary before the junction, the bifurcation is an ordinary internal bifurcation. If the discharge in both branches remains unchanged, the branching is called pseudobifurcation. Some of the bifurcations are temporary; 14 lakes and 16 river bifurcations can be considered perennial. Some of lake bifurcations and about half of river bifurcations are manmade. A few important bifurcations are described in some detail. Three major lakes are bifurcating perennially to different river basins: Lake Muojarvi (area 56 sq km) in Kuusamo and Lakes Lummene and Vesijako in Hame. The most important river bifurcation is located in Junosuando, where part of the waters of River Tornionjoki flow into River Kalixalven. (Author's abstract)
W85-05856

FACTORS AFFECTING CHOICE OF DISTRIBUTION FOR FLOOD SERIES,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
C. Cunnane.
Hydrological Sciences Journal, Vol. 30, No. 1, p 25-36, March, 1985. 3 Fig, 42 Ref.

Descriptors: *Flood series, *Annual floods, *Distribution analysis, Flood peak, Data interpretation, Hydrology, Statistical analysis.

In flood frequency analysis a basic assumption is that a series of flood peaks is a random sample from a stationary population; however, one can never be completely sure that this assumption is true. Rival candidate distributions for modelling flood series may give markedly different magnitude-return period (Q-T) relationships, particularly at high T. A priori theoretical arguments for choice of distribution do not provide a satisfactory answer and the arguments that have been put forward are of doubtful validity. Distribution choice cannot be made on theoretical arguments alone. Observed annual maximum (AM) data display positive skewness and large kurtosis and the skewness is more variable between AM samples than between similar sized random samples from all but one previously used flood distribution. Inference must be based on many sets of flow data simultaneously. Traditional goodness of fit tests are insensitive to distribution tail behavior, which is of most importance hydrologically. Dimensionless sample moments are biased downwards and use of moment-ratio diagrams, without allowance for moment bias, must lead to erroneous inference. The necessity for log and other data transformations in flood frequency analysis is questioned as is the arbitrary use of mixtures of distributions without physical justification. (Collier-IVI)
W85-05901

PREDICTING THE MEAN ANNUAL FLOOD FROM BASIN CHARACTERISTICS IN SCOTLAND,
Institute of Hydrology, Wallingford (England).
M. C. Acreman.
Hydrological Sciences Journal, Vol. 30, No. 1, p 37-49, March, 1985. 2 Fig, 1 Tab, 28 Ref.

Descriptors: *Scotland, *Annual floods, *Basins, *Hydrologic models, *Prediction, Model studies, Rainfall, Soil type, Lakes, Statistical analysis.

Flood data were assembled for 168 Scottish basins containing 3071 station-years of record. Multiple regression techniques were used to produce equations for predicting mean annual flood from physiographic and climatological basin characteristics. Mean annual rainfall (SAAR) gave better results than measures of extreme rainfall (M52D and RSMD). Percentage area of lake storage (LOCH) was found to be a better predictor than fraction of the basin draining through a lake (LAKE). Apart from SAAR and LOCH, the recommended equation requires the basin area (AREA), stream frequency (STMFRQ) and an index of the soil type (SOIL). Measures of average basin slope (AVES) and main stream slope (S1085) were not statistically significant. The standard error of the estimate of the predicted mean annual flood is 0.147. The equation has a coefficient of determination, R-squared, of 0.914 and appears robust over a wide range of basin types without requiring regionally derived multipliers or coefficients. No significant improvement in fit was achieved by ridge regression, Stein estimation or use of the influence function. (Author's abstract)
W85-05902

REGIONAL FLOOD FREQUENCY ESTIMATION USING THE TWO-COMPONENT EXTREME VALUE DISTRIBUTION,
Universita di Reggio Calabria, Cosenza (Italy). Dipt. di Difesa del Suolo.
For primary bibliographic entry see Field 2A.
W85-05903

APPRAISAL OF THE REGIONAL FLOOD FREQUENCY PROCEDURE IN THE UK FLOOD STUDIES REPORT,
Institute of Hydrology, Wallingford (England).
J. R. M. Hosking, J. R. Wallis, and E. F. Wood.
Hydrological Sciences Journal, Vol. 30. No. 1, p 85-109, March, 1985. 11 Fig, 6 Tab, 17 Ref, 1 Append.

Descriptors: *Flood frequency, *Algorithms, *United Kingdom, Computers, Simulation, Monte Carlo method, Estimation.

Upper quantile estimates that appear unrealistic (compared with engineering judgement) may result from use of the Natural Environment Research Council (London) 1975 Flood Studies Report (FSR) algorithm for estimating the regional flood frequency hazard. An automated computer based version of the FSR algorithm was developed and modified so as to be useable as a subroutine in a computer-based Monte Carlo study. Tests with the FSR algorithm were made for observed flood sequences and synthetic data in a Monte Carlo simulation study. Similar tests were conducted with many other regional and at-site flood frequency estimation procedures including a regional generalized extreme value distribution (GEV) procedure and a regional Wakeby distribution (WAK) procedure, both of which used biased probability weighted moments (PWM) in their formulation. For the Monte Carlo simulations, for which the true quantiles to be estimated were known, the FSR algorithm yielded quantile estimates that were always more variable, often by a factor of as much as 4 or 5, than those obtained by either the GEV/PWM or WAK/PWM algorithms. The FSR algorithm yielded quantile estimates that were nearly always more biased than those obtainable by either the GEV/PWM or the WAK/PWM procedures. The use of the FSR algorithm with small data bases, short records, or in regions of high coefficient of variation, or in the presence of outliers in the flood sequences, leads to results that are relatively unreliable when compared with those obtainable by other methods. Analysis of a larger data base than originally used for the preparation of the FSR using the GEV/PWM algorithm may well lead to more accurate and more consistent estimation of the extremal flood hazard for the United Kingdom. (Moore-IVI)
W85-05905

PROBABILITY DISTRIBUTIONS OF ANNUAL MAXIMA OF SEASONAL HYDROLOGICAL VARIABLES,
Bologna Univ. (Italy). Ist. di Costruzioni Idrauliche.
P. Lamberti, and S. Pilati.
Hydrological Sciences Journal, Vol. 30, No. 1, p 111-135, March, 1985. 15 Fig, 6 Tab, 10 Ref. Italian Council of National Research contract 821881.

Descriptors: *Seasonal variation, *Flood discharge, *Probability distribution, *Italy, Flow discharge, Statistical studies, River flow, River forecasting, Flood forecasting.

The influence of 'seasonality' on the distribution of maxima of a hydrological variable was studied theoretically and using data on actual flood discharges. The flood discharges of three rivers in the Po basin of Italy, with different 'seasonalities', were analyzed. Three different types of monthly maxima cumulative distribution function (CDF) were selected: Gumbel, GEV, and an exponential type. The shape of the distribution function of annual extremes is not related to that of the seasonal components which determine it. In particular it is not stable (extreme values asymptotic distribution) even if the components are stable. The analysis of seasonal maxima does not seem to be useful for increasing the reliability of estimates of rare events. The observations available in addition to the the annual maxima, are, by their nature, found mostly in the range of small discharges. These additional observations produce more noise than information and often cause notable errors even in the range of the largest discharges observed. When the maxima of a single season are of concern, it is advisable to also use data pertaining to the other season in which discharges close to those of interest have been observed. (Moore-IVI)
W85-05906

LINEAR APPROACH TO THE INFLUENCE OF DISCHARGE MEASUREMENT ERROR ON FLOOD ESTIMATES,
Genoa Univ. (Italy). Inst. of Hydraulics.
R. Rosso.
Hydrological Sciences Journal, Vol. 30, No. 1, p 137-149, March, 1985. 7 Fig, 3 Tab, 15 Ref.

Descriptors: *Error analysis, *Flow discharge, *Flood flow, Statistical analysis, Prediction, Estimation, Probability distribution, Flood peak.

The presence of consistent error in an observed series of discharge measurements of flood flows may seriously affect statistical analysis, introducing additional bias and uncertainties in flood predictions estimated from such data. A linear approach to the influence of random measurement errors on flood estimates is presented in the form of a simple conditional probability model independent of the parent probability distribution of floods. Flood predictions provided by quantiles are positively biased when performed from a sample of discharge observations affected by measurement errors. Though for design purposes such an effect is conservative, this bias cannot be neglected if the peak discharges are determined from stage measurements by means of the extrapolated tail of the rating curve for the gauging station concerned. Monte Carlo experiments, carried out to analyze small sample effects, have shown that the use of the method of maximum likelihood is able to reduce the bias due to measurement errors in discharge data. (Moore-IVI)
W85-05907

GROUPING BASINS FOR REGIONAL FLOOD FREQUENCY ANALYSIS,
Institute of Hydrology, Wallingford (England).
S. E. Wiltshire.
Hydrological Sciences Journal, Vol. 30, No. 1, p 151-159, March, 1985. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Flood frequency analysis, *Basins, *Regional flood estimation, Estimation, Flood frequency, Rainfall, Soil properties, Catchment basins.

At sites where flood data are limited or absent, engineers may apply a regional flood estimation procedure. The definition of regions may cause difficulties in regional flood estimation; geographical proximity is no guarantee of homogeneity since

neighboring basins can be physically very different. A new method of grouping basins prior to regional flood frequency analysis is presented which is based on measured basin characteristics rather than on geographical regions. The method partitions a set of basins into two groups on the basis of a single partitioning value of one chosen basin characteristic. Average frequency curves are fitted to pooled flood data for each group, and measures of the variability of the data in each group about the fitted group curve are evaluated. The sequence of forming two groups, fitting two frequency curves, and evaluating test statistics is repeated using a range of partition points. The optimum grouping is achieved at the basin characteristic value where the statistics of departure reach a minimum. This process may be repeated for other characteristics for multiple partitions, or indeed for combinations of characteristics. Three groups formed on the basis of soil type and annual rainfall were found to be comparable in efficiency to 10 regions formed on the basis of geographical proximity. (Moore-IVI)
W85-05908

NOMOGRAM FOR VELOCITIES OF PARTIAL FLOWS IN SEWERS,
College of Military Engineering, Poona (India). Dept. of Civil Engineering.
B. R. N. Gupta.
Journal of Environmental Engineering, Vol. 111, No. 2, p 225-230, April, 1985. 1 Fig, 3 Tab.

Descriptors: *Partial flow, *Velocity, *Nomograms, *Sewers, Flow discharge, Slope, Pipelines, Design criteria.

A nomogram is presented to read the velocities of partial flows in sewers quickly, eliminating all the steps and thus saving design time and effort. The new approach presented here is to determine the velocity in sewers for partial flows when the slope and discharge are known. The data on diameter of pipe is somewhat redundant since, in the case of partial flows, the diameter has only limited influence on the velocity for a particular flow and slope of pipe. This assumption is reasonable for design of sewers and the accuracy of results obtained using the above assumption is considered adequate for routine design purposes. A nomogram is developed based on the preceding hydraulic phenomena. The nomogram is based on Mannings equation for flow in sewers. The nomogram can thus save time and labor in solving problems relating to partial flows if depths of flow in sewerage designs do not exceed 0.75 of diameter nor diminish below 0.25 of diameter, which is true in general. Within this range, the assumption holds reasonably well and the chart can be relied upon to give results of fairly reasonable and acceptable accuracies. (Baker-IVI)
W85-06022

EXTENDED STREAMFLOW FORECASTING USING NWSRFS,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
G. N. Day.
Journal of Water Resources Planning and Management, Vol. 111, No. 2, p 157-170, April, 1985. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Streamflow forecasting, *NWSRFS, *Extended forecasting, Forecasting, Snowmelt, Soil water, Rivers, Reservoirs, Simulation, Hydraulic models, Hydrologic models, Flood forecasting, Probability.

Extended forecasting using the National Weather Service River Forecast System (NWSRFS) is done with the NWS Extended Streamflow Prediction (ESP) program. This paper examines the theory, capabilities, and potential applications of the ESP procedure. ESP uses conceptual hydrologic/hydraulic models to forecast future streamflow using the current snow, soil moisture, river, and reservoir conditions with historical meteorological data. The ESP procedure assumes that meteorological events that occurred in the past are representative of events that may occur in the future. Each year of historical meteorological data is assumed to be a possible representation of the future and is used to simulate a streamflow trace. The simulated streamflow traces can be scanned for maximum flow, minimum flow, volume of flow, reservoir stage, etc., for any period in the future. ESP produces a probabilistic forecast for each streamflow variable and period of interest. The procedure was originally developed for water supply forecasting in snowmelt areas, but it can also be used to produce spring flood outlooks, forecasts for navigation, inflow hydrographs for reservoir operation, and time series needed for risk analysis during droughts. (Author's abstract)
W85-06029

STAGE-FREQUENCY ANALYSIS AT A MAJOR RIVER JUNCTION,
Army Engineer District, St. Louis, MO.
G. R. Dyhouse.
Journal of Hydraulic Engineering, Vol. 111, No. 4, p 565-583, April, 1985. 11 Fig, 1 Tab, 7 Ref, 1 Append.

Descriptors: *Stage-frequency analysis, *River junctions, *Illinois River, *Illinois, *Levees, Water surface profiles, Backwater, Flow discharge, Confluent streams, Construction costs, Coincident frequency analysis.

A coincident frequency analysis using the total probability theorem was performed for an 80-mile (129-km) reach of the Illinois River to evaluate existing stage-frequency relationships and revisions caused by a proposed higher levee system. Frequency and duration relationships were derived to establish the upstream and downstream boundaries. A water surface profile model was applied to calculate stage at 210 points in the reach for given starting backwater and discharge conditions. The analytical process was calibrated to stage data in the reach through iterative adjustments in the boundary duration curves. Comparisons of the adopted results to previous analyses using simplified techniques showed a significant reduction in levee design profile and potential cost savings of $1,600,000 in levee construction. (Author's abstract)
W85-06035

KINEMATIC SHOCK: SENSITIVITY ANALYSIS,
San Diego State Univ., CA.
V. M. Ponce, and D. Windingland.
Journal of Hydraulic Engineering, Vol. 111, No. 4, p 600-611, April, 1985. 2 Fig, 4 Tab, 12 Ref, 1 Append.

Descriptors: *Kinematic waves, *Sensitivity analysis, *Kinematic shock, Channel morphology, Computer models, Model studies, Froude number, Waves, Hydrographs, Flow, Mathematical models.

Numerical experiments were performed to determine the flow and channel characteristics that are most conducive to kinematic wave steepening and associated kinematic shock phenomena. Relevant flow and channel characteristics were identified at the outset, and a program of 80 computer runs was completed, varying the inflow hydrograph peak Froude number, time-to-peak, and base-to-peak flow ratio, and the channel cross-sectional shape. Standardized channel lengths were calculated to enable the analysis of shocks at comparable stages of development. Gamma hydrograph inflows are routed from upstream to downstream using a physically based flow routing computer model. The inflow hydrograph peak Froude number, time-to-peak, and base-to-peak flow ratio, and the cross-sectional shape parameter all have a definite effect on kinematic shock development. The size of the wave may be most closely related to the occurrence or nonoccurrence of the shock. Kinematic shock will be most likely to occur under the following conditions: a kinematic wave; a low base-to-peak flow ratio; a high Froude number flow; and a wide and sufficiently long channel. (Moore-IVI)
W85-06037

ESTIMATING MEAN VELOCITY IN MOUNTAIN RIVERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
C. R. Thorne, and L. W. Zevenbergen.
Journal of Hydraulic Engineering, Vol. 111, No. 4, p 612-624, April, 1985. 4 Fig, 3 Tab, 16 Ref, 1 Append.

Descriptors: *Mountain rivers, *Velocity, *Estimation, Boulders, Bed roughness, Slope, Water depth, Mathematical equations, Flow discharge, Flow resistance.

It is often necessary to estimate the mean velocity is ungaged mountain rivers, but the flow resistance equations available for this purpose require further testing and development. Such rivers are characterized by coarse bed materials, steep slopes, and low depths. For these conditions, boulders protrude well into or completely through the flow, and bed roughness is said to be large-scale. Recently, three equations specifically intended for large-scale roughness have been developed to address this problem. Data from a mountain river were used to test the equations. All were prone to errors of the order of 30%. The errors were systematic, all the equations tending to overestimate mean velocity compared to observed values. An investigation of the possible sources of error suggested that sampling error in the knowledge of bed material size was a major source of uncertainty in the predicted velocities, but that this and discharge errors could not wholly account for the observed discrepancies. Boulder shape is not represented in the equations, but this was discounted as an important parameter on the basis of a flume study. It was concluded that further research is required to produce a reliable, process based, flow resistance equation for mountain rivers. (Author's abstract)
W85-06038

FLOW RESISTANCE ESTIMATION IN MOUNTAIN RIVERS,
Institute of Hydrology, Wallingford (England).
J. C. Bathurst.
Journal of Hydraulic Engineering, Vol. 111, No. 4, p 625-643, April, 1985. 8 Fig, 2 Tab, 35 Ref.

Descriptors: *Flow resistance, *Mountain rivers, *Estimation, Slope, Mathematical equations, Channel morphology, Particle size, Friction, Sediment transport, Bed load, Submergence.

Examination of the flow resistance of high-gradient gravel and boulder-bed rivers, using data collected in British mountain rivers with slopes of 0.4-4%, shows that there are differences in resistance variation between mountain and lowland rivers and that between-site variations do not necessarily reflect at-a-site variations. Comparison of data with the familiar resistance equation relating the Darcy-Weisbach friction factor to the logarithm of relative submergence shows that the equation tends to overestimate the resistance in uniform flow. The equation also tends to underestimate the rate of change of resistance at a site (as discharge varies) at high gradients. The influences of nonuniform channel profile, sediment size distribution, channel slope and sediment transport are reviewed, but the data do not allow any quantification of these effects. Instead an empirical approach based on the available data is presented, allowing the friction factor to be calculated from the relative submergence with an error of up to +/- 25% to +/- 35%. A summary of the field data is included. (Author's abstract)
W85-06039

WATER AND SEDIMENT ROUTING THROUGH CURVED CHANNELS,
San Diego State Univ., CA.
H. H. Chang.
Journal of Hydraulic Engineering, Vol. 111, No. 4, p 644-658. April, 1985. 6 Fig, 28 Ref.

Descriptors: *Sediment routing, *Water routing, *Curved channels, Alluvial channels, Simulation, Mathematical models, Sediment transport, Simulation, Streambeds, Channel morphology, Banks, Transverse circulation, Fluid dynamics.

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A mathematical model for water and sediment routing through curved alluvial channels is developed and applied in a case study. This model, which is for alluvial streams with nonerodible banks, may be employed to simulate stream bed changes during a given flow, thereby providing the necessary information for the design of dikes, levees, or other bank protection. This model incorporates the major effects of transverse circulation, inherent in curved channels, on the flow and sediment processes. In the simulation of the evolution in stream bed profile, the effect of transverse flow is tied in with the aggradation and degradation development. River flow through curved channels is characterized by the changing curvature, to which variations of flow pattern and bed topography are closely related. Simulation of these changing features is based upon the fluid dynamics governing the growth and decay of transverse circulation along the channel. (Author's abstract)
W85-06040

MATERIAL AND SITE CONTROLS OF STREAM BANK VEGETATION,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
E. H. Grissinger, and A. J. Bowie.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1829-1835, November-December, 1984. 11 Fig, 1 Tab, 7 Ref.

Descriptors: *Stream banks, *Vegetation, *Mississippi, Banks, Channeling, Vegetation effects, Streambeds.

This article describes three specific conditions which limit the establishment of permanent vegetative cover for many stream banks in northern Mississippi. Critical conditions are imposed either directly or indirectly by the properties and failure mechanisms of the bank materials. These materials are primarily outcrops of valley-fill units that were deposited during the Holocene Epoch. Material properties and failure mechanisms are relatively consistent within units but differ between units. Two of these specific conditions involve bank height and angle. For a given material, these site conditions indirectly limit vegetation by controlling mass failure frequencies. Bank instability occurred when bank heights and/or angles were greater than critical, resulting in a loss of vegetative cover. The third condition was imposed by distinctive properties of the early-Holocene massive silt unit. This material is dense and has a well-developed polygonal structure that causes near-vertical bank angles. Outcrops of this material in the channel bank are typically barren of vegetation, but many such outcrops have been relatively stable except where channel entrenchment has exposed excessively weak toe materials. These results establish that bed and bank-toe stability is a prerequisite to the development of permanent vegetation on channel banks for this study area in northern Mississippi. Additionally, these results illustrate the usefulness of classifying channel bed and bank materials as units of the valley-fill system. (Author's abstract)
W85-06095

OVERVIEW OF FACTORS AFFECTING RIVER STABILITY,
For primary bibliographic entry see Field 2J.
W85-06108

EFFECT OF BRIDGE PIERS ON STREAMFLOW AND CHANNEL GEOMETRY,
J. C. Blodgett.
Transportation Research Record, Vol. 950, No. 2, p 172-183, 1984. 10 Fig, 7 Tab, 4 Ref.

Descriptors: *Streamflow, *Channel morphology, *Piers, Scour, Bridges, Streambeds, River beds, Abutments.

Piers in the waterway affect the velocity distribution across the channel and may act as barriers to floating debris. In addition, they also affect channel geometry by causing general and local scour in the vicinity of the bridge. The level of hydraulic efficiency of an unobstructed channel may be reduced by several percent if piers are placed in the waterway. Reductions of up to 11 percent were observed at sites used in the study. Field studies of several channels indicate that depths of general scour may be greater than local scour. Maximum depths of general scour usually occur midway between piers. General scour may extend several hundred feet upstream and downstream from the bridge. Large piers in alluvial channels may initiate long-term general scour that may continue for decades. General scour at a bridge had been observed to cause enlargement of the channel by as much as 23 percent to compensate for reduced flow area and flow inefficiency associated with bridge piers. Pier design should consider the probability that the channel alignment and geometry will change with time. To reduce the potential for pier damage by streamflow; pier shape, size, spacing, location in the channel, and footing elevation relative to the lowest point in the channel bed should be considered. Pier size should individually or collectively occupy not more than about 5 percent of the original waterway at bankfull discharge. (Author's abstract)
W85-06110

DESIGN GUIDELINES FOR SPUR-TYPE FLOW-CONTROL STRUCTURES,
For primary bibliographic entry see Field 8A.
W85-06112

COMPARISON OF PREDICTION EQUATIONS FOR BRIDGE PIER AND ABUTMENT SCOUR,
For primary bibliographic entry see Field 2J.
W85-06113

COMPUTER-BASED PREDICTION OF ALLUVIAL RIVERBED CHANGES,
For primary bibliographic entry see Field 2J.
W85-06117

MODELING GENERAL SCOUR AT BRIDGE CROSSINGS,
For primary bibliographic entry see Field 2J.
W85-06118

MATHEMATICAL MODEL FOR ESTIMATING SCOUR THROUGH BRIDGE CROSSINGS,
For primary bibliographic entry see Field 2J.
W85-06119

ROLE OF CALIBRATION IN APPLICATION OF HEC-6,
For primary bibliographic entry see Field 2J.
W85-06120

RIVER GAUGING BY ULTRASONICS IN OPEN CHANNELS: INSTRUMENTS AND EXPERIENCE ABROAD (ABFLUSSERMITTLUNG IN OFFENEN GERINNEN MITTELS ULTRASCHALLMESSUNG: IM AUSLAND EINGESETZTE GERATE UND GEWONNENE ERFAHRUNGEN),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
C. Rack.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 5/6, p 159-163, December, 1984. 5 Fig, 9 Ref.

Descriptors: *Ultrasonics, *Flow measurement, *Open channel flow, Rivers, Velocity, Tidal effects, Backwater, Automation, Telemetry, Remote sensing, Measuring instruments.

In recent years there has been an increase in the use of acoustic flow velocity measurement (AVM) devices for river gauging in open natural channels. At gauging sites with problems such as tidal influences, backwater or very low velocities there is a trend toward the use of multipath equipment. The operational sites are equipped with up to 18 paths and have path lengths up to 1200 m. Microprocessors for measurement control, discharge calculation and error control are installed in new sites. Error messages and data are often transmitted by telemetry. AVM devices are often the only possible and/or the least expensive alternative. There are also sites where the method was only partially successful. On the whole, the operators are very satisfied with their installations, even though a few requests for future developments are still to be fulfilled. (Moore-IVI)
W85-06157

2F. Groundwater

PRESENCE OF TIN AND TUNGSTEN IN THERMAL WATERS CONNECTED WITH GRANITES OF SOME SELECTED REGIONS IN EUROPE,
Gdansk Technical Univ. (Poland).
A. Sadurski, W. Blommaert, R. Vandelannoote, and L. Van't Dack.
Annales Societatis Geologorum Poloniae, Vol. 54, No. 1/2, p 3-14, 1984. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Tin, *Tungsten, *Thermal water, *Granites, *Massifs, *Groundwater, *Pyrenees, *Rila Mountains, *Vosges, *France, *Bulgaria, Geochemistry, Molybdenum, Metals.

The dependence between occurrence of the increase in tin and tungsten ion concentrations in thermal waters and the presence of greisens and metamorphosed wall rocks in magma intrusion regions was confirmed with trace element analysis of water samples. The existence of greisens with Sn-W paragenesis appearing in acidic magmatic rocks regions is generally known. Water was sampled from geothermal regions in the Hercynian massifs of the Vosges and the Eastern Pyrenees (France) and the Rila mountains (Bulgaria). The thermal water under consideration at the lowest parts of its circulation path in the rock massif may create conditions similar to those at the hydrothermal stage of residual crystallization. Differences between the Vosgesian and the Pyrenean springs in the content of W, F, Sn and Zr, can not be simply explained by the differences in water-bearing formation and temperature. The largest difference from the geological point of view between these two areas in France is that the Vosges are situated in an active tectonic zone (near the Rhine graben). The uplift of mountains creates facilities for the deeper circulation of the groundwater and the subsequent dissolution of new parts of the mineralized veins. Elements such as F, Sn, W, Mo, and to a lesser extent, U, are enriched in the latest stage of magma cooling (hydrothermal: 100-200 C). Therefor they are situated at the roof of the batholith and are easily accessible to water. Most of the springs of the Eastern Pyrenees are situated on the border of a large batholith and no differences in their chemical compositions have been found. In the Vosges area, Plombieres-les-Bains lie further away from the central part of the batholith. Water from the latter two areas is expected to be more influenced by greisenized zones possibly present at the border of the batholith. (Collier-IVI)
W85-05857

HYDROGEOLOGICAL PROPERTIES OF THE ZALAS PORPHYRY LACCOLITH NEAR KRZESZOWICE (WLASNOSCI HYDROGEOLOGICZNE PORFIROW LAKKOLITU ZALASKIEGO KOLO KRZESZOWIC),
Academy of Mining and Metallurgy, Krakow (Poland). Inst. of Geology and Mineral Deposits.
K. Bogacz, A. F. Adamczyk, T. C. Lesniak, and J. Motyka.
Annales Societatis Geologorum Poloniae, Vol. 54, No. 1/2, p 261-278, 1984. 8 Fig, 2 Tab, 22 Ref.

Descriptors: *Hydraulic contact zones, *Pumping tests, *Poland, *Aquifers, Hydrogeology, Storage, Laccolith.

The area of Zalas near Kreszowice, about 30 km west of Kracow, is a part of the Cracow-Silesian Basin. It is made up of Quaternary, Jurassic, Permian, and Carboniferous sediments. Four aquifers connected through hydraulic contact zones of different types were distinguished in the investigated area; the corresponding hydraulic contacts were sedimentary-transgressive, tectonic, magmatic-in-

trusive, and erosional. The hydraulic structures of porphyries making up the Zalas laccolith consists entirely of thermal, tectonic and weathering fractures. Results of a pumping test were explained assuming the two-layer hydrogeological structure of the porphyry laccolith, and the inertial and storage effects of the pumping well. (Collier-IVI)
W85-05858

TRANSITION ZONE WIDTH IN GROUND WATER ON OCEAN ATOLLS,
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Civil and Systems Engineering.
R. E. Volker, M. A. Marino, and D. E. Rolston.
Journal of Hydraulic Engineering, Vol. 111, No. 4, p 659-676, April, 1985. 10 Fig, 22 Ref.

Descriptors: *Groundwater, *Atolls, *Transition zone, Seawater, Saline-freshwater interfaces, Mixing layer, Tarawa Atoll, Pumping, Mathematical studies, Aquifers.

An analytical solution for the thickness of the transition zone between fresh and seawater in aquifers on ocean islands is presented. The interface is treated as a mixing layer similar to a laminar boundary layer between fluids moving at different velocities. The method requires assumptions of homogeneous isotropic dispersion, uniform hydraulic conductivity and steady flow; all water withdrawal is assumed to occur at the water table. The slope of the sharp interface is used in the solution for the mixing layer and the sharp interface is determined using Dupuit-Forchheimer assumptions of horizontal flow. The method presented efficiently estimates the transition zone thickness, thus providing information not available from sharp interface models. The method is illustrated by application to the freshwater lens on an island of the Tarawa Atoll in the Pacific Ocean, and is used to show the effects of different pumping arrangements on the width of the mixing layer. (Author's abstract)
W85-06041

TRACING GROUNDWATER COMPONENTS BY CHEMICAL, ISOTOPIC AND PHYSICAL PARAMETERS - EXAMPLE: SCHINZNACH, SWITZERLAND,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
E. Mazor, F. D. Vuataz, and F. C. Jaffe.
Journal of Hydrology, Vol. 76, No. 3/4, p 233-246, February, 1985. 9 Fig, 5 Tab, 9 Ref.

Descriptors: *Groundwater, *Chemical composition, *Isotopic studies, *Schinznach, *Switzerland, Hot springs, Groundwater recharge, Geohydrology, Water temperature, Altitude, Ions, Groundwater movement.

Dissolved ions, stable and radioactive isotopes, and physical data obtained from hydrologically related samples, may be processed as 'anonym' and as 'specific' tracers. Answers are obtained to questions pertaining to the number and proportions of intermixing water types, the properties of each end-member, its recharge altitude, depth of circulation, nature of the rocks passed and mode of flow. The methodology of the data processing is demonstrated on observations made over one year on a spring and a well at the spa of Schinznach, Switzerland. Two end-members are identified: (1) warm (39 C), saline (up to 85 meq/l total dissolved ions), circulating at a depth of over 640 m and passing through gypsum/anhydrite- and halite-bearing rocks; and (2) colder (21 +/- 2 C), fresher (30 meq/l total dissolved ions), circulating at a depth of approximately 240 m, passing through a sequence of gypsum/anhydrite-bearing carbonate rocks and flowing in a karstic mode. Both water types are recharged at an average altitude of 550 +/- 100 m a.s.l., a value used in identifying the recharge area. The existence of a separate hotter water body at greater depth is possible. (Author's abstract)
W85-06046

MODEL-DERIVED ESTIMATES OF GROUNDWATER MEAN AGES, RECHARGE RATES, EFFECTIVE POROSITIES AND STORAGE IN A LIMESTONE AQUIFER,
Nevada Univ. System, Las Vegas. Desert Research Inst.
M. E. Campana, and D. A. Mahin.
Journal of Hydrology, Vol. 76, No. 3/4, p 247-264, February, 1985. 4 Fig, 2 Tab, 22 Ref. NSF grant EAR7713633.

Descriptors: *Groundwater age, *Limestone aquifers, *Porosity, *Groundwater storage, *Groundwater recharge, Edwards aquifer, Texas, Water storage, Model studies, Tritium, Groundwater movement.

The Edwards aquifer of south-central Texas is a carbonate aquifer system extending from Austin southwest to Comstock, near the Mexican border. The discrete-state compartment (DSC) model of the Edwards aquifer is capable of using the spatial and temporal distributions of environmental tritium to estimate several important aquifer parameters: recharge, storage, groundwater mean ages and regional estimates of effective porosities. Although this model provided acceptable agreement with the observed tritium data, certain areas showed poor correspondence between real and simulated data. These discrepancies might be due to the use of a 3 month time step and a small number of cells. The current time step provides too much attenuation of the tritium input pulses and recharge events. More cells would provide a more realistic model of the aquifer; the sparse tritium data do not warrant the construction of a model with additional cells. DSC models can be especially useful in providing first approximations to groundwater flow systems, particularly those with sparse data or flow regimes characterized by solution channel and/or fracture flow. When calibrated with environmental isotopes or other suitable tracers, they can provide important information on the flow system and can be used to design future data collection schemes so that ultimately, more sophisticated models can be constructed. (Baker-IVI)
W85-06047

DENITRIFICATION IN A MAJOR LIMESTONE AQUIFER,
Toronto Univ. (Ontario). Dept. of Geology.
K. W. F. Howard.
Journal of Hydrology, Vol. 76, No. 3/4, p 265-280, February, 1985. 8 Fig, 2 Tab, 26 Ref.

Descriptors: *Aquifers, *Denitrification, *Limestone aquifers, Groundwater pollution, Nitrates, Drinking water, Water quality,.

The role of denitrification in the aquifer environment is extremely difficult to evaluate. Nitrate inputs are spatially and temporally variable, flow conditions are transient, and mixing frequently occurs between waters of different origins. In this study, reasonable control over the origins and histories of the groundwaters is afforded by the comprehensive availability of major-, minor-ion and environmental isotope data. Nevertheless only general conclusions concerning nitrate behavior can be drawn and specific questions remain to be answered. Denitrification can not be relied upon to reduce elevated nitrate concentrations in modern recharge waters. There is no indication of denitrification in type II waters, the older and more reducing of the two modern water types. In addition the downgradient reduction of nitrate in type I waters can be satisfactorily explained by type I-type II mixing. Only type III waters show any evidence of denitrification and these waters are over 400 yr old. The study clearly illustrates the risk of interpreting regional nitrate distributions before the origins of the groundwaters and their evolutionary behavior have been established. (Baker-IVI)
W85-06048

ARKANSAS GROUNDWATER MANAGEMENT VIA TARGET LEVELS,
Arkansas Water Resources Research Center, Fayetteville.
For primary bibliographic entry see Field 4B.
W85-06074

PREDICTING DIRECT RECHARGE OF SURFICIAL AQUIFERS,
Cornell Univ., Ithaca, NY.
B. C. Knoch, D. C. Slack, and C. L. Larson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1739-1744, November-December, 1984. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Recharge, *Aquifers, *Computer models, Infiltration, Model studies, Evapotranspiration, Soil water extraction.

A one-dimensional, physically-based computer model was developed for predicting direct groundwater recharge. The model was verified using three years of data from an instrumented site in east central Minnesota. Although the processes of infiltration and redistribution during frozen soil periods were not modeled, the model is capable of operating during both frozen and nonfrozen soil periods. The model includes submodels for evapotranspiration, soil-water extraction, snowmelt, surface depressional storage, infiltration and redistribution. The model predicts water table level and soil moisture. Water extraction may also be modeled. The model predicted both water table elevations and soil moisture levels with reasonable accuracy over the three-year period modeled. (Author's abstract)
W85-06080

CURRENT SUBSURFACE SEAWATER INTRUSION TO BASE LEVELS BELOW SEA LEVEL,
Geological Survey of Israel, Jerusalem.
U. Kafri.
Environmental Geology and Water Science, Vol. 6, No. 4, p 223-227, 1984. 5 Fig, 30 Ref.

Descriptors: *Saline water intrusion, *Seawater, *Groundwater, *Sea level, Groundwater movement, Saline water, Saline-freshwater interfaces, Aquifers, Hydrological continuity.

The Imperial Valley, Jordan-Dead Sea Rift, and the Afar and Qattara depressions, all regions below sea level and the only regions in the world so situated, are characterized by saline and hypersaline groundwaters and lakes, phenomena that to date have been solely attributed to ancient lagoons, salt dissolution, and evaporation. Current subsurface seawater intrusion is herewith suggested as an additional mechanism responsible for the salination of these regions. This type of dynamic seawater flow is feasible where there is (a) a base level below sea level with a hydrological continuity between the two levels, and (b) a low groundwater divide between the base levels with a shallow seawater/freshwater interface situated above the base of the aquifer. (Author's abstract)
W85-06161

2G. Water In Soils

MOISTURE CONDITIONS IN HUMMOCKS AND HOLLOWS IN VIRGIN AND DRAIN SITES ON THE RAISED BOG LAAVIOSUO, SOUTHERN FINLAND,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
For primary bibliographic entry see Field 2H.
W85-05873

IRON MIGRATION IN SANDY PODZOLIC SOILS UNDER INCREASING HYDROMORPHISM PRODUCED BY A RESERVOIR,
Moskovskaya Sel'skokhozyaistvennaya Akademiya (USSR).
For primary bibliographic entry see Field 6G.
W85-05909

HYDRAULIC PROPERTIES OF A SANDY LOAM SOIL AS INFLUENCED BY SALINISATION AND DESALINISATION,
Central Soil Salinity Research Inst., Karnal (India).
K. L. Chawla, B. K. Khosla, and D. R. Sharma.
Irrigation Science, Vol. 4, No. 4, p 247-254, December, 1983. 5 Fig, 2 Tab, 20 Ref.

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Descriptors: *Soil hydraulic properties, *Saline soils, *Soil desalinization, Hydraulic properties, Infiltration, Permeability coefficient, Soil water, Leaching, Precipitation, Soil water suction.

Infiltration, unsaturated hydraulic conductivity and soil moisture characteristic were determined before and after salinization and during desalinization in a sandy loam soil under field conditions. Soil salinization was simulated by irrigating a field plot repeatedly with water of 2.84 S/m electrical conductivity and 38 SAR. The steady state infiltration rate increased from 2.45 cm/day to 4.2 cm/day during salinization, but was reduced to 0.75 cm/day when the soil was leached with good quality water. The unsaturated hydraulic conductivity values in the wet and moist range were higher in the salinized soil as compared to those following desalinization. Field soil moisture characteristics plotted from the tensiometric data showed that the water retained at any given soil water suction remained higher in the desalinized as compared to the salinized soil. The study indicates that in freshly salinized soil, the hydraulic properties are likely to deteriorate when leached with good quality water or during periods of precipitation. The long term influence of such processes, however, needs to be studied in greater detail. (Author's abstract)
W85-05934

THEORY OF SOLUTE TRANSPORT IN SOILS FROM THE METHOD OF CHARACTERISTICS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
D. A. Barry, J.-Y. Parlange, P. G. Saffigna, and C. W. Rose.
Irrigation Science, Vol. 4, No. 4, p 277-287, December, 1983. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Solute transport, *Method of characteristics, *Soil water, Soil properties, Dispersion, Irrigation, Rainfall, Fertilizers, Mathematical equations, Leaching.

Solute dispersion can be caused by variations in soil transport properties, or variability, both spatial and temporal, in water and solute application rates. Irrigation, rainfall, and the surface application of fertilizers are arbitrary functions of time. Because measuring distributions of solute travel time parameters is very difficult, the theory given concentrates on a second mechanism of solute dispersion, variable application rates, which is modeled with parameters more easily measured in practice. An easily-soluble form of the transport equation, which conserves mass of solute and water, has been derived. As a result of focussing on variable application rates, the model predicts solute concentrations in profiles which are averaged over a large area. Rather than individual profiles, the gross features of the field sytem are presented in the model prediction of cumulative leaching with time. (Moore-IVI)
W85-05937

INVESTIGATION OF MOISTURE-INDUCED VARIATION IN SUBGRADE MODULUS BY CROSS-CORRELATION METHOD,
For primary bibliographic entry see Field 8D.
W85-06063

SOLAR EARTH-WATER DISTILLATION FOR WET SAND,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
R. C. Peralta, T. M. Skergan, and D. B. Marx.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1690-1695, November-December, 1984. 4 Fig, 5 Tab, 4 Ref.

Descriptors: *Solar distillation, *Distillation, *Soil Water, Solar stills, Design criteria, Water resources development.

Solar earth-water distillation is a means of extracting moisture from an earth medium. Three designs of the hot-box type of solar earth-water still were tested using wet or saturated sand. The designs included: low height with reflective interior siding, tall height with reflective siding and tall height with absorptive siding. The daily volume of distillate from the different designs was compared. A twenty-centimeter-tall still with reflective siding produced significantly greater yields than one twice as tall. No significant difference in the yield between tall stills with light-absorptive versus light-reflective interior siding was found. A regression equation was developed to predict water production for a low still with reflective siding and a sixteen-degree cover slope. Independent variables included soil moisture, solar radiation and maximum and minimum daily temperature. (Author's abstract)
W85-06073

SOIL PHYSICAL CHARACTERISTICS OF REDUCED TILLAGE IN A WHEAT-FALLOW SYSTEM,
Nebraska Univ.-Lincoln.
L. N. Mielke, W. W. Wilhelm, K. A. Richards, and C. R. Fenster.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1724-1728, November-December, 1984. 1 Fig, 5 Tab, 13 Ref.

Descriptors: *Soil water, *Tillage, *Wheat, *Fallowing, *Soil properties, Density, Air permeability, Infiltration, Precipitation, Runoff.

Soil physical characteristics of reduced tillage for fallow-wheat (Triticum aestivum L.) were compared for two soils in western Nebraska. The soil physical environment influences the amount of water that enters soil, the availability of water for plants, and the microenvironment important to soil biological processes. Fallow tillage (plow, subtill, no till) did not affect bulk density in Alliance silt loam (fine silty, mixed mesic, Aridic Argiustolls). For Duroc loam (fine silty, mixed mesic Pachic Haplustolls), in which native sod was compared to the above three wheat-fallow tillage methods, numerous effects on soil physical properties were found. Reduced tillage reduced bulk density in the 0- to 76-mm layer. Hydraulic conductivity (H.C.) in the surface 300 mm was greater for native sod than for plowed and subtilled soil. Air permeability (ka) was lowest and water permeability (kW) was highest in the native sod. The ratio, ka/kW, an indicator of soil structural stability, showed native sod was most stable and the plowed soil was least stable. Infiltration was least for plowed soil, and after 4 h, infiltration into subtilled, chemical, and native sod was 2.2, 2.4, and 4.7 times greater, respectively. Based on precipitation records and infiltration characteristics, water would seldom run off the surface of these soils. (Author's abstract)
W85-06078

TILLAGE EFFECTS ON CROP YIELD IN COASTAL PLAIN SOILS,
Clemson Univ., SC. Dept. of Agricultural Engineering.
C. R. Camp, G. D. Christenbury, and C. W. Doty.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1729-1733, November-December, 1984. 3 Fig, 3 Tab, 12 Ref.

Descriptors: *Tillage, *Crop yield, *Soils, *Corn, *Soybean, Rainfall, Irrigation, Soil water.

Corn (Zea mays L.) and soybean (Glycine max (L.) Merr.) were grown on an 18-ha site of Coastal Plain soils under nonirrigated and irrigated conditions for the three-year period, 1979-81. The five tillage treatments were double disking and minimum tillage, both with and without in-row subsoiling at planting; and disking with uniform chisel plowing. Rainfall during the growing season was near normal in 1979, below normal in 1981, and much below normal in 1980. There were significant yield differences due to tillage and irrigation for both corn and soybean. Corn yield increases due to deep tillage were greater in magnitude and were more consistent than those for soybean. Minimum tillage without subsoiling produced the lowest yields for both corn and soybean; however, this treatment had the poorest stand and the most severe weed competition of all treatments. Deep tillage and irrigation produced additive yield increases for corn, but not for soybean, indicating the possible need to use both management practices for corn in some soil conditions. Irrigation increased yields for both corn and soybean across all tillage treatments with mean yield increases of 3.37 t/ha (86%) and 0.73 t/ha (51%) for corn and soybean, respectively. The choice of management practices will depend upon their cost relative to their respective yield increase potential. (Author's abstract)
W85-06079

EFFECT OF SOIL SURFACE CONDITIONS ON INFILTRATION FOR SHALLOW WATER TABLE SOILS,
Georgia Coastal Plain Experiment Station, Tifton. Dept. of Agricultural Engineering.
A. Shirmohammadi, and R. W. Skaggs.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 7, p 1780-1787, November-December, 1984. 15 Fig, 5 Tab, 26 Ref.

Descriptors: *Infiltration, *Water table, *Soil water, Seasonal variation, Permeability coefficient, Cultivation, Rainfall.

Experiments were conducted to determine the effects of surface cover and changes in surface conditions on infiltration into soils with shallow water tables. The effects of initial water table depth and time of year were also considered. Experiments were conducted on columns of fine sand with bare or fallow surfaces as well as surfaces planted to fescue grass and soybeans. Highest infiltration was observed for profiles planted to grass. Most of the increase was attributed to higher hydraulic conductivity values in top 20 cm of the grass profiles. Infiltration generally decreased with time of year for all the profiles; this was mostly due to decreased hydraulic conductivity in the surface layer. Exceptions were increased infiltration due to cultivation and to drier initial conditions for some cases. Rainfall in September compacted the bare surfaces and results in lower infiltration rates in subsequent test although it had no significant effect on planted (grass and soybean) profiles. Deep initial water tables resulted in drier profiles and decreased the effect of compressed air on infiltration. This tended to increase infiltration when compared to shallow water table conditions. (Author's abstract)
W85-06087

EFFECTS OF SOIL BULK DENSITY AND WATER REGIMEN ON ROOT GROWTH AND UPTAKE OF PHOSPHORUS BY RYEGRASS,
University of New England, Armidale (Australia). Dept. of Agronomy and Soil Science.
P. S. Cornish, H. B. So, and J. R. McWilliam.
Australian Journal of Agricultural Research, Vol. 35, No. 3, p 631-44, 1984. 8 Fig, 4 Tab, 33 Ref.

Descriptors: *Soil characteristics, *Phosphorus, *Ryegrass, *Grass, *Soil water, Soil density, Roots, Root development, Soil strength.

The effects of soil density (rho) and water content on root extension, phosphorus (P) uptake and plant growth were studied with ryegrass in pot experiments with a sandy loam soil. Uptake was considered in terms of a root cylinder model with parameters of root length and uptake per unit length. Increasing rho (from 1.0 to 1.54 g/cu cm) slightly increased root diameter and reduced root hair length, but the main effect on uptake per unit length of root was related to the increased mass of soil and hence the increased mass of P within the root hair cylinder. The effect of rho on diffusion to the surface of the cylinder appeared to be small. Increasing rho also increased soil strength, causing a reduction in root length which was linearly related to P uptake. Thus the effect of rho on total P uptake was a product of the opposing effects on uptake per unit length and root length. The importance of these two effects was confirmed by calculating potential P uptake using a simple root cylinder model in which rho was a variable. Predicted and observed values were highly correlated (r squared = 0.94). Drying the soil reduced P uptake per unit length of root, but, in compacted soil, this

effect was small compared with the effect of drying on root extension. It appears that, when this soil type is not cultivated, drying will reduce P uptake mainly because mechanical resistance reduced root extension, and root extension ceased well within the available water range in intact soil cores. (Author's abstract)
W85-06098

SOIL SALINITY STATUS AND ITS RELATION TO SOME OF THE SOIL AND LAND PROPERTIES OF THREE IRRIGATION DISTRICTS IN SOUTHERN ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 4A.
W85-06151

COMPARISON OF MODELLED SOIL WATER RESERVES ON CANADIAN PRAIRIE SOILS WITH WATER-HOLDING CAPACITIES OF 280 AND 250 MM,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
R. de Jong, and W. K. Sly.
Canadian Journal of Soil Science, Vol. 65, No. 1, p 219-223, February, 1985. 2 Tab, 6 Ref.

Descriptors: *Soil water, *Model studies, *Prairie soils, Water-holding capacity, Aridity index, Wheat, Water deficit, Rainfall distribution, Temporal distribution, Drought.

Based on soil water modelling results of 19 stations, averaged long-term soil water reserves on the Canadian Prairies were compared for two soils having available water-holding capacities of 280 and 250 mm. The soil water reserves of the 250-mm capacity soil were 6.5%, 8.7% and 6.2% less than those of the 280-mm capacity soil on 1 May after a fallow year, 30 June heading time and 1 May after a crop year, respectively. The aridity indices for wheat at the soft dough stage for the 250-mm capacity soil ranged from 4% less in the drier part of the Prairies to 7-9% more in the wetter regions as compared to the 280-mm capacity soil. Water deficits for a perennial crop grown on a 280-mm capacity soil could not be used to infer the deficits on a 250-mm capacity soil because of the model's sensitivity to rainfall distribution with time. (Author's abstract)
W85-06152

PREDICTING VOLUMETRIC WATER RETENTIONS FOR SUBSOIL MATERIALS FROM COLCHESTER COUNTY, NOVA SCOTIA,
Department of Agriculture, Truro (Nova Scotia). Atlantic Soil Survey Unit.
G. J. Beke, and M. J. MacCormick.
Canadian Journal of Soil Science, Vol. 65, No. 1, p 233-236, February, 1985. 2 Tab, 7 Ref.

Descriptors: *Soil water, *Volumetric water retention, *Colchester County, *Nova Scotia, Soil properties, Soil water suction, Bulk density, Organic matter, Sand, Silt, Clay, Mathematical equations.

Water retention characteristics and pertinent soil properties were determined for soil survey samples from Colchester County, Nova Scotia, in order to develop the relationships between volumetric soil water content, at suctions of 33 and 1500 kPa, and organic matter, bulk density, and sand, silt, and clay content for subsoil materials. The significant variables in the regression equation for soil water content at a suction of 33 kPa were the sand content and the product of silt content and bulk density of the soil. The variables for water retention at 1500 kPa suction were the clay content and the product of organic matter content and bulk density. The multiple correlation coefficients were 0.87 and 0.92 for suctions of 33 and 1500 kPa, respectively. The soil water retentions at suctions of 33 kPa and 1500 kPa were estimated adequately by the developed equations from sand, silt, clay, organic matter, and bulk density. (Moore-IVI)
W85-06154

2H. Lakes

TROPHIC RELATIONSHIPS BETWEEN BACTERIA AND PROTOZOA IN THE HYPOLIMNION OF A MEROMICTIC MESOTROPHIC LAKE,
Innsbruck Univ. (Austria). Dept. of Limnology.
R. Psenner, and K. Schlott-Idl.
Hydrobiologia, Vol. 121, No. 2, p 111-120, February, 1985. 5 Fig, 2 Tab, 41 Ref.

Descriptors: *Bacteria, *Protozoa, *Mesotrophic lakes, *Trophic level, *Hypolimnion, Nutrients, Nitrates, Nitrites, Organic carbon, Biomass, Lakes, Phosphorus.

The development of ciliated protozoan biomass in the hypolimnion of Piburger See, a small subalpine lake, was demonstrated to depend mainly on two factors. Firstly, the availability of oxygen or nitrate as electron acceptors determines the depth profiles of ciliates. Large quantities of ciliates and even maximum numbers were found at depths where no oxygen could be detected. If nitrate also disappeared during the summer stagnation period, the biomass of protozoa was strongly reduced. Nitrite peaks generally corresponded with ciliate peaks. An extension of Finlay's findings (dissimilatory nitrate reductase within the inner mitochondrial membrane) to other ciliate groups is hypothesized. Secondly, the biomass development of hypolimnetic ciliates was strongly correlated with the bacterial biomass registered approximately 2 weeks before (r squared = 0.891, n = 14). The biomass of bacteria, on the other hand, was dependent upon the sedimentation rate of organic carbon (r squared = 0.850, n = 15), if a time lag of approximately 2 weeks was taken into account. Therefore a total time lag of approximatly 4 weeks was assumed to take place between sedimentation of organic substance and the corresponding increase in ciliate biomass (r squared = 0.853, n = 14). Bacteria were shown to be an important intermediate link in the food chain of the hypolimnion. They appear to represent the principal energy source for pelagic ciliates. Sedimentation of organic carbon, nitrogen and phosphorus is the driving force for the establishment of the hypolimnetic microbial community. (Author's abstract)
W85-05864

SULFUR DISTRIBUTION IN LAKE SEDIMENT PROFILES AS AN INDEX OF HISTORICAL DEPOSITIONAL PATTERNS,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
For primary bibliographic entry see Field 5B.
W85-05865

CHIRONOMIDAE IN A PENNINE STREAM SYSTEM RECEIVING MINE DRAINAGE AND ORGANIC ENRICHMENT,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 5C.
W85-05868

CHLOROPHYLL-NUTRIENT RELATIONSHIPS IN NORTH ISLAND LAKES (NEW ZEALAND),
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. D. Pridmore, W. N. Vant, and J. C. Rutherford.
Hydrobiologia, Vol. 121, No. 2, p 181-189, February, 1985. 6 Fig, 5 Tab, 34 Ref.

Descriptors: *Chlorophyll, *Nutrients, *New Zealand, *North Island, *Lakes, Model studies, Nitrogen, Phosphorus, Water depth, Seasonal variation.

A model for the prediction of chlorophyll alpha in the near surface waters (1 m) of North Island lakes was developed using data from the literature and a study of 12 North Island lakes. Annual geometric mean concentrations of chlorophyll alpha, total nitrogen and total phosphorus were used since no distinct growing season was discernable. Annual mean ratios of total nitrogen to total phosphorus in the near surface waters ranged between 10 and 59 (by weight). Strong correlations were obtained between log-transformed values of chlorophyll alpha and total nitrogen (r squared = 0.53, n = 16), chlorophyll alpha and total phosphorus (r squared = 0.71, n = 21), and between total nitrogen and total phosphorus (r squared = 0.69, n = 16). After correcting for the high interdependency between total nitrogen and total phosphorus, only total phosphorus was found to be important in predicting chlorophyll concentrations. Much of the variance in the chlorophyll-phosphorus relation was attributable to differences in mean lake depth. Lakes with mean depths less than 11 m had significantly more chlorophyll alpha per unit of total phosphorus (mean = 0.54 micro g/micro g, SE = 0.05, n = 6) than lakes of greater mean depth (mean = 0.17 micro g/micro g, SE = 0.02, n = 14). When the effect of mean depth was taken into account, 89% of the variance in chlorophyll alpha was explained compared with 71% for the similar linear regression on total phosphorus alone. (Author's abstract)
W85-05869

MOISTURE CONDITIONS IN HUMMOCKS AND HOLLOWS IN VIRGIN AND DRAIN SITES ON THE RAISED BOG LAAVIOSUO, SOUTHERN FINLAND,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
T. Lindhomlm, and I. Markkula.
Annales Botanici Fennici, Vol. 21, No. 3, p 241-255, 1984. 8 Fig, 4 Tab, 60 Ref.

Descriptors: *Bogs, *Bog Laaviosuo, *Finland, *Soil water, *Hummocks, *Hollows, Water table, Rainfall, Wetlands, Mires, Peat bogs.

The dynamics of the water table and soil water tension in the surface peat was studied in a raised bog. Comparisons were made between hummocks and hollows in two consecutive summers, and also between virgin and drained sites. In most cases a linear regression gave a good fit for the relationship between soil water tension in the surface peat and the distance to the water table. An exception was the relationship in the drained hummock, where the water table was lower; when rain occurred as infrequent showers, the relationship between the soil water tension and the water table level was logarithmic. Under such conditions, the moisture tension in the drained hummock was mainly regulated by the rain and not by the height of the water table. Hollows which are wet in the virgin state remain rather wet even after drainage. The relationship between the height of the water table and soil water tension was similar at different depths in the surface peat; only the magnitude of the tension changed with the depth in the peat. There was also a clear relationship between the levels of the water tables in virgin and drained sites. Heavy rains, however, caused deviations from this relationship, due to the difference in the rate of runoff from the two sites. The regression was slightly curvilinear, because the levels in the two sites converged when the water table was deep. The biological consequences of the soil water conditions in virgin and drained sites were reviewed. (Author's abstract)
W85-05873

EXCRETION OF PHOTOSYNTHETICALLY FIXED ORGANIC CARBON BY METALIMNETIC PHYTOPLANKTON,
Purdue Univ., Lafayette, IN. Dept. of Biological Sciences.
C. R. Lovell, and A. Konopka.
Microbial Ecology, Vol. 11, p 1-9, 1985. 3 Fig, 5 Tab, 20 Ref. NSF grant DEB-8201857 and Office of Water Resources and Technology grant B-127:IND.

Descriptors: *Photosynthesis, *Phytoplankton, *Little Crooked Lake, *Indiana, *Organic carbon, Hydrogen ion concentration, Dissolved oxygen, Bacteria, Algae, Light intensity.

The effects of light intensity, oxygen concentration, and pH on the rates of photosynthesis and net excretion by metalimnetic phytoplankton popula-

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tions of Little Crooked Lake, Indiana, were studied. Photosynthetic rates increased from 1.42 to 3.14 mg C/mg chlorophyll a/hour within a range of light intensities from 65 to 150 micro E/sq m/sec, whereas net excretion remained constant at 0.05 mg C/mg chlorophyll a/hour. Bacteria assimilated approximately 50% of the carbon released by the phytoplankton under these conditions. Excreted carbon (organic compounds either assimilated by bacteria or dissolved in the lake water) was produced by phytoplankton at rates of 0.02-0.15 mg C/mg chlorophyll a/hour. These rates were 6%-13% of the photosynthetic rates of the phytoplankton. Both total excretion of carbon and bacterial assimilation of excreted carbon increased at high light intensities whereas net excretion remained fairly constant. Elevated oxygen concentrations in samples incubated at 150 micro E/sq m/sec decreased rates of both photosynthesis and net excretion. The photosynthetic rate increased from 3.0 to 5.0 mg C/mg chlorophyll a/hour as the pH was raised from 7.5 to 8.8. Net excretion within this range decreased slightly. Calculation of total primary production using a numerical model showed that whereas 225.8 g C/sq m was photosynthetically fixed between 12 May and 24 August 1982, a maximum of about 9.3 g C/sq m was released extracellularly. (Author's abstract)
W85-05876

AQUATIC INSECT ABUNDANCE IN A REGULATED STREAM UNDER FLUCTUATING AND STABLE DIEL FLOW PATTERNS,
Washington Univ., Seattle. Fisheries Research Inst.
J. C. Gislason.
North American Journal of Fisheries Management, Vol 5, No. 1, p 39-46, 1985. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Skagit River, *Washington, *Water level fluctuations, *Regulated flow, *Ecological effects *Aquatic insects, Fish, Population density.

Aquatic insect abundance at water depths of 15-45 cm was examined in a fifth-order reach of the Skagit River, Washington from May to November in 1976 and 1977. The study site was subject to diel flow fluctuation in 1976 from hydroelectric powerpeaking, and to a relatively stable flow pattern in 1977 while peaking was curtailed. Under fluctuating flow conditions, insect density increased from shallow to deep water and was negatively correlated ($r = -0.76$, $P < 0.001$) with hours of dewatering during the 2 weeks prior to sampling. Current fluctuation appeared to limit insect density at the 45-cm deep sampling locations that were not extensively dewatered during the daily peaking cycle. The highest density observed in 1976 was 1,788 insects/sq m at 25 cm in July. Under stable flow conditions, the abundance of benthic insects was greatly enhanced and the densities at corresponding depths and months were 1.8-59 times higher in 1977 than in 1976. Insect densities increased steadily from May 1977 through September 1977 when they reached a maximum level of 16,763 insects/sq m at 15 cm. Reduction in the amplitude and duration of powerpeaking flow fluctuation can be a highly effective management strategy for enhancing aquatic insect standing crop, with a potential for increasing the survival and growth of fish dependent on insects for food. (Author's abstract)
W85-05880

STUDIES OF THE INTERNAL WAVE IN SMALL LAKES (II) - EFFECT OF THE LAKE BASIN SHAPE ON THE INTERNAL WAVE - (IN JAPANESE),
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
S. Kodomari.
Japanese Journal of Limnology, Vol. 45, No. 4, p 269-278, October, 1984. 10 Fig, 2 Tab, 13 Ref.

Descriptors: *Internal waves, *Lake basins, *Water circulation, *Lakes, Mathematical models, Islands, Model studies.

Using the two-layer model, numerical calculations were made for 24 small lake models. Two types of internal wave are noted dominantly. The one rotates counterclockwise round the basin by the effect of the earth's rotation, and the other clockwise. The former is characterized by the uninodal longitudinal mode in the zero-rotation case and the latter is the uninodal transverse one. Due to the lake basin shape, the period of the counterclockwise internal wave is prolonged. The island makes the period of the clockwise internal wave longer. When the length of the minor axis is shortened by the lake basin shape, the clockwise internal wave is not dominant in the complex figure model or its period becomes shorter than that of the rectangular lake model. There are cases where the magnitude of displacement of two internal waves is reversed at some position in the lake. The effect of the lake basin shape is larger on the clockwise internal wave than on the counterclockwise one. (Author's abstract)
W85-05998

CIRCULAR CURRENTS IN THE NORTH BASIN OF LAKE BIWA (II) - COMPARISONS BETWEEN OBSERVED CURRENT AND GEOSTROPHIC CURRENT - (IN JAPANESE),
Shiga Univ., Otsu (Japan). Dept. of Earth Science.
S. Endoh.
Japanese Journal of Limnology, Vol. 45, No. 4, p 289-295, October, 1984. 6 Fig, 3 Tab, 10 Ref.

Descriptors: *Water currents, *Geostrophic currents, *Lake Biwa, *Japan, Water circulation, Lake basins, Water temperature, Water depth, Internal waves, Centrifugal force.

In order to determine the validity of applying a geostrophic relationship to the circular currents in Lake Biwa, a series of quasi-simultaneous observations of currents and water temperature were carried out. The current measurements were made using the drifters with cross-board placed at several depths. The vertical profiles of water temperature were measured by the bathythermograph at four points about 500 m away from the current station. The comparisons between the directly measured current and estimated geostrophic current show that the geostrophic approximation is not so valid for the current observed at a specified time and space. On the other hand, the current averaged over a time long enough to cancel the effect of the slowest internal wave, can serve as the baroclinic geostrophic current including the centrifugal force. (Author's abstract)
W85-05999

CHLOROPHYLL DIFFERENCES IN MONO LAKE (CALIFORNIA) OBSERVABLE ON LANDSAT IMAGERY,
California Univ., Santa Barbara. Dept. of Geography.
E. Almanza, and J. M. Melack.
Hydrobiologia, Vol. 122, No. 1, p 13-17, March, 1985. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Chlorophyll, *Satellite technology, *Remote sensing, *Mono Lake, *California, Saline lakes, Reflectance, Transparency, Landsat.

Mono Lake (California) is a large, deep, saline lake in the North American Great Basin. Mono Lake was sampled during 1979 at ten sites distributed lake-wide at the time of two Landsat overpasses and at one site (middle of western bay) in conjunction with five radiometric measurements made at the lake. Chlorophyll concentrations in the euphotic zone increased from 4 to 45 micro-g/l between July and October 1979. These seasonal changes in chlorophyll are detectable on imagery obtained with the multispectral scanner on Landsat. Computer-compatible tapes of Landsat images were normalized for solar zenith and corrected for atmospheric scatter and absorption to obtain Landsat emittances. Variation in per cent reflectance are not consistently correlated with the changes in chlorophyll concentration. It is possible that the coccoid green alga that dominates the phytoplankton of Mono Lake provides an especially weak signal to the hand-held Landsat radiometer. The per cent reflectances in bands 5, 6, and 7 are even lower than those in band 4 and interpretation of the small differences among the days is equivocal. Correlation coefficients were determined for Landsat values in bands 4, 5, and 6, individually correlated against chlorophyll and Secchi disk transparency for the Landsat imagery from July and October for the separate images. Spatial heterogeneity was not detectable. (Moore-IVI)
W85-06004

INTERNAL PHOSPHORUS LOADING TO SHALLOW EDINBORO LAKE IN NORTHWESTERN PENNSYLVANIA,
Pittsburgh Univ., PA. Dept. of Biological Sciences.
K. J. Garber, and R. T. Hartman.
Hydrobiologia, Vol. 122, No. 1, p 45-52, March, 1985. 5 Fig, 4 Tab, 30 Ref.

Descriptors: *Phosphorus, *Internal loading, *Edinboro Lake, *Pennsylvania, Nutrients, Eutrophic lakes, Stratification, Lake sediments, Chlorophyll, Anaerobic conditions.

Edinboro Lake (Pennsylvania) is small, shallow and highly productive. The mean, volume-weighted summer epilimnetic total phosphorus concentration exceeds 60 micro-g/l and the mean summer stratification Secchi depth is on the order of 1.5 m. A mass balance phosphorus model was used to develop a phosphorus budget for Edinboro Lake during the stratification period (mid-June to mid-August) in 1981 and 1982. Strong clinograde temperature and dissolved oxygen profiles developed during summer stratification in Edinboro Lake. Phosphorus loading from internal sources contributed 141 kg (79%), and 55 kg (68%), of the mass phosphorus increase in the lake in 1981 and 1982, respectively. Calculated anaerobic sediment release rates of total phosphorus were 9.9 and 3.7 mg/sq m/day for these two years. Chlorophyll a concentration ranged from a prestratification minimum of 4 mg/cu m to a maximum concentration of 33 mg/cu m in 1981. The observed summer maximum chlorophyll a concentration was 1.5-3 times greater than that predicted by existing models. Since the absolute size of the internal phosphorus load in lakes is so variable and since morphometry influences the unique response of each lake following nutrient abatement, it is difficult to predict how long internal loading will influence trophic state after external nutrient diversion. (Moore-IVI)
W85-06006

PRIMARY PRODUCTION IN TEN RESERVOIRS IN SOUTHERN BRAZIL,
Sao Paulo Univ. (Brazil). Inst. Oceanografico.
S. M. F. Gianesella-Galvao.
Hydrobiologia, Vol. 122, No. 1, p 81-88, March, 1985. 7 Fig, 1 Tab, 27 Ref.

Descriptors: *Primary productivity, *Reservoirs, *Sao Paulo State, *Brazil, Seasonal variation, Chlorophyll a, Phytoplankton, Solar radiation, Water depth, Nutrients, Turbidity.

Through 1979, phytoplankton primary production of ten reservoirs in Sao Paulo State (Brazil) was measured using the C-14 method. Each reservoir was sampled four times during the year: twice during the warmer (summer) period and twice during the cooler (winter) period. Production rates, depth, profiles and integral productivity were analyzed with respect to chlorophyll-a data and various abiotic environmental factors. The vertical distribution of primary production showed normal surface maxima even under high radiation, attributable to a predominance of phytoplankton communities with 'sun type' behavior (high production rates under high solar radiation. Productivity was low (except in the euthrophic Americana Reservoir), and peaked in summer. Maximum production rates in the depth profiles ranged from 0.8 to 160.3 mg C/sq m/h, and integral production from 0.8 to 92.1 mg C/sq m/h. Nanoplankton was responsible for most of the primary production. The limiting factors were nutrients (mainly phosphate) and turbidity, during winter in the monomictic reservoirs and much of the year in the polymictic reservoirs. (Moore-IVI)
W85-06008

ECOLOGY OF THE LIMNOFAUNA IN THE RIVER KOSI OF THE KUMAUN HIMALAYA (UTTAR PRADESH),
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
S. D. Bhatt, Y. Bisht, and U. Negi.
Proceedings of the Indian National Science Academy, Vol. B50, No. 4, p 395-405, August, 1984. 5 Fig, 2 Tab, 27 Ref.

Descriptors: *Aquatic animals, *Rivers, *Kosi, *India, Invertebrates, Fish, Turbidity, Velocity, Dissolved oxygen, Seasonal variation, Benthic fauna, Aquatic insects, Biomass.

The river Kosi, on of the major rivers draining a large area along the central and south-central parts of the Kumaun Himalaya, is joined by several spring-fed tributaries. Hydrobiological studies in a 47 km stretch of the river were conducted during January 1982 - December 1983. Physico-chemical factors such as turbidity, velocity and dissolved oxygen depicted subtle seasonal variations and were found to alter the biological balance of the river water. The river water represented a mixed assemblage of a wide variety of micro and macroinvertebrates. A sharp distinction and a definite variability in the numerical dominance of a certain species was not characteristically observed in different sections of the river. The main bulk of the benthic fauna was comprised of insect nymphs and larvae. The biota showed highest biomass in the winter-summer interphase and a depression in the rainy season. Random surveys of the Kosi identified an enormous potential for the development of the fish fauna through management. The headwater zone was dominated by rheophilic species (loaches and catfish), the rapid but clear-water zone by snow-trout, mahaseer and a few loaches, and the rapid turbid-water zone by snow-trout, mahaseer and minor carps. (Moore-IVI)
W85-06011

PHYSIOGRAPHY AND LIMNOLOGY OF THREE LAKES IN THE ENVIRONS OF THE UNION TERRITORY OF DELHI, INDIA,
Delhi Univ. (India). Ecology and Experimental Taxonomy Lab.
K. M. M. Dakshini, and S. K. Gupta.
Proceedings of the Indian National Science Academy, Vol. B50, No. 4, 417-430, August, 1984. 2 Fig, 6 Tab, 42 Ref.

Descriptors: *Limnology, *Physiography, *Badkhal Lake, *Peacock Lake, *Damdama Lake, *India, Vegetation, Reservoirs, Eutrophication, Physico-chemical properties, Geology.

Badkhal and Peacock lakes are situated in the southern part of the Union territory of Delhi, India. Damdama is situated southeast of Delhi. The climate of the area is of semi-arid type with marked diurnal differences in temperature, high saturation deficit and moderately low rainfall. The vegetation cover in and around the catchment area of these lakes is an open scrub. Badkhal Lake was created in the early 20th century by making an earthen wall across the Parsaun Nadi (river). Damdama Lake is a man-made perennial impoundment which is bounded on three sides by high hillocks and on the west by a bund (earthen wall) constructed during 1947-1949. Peacock Lake is situated in a valley which has been dammed since 1908 by a bund. Investigations on geography, geology, physico-chemical and biological characteristics of the three small freshwater lakes suggested that age of a lake and the ecological processes prevalent in the catchment area are of greater importance in controlling its maturation and stability than its geography. Eutrophication in these lakes is partly natural and partly cultural. (Moore-IVI)
W85-06012

BIOLOGY AND MANAGEMENT OF AN INLAND SALINE LAKE,
Crewe and Alsager Coll. of Higher Education, Alsager (England).
A. A. Savage.
Biological Conservation, Vol. 31, No. 2, p 107-123, 1985. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Saline lakes, *Watch Lane Flash, *Cheshire, *England, *Ecological effects, *Species composition, Saline water, Lakes, Lake management, Precipitation, Inverterates, Aquatic plants.

Annual quantitative changes in the species composition of the higher plant flora and macroinvertebrate fauna of an inland saline lake during the period 1969-79 were compared with environmental data relating to temperature, conductivity of surface waters and major management decisions. Changes in species composition of the flora and fauna of Watch Lane Flash, Sandbach, Cheshire, England, showed considerable variation in relation to environmental factors of both natural and human origin. An attempt was made to determine causal relationships with the aid of other relevant data. Flora and fauna formed a rare community reflecting the saline conditions similar to communities in coastal regions. The primary relationship of the flora was with brackish coastal waters wheras the primary relationship of the fauna was with local fresh water. Rapid fluctuations in the community of the flash show that it was extremely sensitive to environmental factors. Net precipitation was the main factor governing conductivity. The two major changes were initiated by human activity. The modifications to drainage from the brine springs in 1971 were designed to prevent flooding of the road and effects on the flash were not considered. The transfer of water from the canal was an example of deliberate management intended to conserve the saltmarsh and fish population. Both had unforseen consequences for the community. Landscaping and the lowering of the water level were successful in that no unexpected effects were noticed. The main objective of management should be to counteract the fundamental chemical and biological instability of the habitat; it may then fluctuate within a more natural range. Successful management for conservation is dependent upon the maintenance of a stable water level. (Collier-IVI)
W85-06101

LONG-TERM PATTERNS OF PROTOZOAN COLONIZATION IN DOUGLAS LAKE, MICHIGAN,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
J. R. Pratt, and J. Cairns, Jr.
Journal of Protozoology, Vol. 32, No. 1, p 95-99, February, 1985. 3 Fig, 3 Tab, 30 Ref.

Descriptors: *Protozoa, *Douglas Lake, *Michigan, *Aquatic animals, Microorganisms, Species composition, Substrates.

Long-term patterns of noninteractive and interactive protozoan colonization of polyurethane foam (PF) artificial substrates in Douglas Lake, Michigan, were examined for a 14-yr period. Species-time data were fitted to the MacArthur-Wilson equilibrium model, S = (S sub eq)(1 - (e to the -Gt power)), and examined through time from 1969-1982. Comparisons were made to historical water chemistry measurements. No long-term changes in water chemistry were evident. Similarly, equilibrium species number (S sub eq) and colonization rate (G) oscillated about a mean through time. Protozoan colonization of PF substrates appeared stable for extended periods and showed modest variation from year to year. Examination of 7-yr-old substrates in 1982 revealed little difference from young (< 50 days) substrates. Previous reports of senescence of artificial substrate communities may have been due to habitat loss within the substrates. No evidence existed for chemical or biological degradation of the lake. (Collier-IVI)
W85-06134

VERTICAL DISTRIBUTION OF POTENTIALLY PATHOGENIC FREE-LIVING AMOEBAE IN FRESHWATER LAKES,
Clemson Univ., SC. Dept. of Biological Sciences.
D. E. Kyle, and G. P. Noblet.
Journal of Protozoology, Vol. 32, No. 1, p 95-105, February, 1985. 7 Fig, 3 Tab, 53 Ref.

Descriptors: *Amoeba, *Lakes, *Aquatic animals, *Vertical distribution, *Pathogens, Monomictic lakes, Thermal stratification, Phytoplankton, Stratification, Distribution.

The vertical distribution of thermotolerant (37 C and 45 C) free-living amoebae (FLA) in warm monomictic lakes was determined in relation to the onset of thermal stratification and associated physical and chemical changes. The position of abiotic or biotic particulate layers in the water column was located by using a submersible horizontal beam transmissometer that measures attenuance, or the adsorption and scattering of light by particulates in the water column. During mixis, the vertical distribution of amoebae was sporadic with significant numbers of FLA only occurring in clay layers caused by runoff after heavy rains. With the onset of thermal stratification in the lakes, phytoplankton layers began to form. Few amoebae were isolated from layers containing flagellated phytoplankton; however, significant ($P < 0.005$) numbers of FLA were isolated from two particulate layers dominated by the filamentous blue-green algae Aphanizomenon and Lyngbya, respectively. By late June, a persistent detrital or decomposition layer formed in the lower metalimnion, as well as a hypolimnetic iron layer where the Fe(2+) state was predominant. In this midsummer period, 13 Naegleria fowleri were isolated, with three from the detrital layer and seven from the iron layer. The presence of attenuation zones was found to be the best indicator of the vertical distribution of FLA in the water column, and such layers represent an important, previously undescribed habitat for potentially pathogenic FLA. (Author's abstract)
W85-06135

COPPER-BINDING CHARACTERISTICS OF EXOPOLYMERS FROM A FRESHWATER-SEDIMENT BACTERIUM,
California State Univ., Long Beach. Dept. of Microbiology.
M. W. Mittelman, and G. G. Geesey.
Applied and Environmental Microbiology, Vol. 49, No. 4, p 846-851, April, 1985. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Copper, *Sediments, *Exopolymers, *Bacterial metabolism, Humic acids, Xanthan, Carbohydrates, Metals, Fate of pollutants.

Copper-binding activity by exopolymers from adherent cells of a freshwater-sediment bacterium was demonstrated by a combination of equilibrium dialysis and flameless atomic absorption spectrometry. Crude, cell-free exopolymer preparations containing protein and polysaccharide components bound up to 37 nmol of Cu per mg (dry weight). A highly purified exopolysaccharide preparation bound up to 253 nmol of Cu per mg of carbohydrate. The conditional stability constant for the crude exopolymer-Cu complex was 7.3 x 10 to the 8th power. This value was similar to those obtained for Cu complexes formed with humic acids and xanthan, an exopolysaccharide produced by Xanthomonas campestris. Studies conducted at copper concentrations, pHs, and temperatures found in sediments from which the bacterium was isolated indicated that the exopolymers were capable of binding copper under natural conditions. (Author's abstract)
W85-06144

INTERACTION OF ACETOGENS AND METHANOGENS IN ANAEROBIC FRESHWATER SEDIMENTS,
Freshwater Biological Association, Ambleside (England).
J. G. Jones, and B. M. Simon.
Applied and Environmental Microbiology, Vol. 49, No. 4, p 944-948, April, 1985. 3 Fig, 3 Tab, 23 Ref.

Descriptors: *Anaerobic conditions, *Lake Sediments, *Bacterial metabolism, *Blelham Tarn, *England, *Acetogenic bacteria, *Methanogenic bacteria, Interstitial water, Sediments.

Anaerobic decomposition processes in the profundal sediments of Blelham Tarn (English Lake Dis-

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trict) are often limited during late summer by the input of organic carbon. The concentration of acetate in the interstitial water fell from about 100 microM (immediately after sedimentation of the spring diatom bloom) to a relatively constant value of about 20 microM in late summer, during which acetate utilization appeared to be balance by production. Addition of chloroform and molybdate caused an accumulation of cold acetate in large sediment cores and of (C-14)acetate in small cores to which (C-14)bicarbonate had been added. In both cases chloroform caused the greater accumulation, implying that acetoclastic methanogens were the more active consumers. The conversion of labeled CO2 to (C-14)acetate was inversely related, with depth, to its conversion to labeled CH4. Methanogenesis from CO2 decreased during late summer, whereas acetogenesis and acetoclastic methanogenesis increased over the same time period. The production of acetate from CO2 was generally equivalent to less than 10% of the acetate carbon utilized but could be as high as 25% of that value. Hydrogen consumption by acetogens could be as high as 50% of that utilized in methanogenesis. The role of acetogenic bacteria in anaerobic processes may therefore be of greater significance in lakes such as Blelham Tarn than in more eutrophic systems. (Author's abstract)
W85-06146

2I. Water In Plants

MECHANISTIC SIMULATION ANALYSIS OF WATER USE, LEAF ANGLES, AND GRAZING IN EAST AFRICAN GRAMINOIDS,
Syracuse Univ., NY. Biological Research Labs.
M. B. Coughenour.
Ecological Modelling, Vol. 26, No. 3/4, p 203-230, December, 1984. 9 Fig, 5 Tab, 66 Ref.

Descriptors: *Simulation analysis, *Water use, *Leaves, *Grazing, *Grasslands, *Africa, Model studies, Photosynthesis, Plant morphology, Plant physiology, Transpiration, Vegetation.

A simulation model was constructed in order to interrelate the effects of defoliation by large mammalian herbivores with growth, photosynthesis, water use and light interception of representative graminoid vegetation from East Africa. Abiotic submodels describing water flows, light penetration and interception, and energy balance relationships were interfaced with a graminoid growth model that was specifically designed to examine grazing responses. Defoliation reduced rainfall interception and reduced transpiration, thereby increasing soil and plant water levels. Morphological adaptations made compensatory shoot growth possible, but grazing effects on plant water contents largely determined the degree of compensatory growth. Above-ground productivities were greatest at moderate grazing intensities while below-ground productivities were greatest at lower grazing intensities. The success of a given water use strategy depended on simultaneous consideration of the abiotic environment and grazing. Under frequent grazing soil water conservation and reduced shoot/root ratio counteracted the depletion effect of high stomatal conductance on plant water content. Consequently photosynthesis under frequent grazing was maximized by higher stomatal conductance. Canopy geometry was adaptive for maximal light harvesting subject to the constraints imposed by transpiration, water availability, and herbivory. Total photosynthesis was increased by erect leaf angles for tall but not short grasses. For frequently grazed short-grasses the benefits of prostrate leaves associated with escape from grazing exceeded the associated costs of reduced photosynthate. (Author's abstract)
W85-05870

WATER TRANSFER FROM SOIL THROUGH PLANTS TO THE ATMOSPHERE IN WILLOW ENERGY FOREST,
Sveriges Lantbruksuniversitet, Uppsala. Energy Forestry Project.
P. J. Kowalik, and H. Eckersten.
Ecological Modelling, Vol. 26, No. 3/4, p 251-284. December, 1984. 11 Fig, 117 Ref.

Descriptors: *Transpiration, *Forests, *Simulation analysis, *Model studies, Vegetation, Canopy, Soil water potential, Air temperature, Solar radiation, Leaf water potential, Willow.

A new continuous simulation model for transpiration from energy forest was formulated and solved numerically: the model describes interrelations of water state and transpiration in the soil-plant-atmosphere system under realistic field conditions and specifically includes the water stored in the plant. In the well-known Penman-Monteith method for transpiration determination, the surface temperature and humidity are eliminated by combining the bulk aerodynamic and heat budget relationships. In the method proposed here, the surface values are not eliminated but are computed by an iterative method, using empirically established stomatal resistance for the considered type of vegetation. Driving input variables (continuously recorded) are air temperature and relative humidity, solar radiation and soil water potential. Input also includes the values of aerodynamic resistance and plant liquid water resistance as well as time-invariant relations between leaf water potential and plant water content, stomatal resistance and leaf water potential, stomatal resistance and solar radiation, and soil-root hydraulic resistance and soil water potential, respectively. The simulation runs with a fixed time interval of 1 min. The model describes the changes in the diurnal course of transpiration, stomatal behavior, leaf water potential and leaf canopy temperature of willow plantations. The calculated daily cumulative values of transpiration (including evaporation of intercepted water) compared well with measured values observed in lysimeters in Salix stands at Studsvik (Sweden). The model has wider application than simply for willow; a change in the computer simulation from one plant species to another may be achieved by altering the root, xylem and leaf parameters of the model. (Author's abstract)
W85-05871

COMPARISONS OF FLOODING TOLERANCE IN FOUR BARLEY CULTIVARS (HORDEUM VULGARE) GROWN IN FINLAND, AND IN CAREX ROSTRATA,
Helsinki Univ. (Finland). Dept. of Botany.
K. Fagerstedt.
Annales Botanici Fennici, Vol. 21, No. 4, p 292-298, 1984. 1 Fig, 1 Tab, 23 Ref.

Descriptors: *Barley, *Flooding, *Sedges, *Plant physiology, Vegetation, Flood tolerance, Chlorophyll, Enzymes.

Four Finnish barley cultivars (Hordeum vulgare L. cvs. Hankkija-673, Pokko, Kustaa, and No. 59) and Carex rostrata Stokes were grown in sand culture in flooded conditions. When the flooding had lasted 0, 5, 10 and 15 days, root samples were taken for measurements of alcohol dehydrogenase (ADH) and glucose-6-phosphate dehydrogenase (G6-PDH) activity, and leaves for chlorophyll determinations. In all the barley cultivars the ADH activity was higher in the flooded plants than in the controls. In C. rostrata no changes occurred in ADH activity. The G6-PDH activity remained at the same level in the barely cultivars throughout the flooding period. The flooded barely seedlings rapidly developed chlorosis; in contrast the chlorophyll content of the oldest leaves of C. rostrata increased somewhat during the experiment in both the flooded and control plants. The results agree with Crawford's metabolic theory on flooding tolerance. The reasons for chlorosis in the leaves and flooding injury in the roots are discussed. (Author's abstract)
W85-05874

WATER USE EFFICIENCY OF NARROW ROW COTTON,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
For primary bibliographic entry see Field 3F.
W85-05918

PROLINE ACCUMULATION IN THE GRAINS, FLORAL ORGANS AND FLAG LEAVES OF WHEAT AND BARLEY IN RESPONSE TO VARIATIONS IN WATER AND NITROGEN SUPPLY,
Waite Agricultural Research Inst., Glen Osmond (Australia). Dept. of Plant Physiology.
D. Aspinall, K. V. M. Parameswaran, and R. D. Graham.
Irrigation Science, Vol. 4, No. 3, p 157-166, August, 1983. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Water stress, *Proline, *Wheat, *Barley, *Nitrogen, Plant growth, Drought, Plant water relations, Leaves, Grain, Water potential.

In wheat plants grown at two levels of water supply and three levels of nitrogen supply, proline accumulation in flag leaves and ears was enhanced by low water potential. Proline was increased by the presence of nitrogen through its effects on water potential. There were marked differences between two cultivars under study. With the ears of both wheat and barley a considerable discontinuity existed in accumulation of proline under stress. While the maternal tissues accumulated high concentrations of proline under stress, very little increase was found in the grain. This partitioning occurred also in excised ears, and so was independent of the rest of the plant; nor was it dependent on in situ synthesis of the respective tissues alone, since exogenous L-proline was also distributed in the same way. Some exogenously supplied DL-proline however, did enter the grain. Grain proline content was not maintained at a low level due to proline incorporation into protein. The significance of these results is discussed in relation to the evidence that wheat plants under water stress nevertheless maintain a high water potential in the grain. (Baker-IVI)
W85-05919

WATER UPTAKE OF BARLEY ROOTS FROM RHIZOSPHERIC SOIL SOLUTIONS OF DIFFERENT SALT CONCENTRATIONS,
Technische Univ., Brunswick (Germany, F.R.). Leichtweiss Inst. for Water Research.
U. Schleiff.
Irrigation Science, Vol. 4, No. 3, p 177-189, August, 1983. 8 Fig, 19 Ref.

Descriptors: *Soil water, *Salinity, *Rhizosphere, *Barley, Absorption, Roots, Transpiration, Saline soils, Osmotic potential, Soil solution, Plant growth.

Results of a simple method to obtain data on the root uptake of soil water from rhizospheric soil solutions differing in salt concentrations are presented. Some parameters of the shoots are presented in order to relate their growth potential in the osmotic potential of the rhizospheric soil solution. Restricted water availability is the main growth limiting factor in saline soils. The water supply of the shoot from a saline soil solution is a very complex process. It is suggested that there are two essential mechanisms involved in the water uptake of a root system, neither of which have been elucidated quantitatively as yet. First, nonrhizospheric soil solution moves into the rhizosphere, from where the soil water is taken up by the roots leaving behind most of the translocated salts in the rhizospheric soil solution. Simultaneously other roots grow into nonrhizospheric soil, which contains soil solution of low salt concentrations. Thus salt tolerance and total water uptake of a root system from a saline soil are essentially affected by two factors: the ability of a root to absorb soil water from rhizospheric soil solutions of decreasing osmotic potentials and the expansion of a root system in order to utilize soil solution of low salt concentrations from outside the rhizosphere. From the results of this experiment one can estimate the effect of increasing salt concentration in the rhizospheric soil solution on the water uptake by roots of a salt tolerant plant. A plant of lower salt tolerance such as maize did not depress the osmotic potential of its rhizospheric soil solution below -0.9 MPa. In contrast to maize, barley roots reduced the value to less than -2.5 MPa. From a soil solution of -0.9 MPa, when roots of young maize plants ceased their water uptake, the water uptake rate of barley roots was only slightly reduced. (Baker-IVI)

W85-05920

EFFECT OF SODIUM AND BICARBONATE IRRIGATION WATERS ON SODIUM ACCUMULATION AND ON MAIZE AND WHEAT YIELDS IN NORTHERN INDIA,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
M. S. Bajwa, G. S. Hira, and N. T. Singh.
Irrigation Science, Vol. 4, No. 3, p 191-199, August, 1983. 4 Fig, 7 Tag, 12 Ref.

Descriptors: *Sodium, *Bicarbonate, *Irrigation water, *Crop yield, *Corn, *Wheat, *India, Salinity, Plant growth, Irrigation effects, Hydrogen ion concentration, Electrical conductivity, Saline soils, Infiltration rate, Gypsum, Saline water.

The effect of five years use of irrigation water containing sodium and bicarbonate on sodium accumulation in soils and yields of maize ahd wheat was studied in pots embedded in trenches in the field. Differences in irrigation water quality were significantly reflected in pH and electrical conductivity of soils throughout the depth. Nagar soil retained twice as much Na and Cl as Tulewal soil. Clay content and CEC on Nagar soil were double that of Tulewal sandy loam. Final water infiltration rates in Tulewal soil were about twice that compared with Nagar loam. Higher infiltration rate and low water retention capacity of coarse textured soil resulted in displacing the salts to deeper depths from where their redistribution to surface was limited as compared with the finer textured soil. Gypsum application reduced the pH and the ESP of both soils. In comparison with canal water, the ESP of soil receiving sodium water was high even after gypsum treatment. Pooled analysis of data for five years showed that maximum yields for maize fodder and wheat were obtained with canal water. Increase in salt concentration, sodium adsorption ratio, and residual sodium carbonate of irrigation water significantly reduced maize fodder yield. Simultaneous application of gypsum and salt-treated water significantly increased maize yield as compared with salt water alone but the yields were still significantly lower than those obtained with canal water. Single application of gypsum on cumulative basis showed less improvement in soil properties as well as in maize-fodder yield. Application of 50% extra depth of irrigation water over and above the evapotranspiration needs also increased maize fodder yield. Wheat yields were not significantly affected by any of these waters. (Baker-IVI)
W85-05921

MICROCLIMATE AND CROP RESPONSES TO CENTER PIVOT SPRINKLER AND TO SURFACE IRRIGATION,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
For primary bibliographic entry see Field 3F.
W85-05922

CHLOROPHYLL FLUORESCENCE INDUCTION: A SENSITIVE INDICATOR OF WATER STRESS IN MAIZE PLANTS,
Universite Libre de Bruxelles (Belgium).Lab. de Physiologie Vegetale.
M. Havaux, and R. Lannoye.
Irrigation Science, Vol. 4, No. 2, p 147-151, June, 1983. 1 Fig, 19 Ref.

Descriptors: *Chlorophyll, *Fluorescence, *Corn, *Water stress, Indicators, Drought, Leaves, Chloroplasts.

When green plants are illuminated they fluoresce. Upon a dark-light transition, the fluorescence yield shows several transients. This chlorophyll fluorescence induction phenomenon is a sensitive indicator for photosynthetic processes. Measurements of chlorophyll fluorescence provide a rapid and sensitive means of following the onset of drought injury in maize plants. In maize submitted to water stress sufficient to dehydrate leaves to 68% of original water content, a drastic reduction of the maximum to the minimum chlorophyll fluorescence ratio and strong inhibition of the slow fluorescence induction transients were noted. The maximum/minimum ratio value and the typical PSMT induction sequence were restored following the removal of drought conditions. Irreversible damage on the chloroplastic membranes was evidenced by the fact that the slow quenching of chlorophyll fluorescence to the steady state remained noticeably altered. This method could be valuable for rapid detection of drought injury in the field by using a portable fluorometer. (Baker-IVI)
W85-05931

DIURNAL CHANGES IN THE WATER RELATIONS AND TRANSPIRATION OF A SOYBEAN CROP SIMULATED DURING THE DEVELOPMENT OF WATER DEFICITS,
Gdansk Technical Univ. (Poland). Inst. of Hyrdotechnics.
P. J. Kowalik, and N. C. Turner.
Irrigation Science, Vol. 4, No. 4, p 225-238, December, 1983. 7 Fig, 36 Ref.

Descriptors: *Soybeans, *Diurnal variation, *Transpiration, *Simulation, *Water deficit, Plant water potential, Leaves, Leaf temperature, Mathematical models, Stomatal resistance, Water storage.

A mathematical model was developed to describe the changes in the diurnal patterns of leaf water potential and transpiration when a crop is exposed to increasing water deficits in the field. The model specifically includes the water stored in the plant. The model was developed for soybeans but could be extended to other crops with the substitution of suitable parameters. Feedback relationships are described for leaf temperature, transpiration, stomatal resistance, leaf water potential and amount of water stored in the plant. The calculated values of leaf water potential and transpiration compared well with measured values observed during the development of water deficits in a soybean crop growing on a grey cracking clay soil. The model should prove beneficial in refining and making models for irrigation scheduling more useful. (Moore-IVI)
W85-05932

EFFECT OF WATER STRESS AT THREE GROWTH STAGES ON THE YIELD AND WATER-USE EFFICIENCY OF DWARF WHEAT,
Haryana Agricultural Univ., Hissar (India). Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W85-05933

WATERLOGGING OF CONTAINERIZED RABBITEYE BLUEBERRIES IN FLORIDA,
Florida Univ., Gainesville. Dept. of Fruit Crops.
F. S. Davies, and D. Wilcox.
Journal of the American Society of Horticultural Science, Vol. 109, No. 4, p 520-524, July, 1984. 3 Fig, 4 Tab, 21 Ref.

Descriptors: *Flooding, *Plant growth, *Blueberries, *Florida, Soil properties, Temperature effects, Abaxial diffusive resistance, Flooding stress, Leaves, Containerized plants.

Attempts were made to determine what effects flooding had at various times during the season on growth and survival of rabbiteye blueberry, to test if abaxial diffusive resistance (ADR) of the leaf is an accurate indicator of flooding stress, and to compare the extent of damage in native soils compared with a peat:pine bark mixture commonly used in the production of containerized blueberies. Woodward plants survived 26 days of flooding with little shoot damage, but regrowth was severely impaired for the next 15 weeks. Leaf ADR of flooded Woodard rabbiteye blueberry plants was significantly greater than for nonflooded plants after 7 days of flooding and remained so over the course of the experiment. Attainment of maximum ADR was not an accurate indicator of plant survival since all plants lived. Woodward plants flooded from May to July survived as long as 58 days of flooding, but plants were severely damaged. Root resistance contributed significantly to ADR of flooded plants. ADR decreased about 80% within 30 min of root excision and became stable after 1 hr, while ADR of nonflooded plants did not change with excision. ADR was significantly greater for flooded plants in peat:pine bark than for those in Leonfine sand beginning 7 days after flooding. ADR was comparable for both soil types after 21 days of fooding. Developmental stage or cultivar seemed to have less effect on ADR than soil temperatures. An increase in ADR was a good indicator of short term flooding damage and cessation of shoot growth, but not of survival. Shoot growth of plants growing in native soil was affected less by flooding than that in a peat:pine bark mixture, although survival time was unaffected. Consequently, soil type should be considered when making flooded comparisons within and among species. (Baker-IVI)
W85-06059

CROP MOISTURE STRESS ANALYSIS USING COMPUTER-CONTROLLED ENVIRONMENTAL CHAMBERS AND SIMULATED WEATHER SEQUENCES,
Nebraska Univ.-Lincoln. Inst. of Agriculture and Natural Resources.
G. E. Meyer, J. A. Lamb, and W. E. Splinter.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 7, p 1862-1870, November-December, 1984. 9 Fig, 3 Tab, 29 Ref.

Descriptors: *Moisture stress, *Data interpretation, *Environmental chambers, *Weather, *Crop yield, Corn, Soybeans, Crop production, Water use efficiency.

Computer-controlled environmental plant growth chambers (PGC) were used to measure responses of water stressed and non-stressed corn and soybeans to simulated weather sequences. Simulated weather was patterned after actual hourly environmental conditions measured during a previous summer with a CR-21 weather station. Seasonal and diurnal crop water use in the PGC was controlled and monitored with an electronic lysimeter and a second computer system. Seasonal crop phenological responses were measured and show a remarkable pattern of stages of growth similar to field plants. 'LAST DAY' measurements of seed dry matter and seed number gave from 15.0 to 20.1 g per 100 seed and from 5 to 60 fruits per plant for soybeans. The PGC can be used to elicit the upper and lower limit growth responses to moisture-stress for certain crops. (Author's abstract)
W85-06097

EFFECTS OF SOIL BULK DENSITY AND WATER REGIMEN ON ROOT GROWTH AND UPTAKE OF PHOSPHORUS BY RYEGRASS,
University of New England, Armidale (Australia). Dept. of Agronomy and Soil Science.
For primary bibliographic entry see Field 2G.
W85-06098

WATER USE EFFICIENCY OF WHEAT IN A MEDITERRANEAN-TYPE ENVIRONMENT. II SOME LIMITATIONS TO EFFICIENCY,
South Australia Dept. of Agriculture, Adelaide.
R. J. French, and J. E. Schultz.
Australian Journal of Agricultural Research, Vol. 35, No. 6, p 765-775, 1984. 3 Fig, 2 Tab, 41 Ref.

Descriptors: *Water use efficiency, *Wheat, *Crop yield, *Nutrient requirements, Evaporation, Transpiration, Solar radiation.

Water use efficiency and yield of wheat were reduced by insufficient leaf area and by inadequate content of nutrients in the top growth. Yields from field trials were compared with the potential yield, and limitations caused by weeds, the incidence of diseases and the harvest index were reviewed. Crop production is governed by the interception of radiant energy and the efficiency of converting this energy to dry matter. In the early growth stages, the interception is limited by the leaf canopy, and it is not until a leaf area index (LAI) of about 3 has been obtained that the crop starts producing dry matter efficiently. Average values for nutrient content of plant tops at different stages of growth

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were measured for 31 sites. The maximum content of nutrient (except for potassium and chlorine) occurs close to the soft dough stage and the nutrient content at maturity is generally lower. Maximum nitrogen content is related to water use; after the soil evaporation value of 110 mm, the efficient crops take up 0.65 kg/ha nitrogen for each mm of water transpired. Rates of accumulation of nutrients in the top growth to give maximum yield of dry matter per mm water transpired indicate that to produce the potential yield of 55 kg/ha dry matter (and 20 kg/ha grain) per mm water transpired, the crop needs to take up either by mass flow or diffusion, 0.65 kg/ha nitrogen and 0.07 kg/ha phosphorus for each mm water transpired. The data highlight the need for field experiments to define the evaporation and transpiration components of water use in each environment. They also indicate the need for multi-factorial treatments to overcome all yield limitations and thereby attain the potential yield. (Collier-IVI)
W85-06100

EFFECTS OF WATER STRESS ON INTERNAL WATER RELATIONS OF APPLE LEAVES,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Biologia.
L. Fanjul, and P. H. Rosher.
Physiologia Plantarum, Vol. 62, No. 3, p 321-328, November, 1984. 6 Fig, 3 Tab, 47 Ref.

Descriptors: *Apple trees, *Trees, *Water stress, *Plant physiology, Leaves, Drought, Stress, Sugars.

The capacity of apple (Malus pumila Mill. cv. James Grieve and Golden Delicious) pot- and orchard-grown trees to adjust osmotically in response to drought was investigated. Stressed leaves exhibited alterations in the moisture release curves when compared to well hydrated control leaves. Results suggest that osmotic adjustment occurred in both field- and pot-grown trees. Water potential for zero turgor was lowered by 0.5 MPa in leaves of potted trees and by 1.1 MPa in leaves of field-grown trees as a result of stress treatments. A decrease in the osmotic potential was responsible for that adjustment allowing the leaf to maintain turgor at lower water potentials and relative water contents. The extent of adjustment was similar for both potted and orchard trees despite the difference in the rate of stress imposition and its intensity. Changes in the concentration of sugars apparently contributed to this adjustment. (Author's abstract)
W85-06103

TRIADIMEFON REDUCES TRANSPIRATION AND INCREASE YIELD IN WATER STRESSED PLANTS,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
R. A. Fletcher, and V. Nath.
Physiologia Plantarum, Vol. 62, No. 3, p 422-426, November, 1984. 5 Fig, 3 Tab, 12 Ref.

Descriptors: *Fungicides, *Water stress, *Crop yield, *Transpiration, Wheat, Peas, Soybean, Triadimefon, Radish.

Two-week-old wheat (Triticum aestivum L. cv. Fredrick), peas (Pisum sativum L. cv. Little Sweetie) and soybean (Glycine max L. cv Hodgson) seedlings were transferred to paper cups containing various concentrations of triadimefon (1-(4-chlorophenoxy)-3,3 dimethyl-1 (1H-1,2,4-triazol-1-yl)-2 butanone) a fungicide. Twelve days after treatment, triadimefon (20 micro g/ml) significantly reduced transpiration in wheat, peas and soybeans by 40, 29 and 19%, respectively. The reduction of transpiration prevented the leaves from wilting and becoming senescent. In another experiment, triadimefon was applied as a soil drench after the initiation of flowers in soybeans and peas and after swelling in radish (Raphanus sativus L. cv, Cherry Belle) roots. After treatment the water level was maintained at half field capacity. In all three species, the treated plants were shorter, more compact and had thicker and greener leaves than the control plants. In the case of radish, the treatment also prevented flowering. Triadimefon significantly increased the seed yield of soybeans and peas and the root to shoot ratio in radish. Hence root application of triadimefon reduces transpiration, protects plants, and increases yield under water stress conditions. (Author's abstract)
W85-06104

EFFECTS OF LOW CONCENTRATIONS OF O3, LEAF AGE AND WATER STRESS ON LEAF DIFFUSIVE CONDUCTANCE AND WATER USE EFFICIENCY IN SOYBEAN,
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
P. B. Reich, A. W. Schoettle, and R. G. Amundson.
Physiologia Plantarum, Vol. 63, No. 1, p 58-64, January, 1985. 4 Fig, 3 Tab, 34 Ref.

Descriptors: *Ozone, *Leaves, *Water stress, *Soybean, *Water use efficiency, Irrigation, Stomata, Plant tissues.

Ozone, leaf age and water stress each affected leaf conductance in soybean (Glycine max (L.) Merr. Hodgson), but there were no interactions among these factors. Exposure to increased concentrations of O3 (0.01, 0.05, 0.09, and 0.13) resulted in linear declines in abaxial and adaxial conductances in leaves of all ages. There were no differences in relative response to O3 between the two leaf surfaces. For well-watered plants, water use efficiency also decreased with exposure to increased O3 concentrations (water-stressed plants were not tested). Abaxial conductance increased as leaves aged from 4 to 10 days and then declined with further aging. Adaxial conductance decreased with all increases in leaf age beyond 4 days, and the ratio of abaxial/adaxial conductance increased continuously throughout the leaf lifespan. During water-stress cycles (water withheld for 2-3 days) leaves of water-stressed plants had lower conductances than those from well-watered plants, and there was no difference in relative response between abaxial and adaxial stomata. (Author's abstract)
W85-06105

INTERDEPENDENCE OF GROWTH, WATER RELATIONS AND ABSCISIC ACID LEVEL IN PHASEOLUS VULGARIS DURING WATERLOGGING,
Utrecht Rijksuniversiteit (Netherlands). Botanical Lab.
H. Wadman-van Schravendijk, and O. M. van Andel.
Physiologia Plantarum, Vol. 63, No. 2, p 215-220, February, 1985. 5 Fig, 33 Ref.

Descriptors: *Plant growth, *Abscisic acid, *Beans, *Water potential, Plant physiology, Transpiration, Diffusion resistance, Flooding.

The interdependence between changes in growth and water relations after waterlogging was investigated by recording simulaneously growth, transpiration, water potential, turgor, leaf diffusion resistance and abscisic acid content in Phaseolus vulgaris L. cv. bruine Noord-Hollandse. Growth was inhibited immediately after flooding, whereas transpiration decreased gradually to a low level in about three days. The first two days after flooding a small increase in abscisic acid content in the leaves was observed which accompanied by an increase in diffusion resistance. The increase in abscisic acid content could result from an inhibited export from the leaves. After the first two days a decrease in water potential and turgor was accompanied by a drastic increase in both abscisic acid content and diffusion resistance. This large increase in abscisic acid content occurred before the turgor had reached its minimum value. The change in diffusion resistance kept showing a lag of about one day with the change in abscisic acid content. The possibility is discussed that besides abscisic acid also its metabolite phaseic acid is involved in stomatal closure. After the formation of adventitious roots on the hypocotyl, abscisic acid level, diffusion resistance, water potential and turgor returned to the control values. Transpiration showed a slow recovery from the sixth day after flooding, whereas growth was inhibited for at least nine days. A remarkable similarity exists between our observations on the responses of bean plants to flooding and the well known responses to drought. (Author's abstract)
W85-06106

EFFECTS OF SINGLE AND MULTIPLE WATERLOGGINGS ON THE GROWTH AND YIELD OF WINTER WHEAT ON A CLAY SOIL,
Agricultural Research Council, Wantage (England). Letcombe Lab.
R. K. Belford, R. Q. Cannell, and R. J. Thomson.
Journal of the Science of Food and Agriculture, Vol. 36, No. 3, p 142-156, March, 1985. 5 Fig, 9 Tab, 34 Ref.

Descriptors: *Wheat, *Plant growth, *Soil water, *Waterlogging, *Clays, Oxygen, Population density, Nitrates, Nutrients, Crop yield.

The response of winter wheat to surface waterlogging in monoliths of clay soil in lysimeters was studied. The treatments, selected as corresponding to the most extreme likely in Britain, were: 5 days of waterlogging in October between germination and emergence; 42 days of waterlogging during tillering January and February; and 21 days from mid-April during stem elongation. These treatments were used singly and in all combinations and were compared with a freely-drained control. During waterlogging, the oxygen concentration in the soil declined most rapidly when the soil was warmer (in October and April) and at the shallower depths (5, 20 cm); also, a decrease in soil solution nitrate was accompanied by an increase in nitrous oxide evolution. Pre-emergence waterlogging restricted plant population to 35/sq m compared to 338/sq m under free drainage. Subsequently, compensatory growth resulted from diminished interplant competition for nitrogen, water and light; a greater proportion of tillers survived and the flag leaves were larger, although ears at harvest were fewer in all treatments waterlogged before emergence. After waterlogging during tillering, grain loss was accounted for entirely by a decrease in the number of ear-bearing tillers. After waterlogging during stem elongation, yield losses were associated primarily with fewer grains per spikelet. Grain yield was depressed by about 4-12% after single waterloggings, by 20% after any two waterloggings, and by 32% when plants were waterlogged on all three occasions. (Author's abstract)
W85-06136

MEASUREMENTS OF CANOPY INTERCEPTION AT THE ST. ARNOLD LYSIMETER STATION/MUNSTERLAND (DIE INTERZEPTIONSMESSUNGEN AN DER GROSSLYSIMETERANLAGE ST. ARNOLD),
Amt fuer Wasser- und Abfallwirtschaft, Muenster (Germany, F.R.).
M. Schroder.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 5/6, p 164-171, December, 1984. 10 Fig, 9 Tab, 6 Ref.

Descriptors: *Interception, *Canopy, Evaporation, Precipitation, Forests, Grasslands, Water loss, Wetting capacity, Wetting loss.

An objective method is described for the determination of the wetting capacity and wetting losses (interception loss and interception evaporation) for particular precipitation events and daily precipitation totals and thus description of the relationships between net-supply rainfall in a forest area and open-land rainfall in an unwooded grassland area. These functions are of importance in calculating area-related water balances with corresponding temporal resolution. It appears to be necessary to introduce a characteristic index for forest crops, similar to the leaf area index, which can be efficiently used in determining the wetting capacity. Roughly estimated values for the net-supply rainfall in a forest area can be derived from the open-land rainfall on the basis of linear interrelations between these two precipitation amounts, calculated from monthly precipitation data. (Moore-IVI)

W85-06158

2J. Erosion and Sedimentation

RELATION BETWEEN THE COMPOSITION OF GRAVEL FRAGMENTS OF THE JIZERA RIVER AND THE GEOLOGY OF ITS BASIN (VZTAH MEZI SLOZENIM ULOMKU FLUVIALNICH SEDIMENTU JIZERY A GEOLOGICKOU STAVBOU JEJIHO POVODI),
Karlova Univ., Prague (Czechoslovakia). Dept. of Geology.
J. Plaminkova, and J. Plaminek.
Acta Universitatis Carolinae - Geologica, No. 4, p 297-309, 1983. 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Jizera River, *Gravel, *Riverbeds, *Sediments, *Poland, Petrography, Geology, Sediment transport.

The petrographic composition of the fraction exceeding 1 cm in the fluviatile sediments of the river Jizera is closely associated with the geological structure of the drainage basin. The content of a material in a clastic sediment corresponds to the relation where the areal extent of the occurence of this material in its source area and the average length of its transport are considered. Curves were plotted expressing the ascertained contents of the individual materials contained in the river sediment. The departures of the expected from the real contents of these materials was evaluated and resistance to transport was determined. The results obtained on the basis of this method may be used (1) for the assessment of the quantities of the individual materials, based on study of fluviatile sediments in geologically unsufficiently explored areas, (2) for an assessment of the amounts and the petrographic composition of the gravels, based on an analysis of the geological structure of the drainage basin, in any place of the river, (3) for the reconstruction of the pre-recent geological structure of the basin, on the basis of studies of terrace sediments. (Author's abstract)
W85-05859

OFF-SITE COSTS OF SOIL EROSION,
Conservation Foundation, Washington, DC.
For primary bibliographic entry see Field 5C.
W85-05941

SEDIMENT DEPOSITS IN DRAINAGE DITCHES: A CROPLAND EXTERNALITY,
Ohio State Univ., Columbus.
D. L. Forster, and G. Abrahim.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 141-143, January-February, 1985. 1 Tab, 8 Ref.

Descriptors: *Drainage ditches, *Sediment deposition, Ohio, Erosion control, Costs, Soil erosion, Soil conservation, Cropland.

Soil loss estimates have been used as a proxy for off-site costs, but the relationship between soil loss and off-site costs remains inexact. One externality of soil loss from cropland is sedimentation of drainage ditches. A study was conducted in six Ohio counties to determine the relationship between gross soil erosion estimates and actual sediment deposition in water bodies and to measure one of the downstream costs of soil loss, sediment removal from drainage ditches. Drainage ditch sediment deposits related significantly to gross soil erosion estimates calculated with the universal soil loss equation (USLE). Removal of the sediment cost an average of 45 cents per cropland acre served by the drainage ditches. This cost could be reduced nearly 25% with the use of common soil conservation practices. The results support the contention that gross erosion near water bodies causes more sediment deposition that distant soil erosion. It follows that conservation practices used in proximity to drainage ditches can effectively reduce sediment deposition. (Moore-IVI)
W85-05965

CHANNEL CROSS-SECTION CHANGES IN MISSISSIPPI'S GOODWIN CREEK,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
J. B. Murphey, and E. H. Grissinger.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 148-153, January-February, 1985. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Channel morphology, *Bank erosion, *Goodwin Creek, *Mississippi, Lithology, Stream banks, Bed erosion, Sediment erosion, Slab failure.

Selected channel cross sections in a 3.86-km reach of Goodwin Creek in southeastern Panola County, Mississippi, were periodically resurveyed from November 1977 through June 1983. Rates of channel enlargement varied with bank and bed material lithology, but short-term changes were variable in time and space. Banks composed of early Holocene deposits were relatively stable; however, they failed in polygonal blocks after bank toe removal. Banks composed of late-Holocene deposits were more erodible, and gravity-induced slab failures followed loading and tension crack development. Within individual reaches, channel changes were highly variable. Average net erosion of the channel bed and banks over the 5 1/2-year period was about 21 tons of sediment from each meter of channel length in the reach. (Author's abstract)
W85-05967

PLANT NUTRIENT LOSSES BY SOIL EROSION AND MASS MOVEMENT AFTER WILDFIRE,
Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
J. D. Helvey, A. R. Tiedemann, and T. D. Anderson.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 168-173, January-February, 1985. 8 Fig, 6 Tab, 22 Ref.

Descriptors: *Fire, *Soil erosion, *Mass wasting, *Nutrients, *Washington, Sediment yield, Debris torrents, Suspended solids, Sediment transport, Nitrogen, Phosphorus, Calcium, Magnesium, Potassium, Sodium, Alluvial fans, Forest watersheds.

Annual sediment yields increased as much as 180 times above pre-fire levels after wildfire destroyed all vegetation on three forested watersheds in the Entiat Experimental Forest in the eastern Cascade Range of Washington. Sediment was transported in debris torrents, in suspension, and as bedload. Suspended sediment concentration correlated well with turbidity. Total N losses by erosion processes increased from a pre-fire average of 0.004 kg/ha/yr to 0.16 kg/ha/yr. Available P losses increased from 0.001 ka/ha/yr before the fire to 0.014 kg/ha/yr. The combined erosion loss of Ca, Mg, K, and Na increased from an average of 1.98 kg/ha/yr before the fire to 54.3 kg/ha/yr. Greatest nutrient losses occurred with mass soil movements (debris torrents). Material deposited in alluvial fans represented losses of 13.5 kg/ha of total N, 3.4 kg/ha available P, and 3,850 kg/ha of Ca, Mg, K, and Na combined. An unmeasured but certainly large quantity of soil and rock entered the river during the debris flows. Nutrient losses on eroded soil, although greater than solution losses, were insignificant to site productivity and stability compared with the physical effects of channel scouring associated with greater runoff, higher peak flows, and debris torrents following fire. (Author's abstract)
W85-05972

PARTICLE SIZE DISTRIBUTION, CHEMICAL COMPOSITION AND CALCULATION OF STANDARD MINERALOGICAL COMPOSITION OF SUSPENDED SEDIMENT TRANSPORTED BY A STREAM IN OKINAWA ISLAND,
Okinawa Inst. of Physicachemical Research, Okinawa City.
E. Tohyama.
Japanese Journal of Limnology, Vol. 45, No. 4, p 253-259, October, 1984. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Stream sediments, *Chemical composition, *Minerals, *Makiminato, *Okinawa, Sediment transport, Particle size, Suspended sediments, Clay, Silt, Sand.

Makiminato stream drains the central part of the Shimajiri marl area, which is situated in the southern province of Okinawa Island, and subsequently flows into the East China Sea. Suspended sediment delivered by Makiminato during a flood period consists of about 40% clay, 58% silt and 2% sand in terms of weight. The sediment, judging from its high Al2O3 content, can be classified as an argillaceous type. The chemical composition of the sediment is more analogous to that of terrigenous clay than red clay and nearshore marine clay. In comparison to the terrigenous clay, it is relatively low in SiO2 and significantly high in CaO which is traceable to the calcareous fossils within the Shimajiri formation and the Ryukyu limestones. The mineral composition of the sediment is calculated by recasting the chemical oxide components into standard minerals: plagioclase, K-feldspar, Ca-feldspar, calcite, dolomite, enstatite, anhydrite, chlorite, montmorillonite, kaolinite, illite, ilmenite, quartz and hematite. (Moore-IVI)
W85-05996

EFFECTS OF BENTHIC MACROINVERTEBRATES ON THE EXCHANGE OF SOLUTES BETWEEN SEDIMENTS AND FRESHWATER,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2K.
W85-06005

CHANNEL CHANGES AND INVERTEBRATE FAUNAS BELOW NANT-Y-MOCH DAM, RIVER RHEIDOL, WALES, UK,
Loughborough Univ. of Technology (England). Dept. of Geography.
For primary bibliographic entry see Field 6G.
W85-06007

WATER AND SEDIMENT ROUTING THROUGH CURVED CHANNELS,
San Diego State Univ., CA.
For primary bibliographic entry see Field 2E.
W85-06040

SCOUR AT CYLINDRICAL BRIDGE PIERS IN ARMORED BEDS,
Auckland Univ. (New Zealand).
A. J. Raudkivi, and R. Ettema.
Journal of Hydraulic Engineering, Vol. 111, No. 4, p 713-731, April, 1985. 10 Fig, 2 Tab, 7 Ref, 1 Append.

Descriptors: *Scour, *Piers, *Bridges, *Armored beds, Sediment erosion, Bed sediments, Hydraulic models, Model studies.

The depth of scour at a pier placed in a river bed covered by an armor layer of sediment that is coarser than the underlying bed sediment may significantly exceed that which occurs if the pier were placed in an unlayered bed. Laboratory experiments were conducted on the development of scour around a cylindrical pier placed in a bed a cohesionless sediment overlain by an armoring layer of coarser sediment. Both the armoring layer and the bed beneath it were composed of uniform-sized sediment. The presence of an armor layer can extend the clear water condition of local scour at a pier from the limit for the stability of the bed sediment to the stability limit for the armor layer covering the finer sediment. When the armor layer remains intact around the pier, a maximum equilibrium depth of local scour of about three times the effective pier width can result. The simultaneous development of the local scour around the pier and the localized bed scour, or armor-break scour can lead to a large number of equilibrium scour forms. There are two significant depths of scour pertaining to the scour of armored bed sediments in the vicinity of a pier: the total depth of scour measured at the pier, and the maximum depth of localized bed scour due to the erosion of the armor layer. (Moore-IVI)
W85-06042

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DEBRIS FLOWS AND DEBRIS TORRENTS IN THE SOUTHERN CANADIAN CORDILLERA,
VanDine Geological Engineering Services, Victoria (British Columbia).
D. F. VanDine.
Canadian Geotechnical Journal, Vol. 22, No. 1, p 44-68, February, 1985. 17 Fig, 4 Tab, 86 Ref, 1 Append.

Descriptors: *Debris torrents, *Debris flows, *Mass wasting, British Columbia, Yukon, Alberta, Debris, Bridges, Flow discharge, Creeks, Slope, Check dams, Slope stabilization, Land use, Debris barriers.

In Canada, debris torrents (also referred to as channelized debris flows) occur in parts of British Columbia, Alberta, and the Yukon. At least 17 deaths and an estimated $100 million of damage to bridges and property can be attributed to this natural hazard. The debris mainly comprises large boulders, rock fragments, gravel- to clay-sized material, tree and wood mulch-materials that accumulate in the mountain creeks. To be susceptible to a debris torrent, a creek must have a drainage area within a critical range, a profile that is sufficiently steep, an accumulation of debris, and some form of triggering mechanism. The most common triggering mechanism is an extreme water discharge, which may result from a very intense rainfall or a temporary damming of the creek. In western Canada, the resulting torrents involve masses of debris, typically less than 50,000 cu m, that the travel down creeks at speeds between 3 and 12 m/s. Several passive and active forms of mitigation can be used to reduce the impact of debris torrents on creek crossings and neighboring residents. Passive mitigation methods include avoidance of the area, relocation of structures and facilities, land use restrictions, and some form of warning system. Active mitigation methods include remedial measures to remove or counter the causes, and various forms of designed protection. Constructing check dams near the headwaters of the creek and stabilizing the valley slopes that border the creeks are examples of remedial measures. Constructing debris barriers or clear span bridges with adequate clearance are examples of designed protection. Howe Sound, north of Vancouver, British Columbia, has had a relatively high number of debris torrents. Recently, several major studies have addressed the extent of the hazard and recommended mitigative measures for this area. Many of the examples presented in this paper are drawn from this case history. (Author's abstract)
W85-06044

NITROGEN AND PHOSPHORUS EXPORTATION IN THE GARONNE BASIN (FRANCE),
Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
For primary bibliographic entry see Field 5B.
W85-06049

SOIL EROSION STUDY OF EXPOSED HIGHWAY CONSTRUCTION SLOPES AND ROADWAYS,
For primary bibliographic entry see Field 4D.
W85-06069

ROADSIDE EROSION CAUSES AND FACTORS: MINNESOTA SURVEY ANALYSIS,
R. Sullivan, and L. E. Foote.
Transportation Research Record, Vol. 948, p 47-54, 1984. 8 Fig, 1 Tab.

Descriptors: *Erosion, *Soil erosion, *Road construction, *Minnesota, Construction methods, Management planning.

A roadside erosion survey was conducted along all state, county, and township roads in Minnesota to identify and document the location and amount of erosion present. Roadside survey field work was conducted in the spring after snowmelt, but before extensive vegetation growth, or in the fall after growth had stopped and had been affected by frost. A total of 116,203,336 cu ft of erosion was distributed over 17,702 sites located along 115,570 miles of roadway. Erosion ranged from 20,894 to 23,444,632 (median: 521,681) cu ft per county and from 17 to 17,173 (median: 433) cu ft per mile. The average volume of soil lost per county was 1,335,728 cu ft, but only 15% of the counties had more than the average estimate. Specific causes of soil loss in counties with the most severe loss included lack of vegetative cover, rough terrain, use of roadsides as borrow areas, lack of erosion control during development, recreational activities, lack of past administrative emphasis on erosion control and repair, and lack of funds to correct existing problems. Occurrences of erosion per county ranged from 9 to 1,015 (median: 166), or one site every 8.3 miles. The average size of erosion occurrences ranged from 230 to 37,006 (median: 3,008) cu ft. The greatest volume of erosion was found on roadways built according to the cut-fill design; the lowest estimated volume of erosion was along the fill-design roads. Erosion occurred most frequently on at-grade roads: 40% of all occurrences noted by design were on at-grade roads. The most frequently noted location of erosion was ditch bottoms (30% of sites); loss of soil from adjacent areas and in-slopes accounted for 25% and 24%, respectively. The larger sites of erosion in Minnesota are generally caused by (1) inadequate design of roads, especially in areas of rough terrain or poor soils and near streams and rivers, and (2) lack of administrative direction and emphasis, especially in establishment of vegetative cover, maintenance repair of erosion sites, and control of unauthorized activities along the roadside, such as farming and use of the roadside for borrow or recreational purposes. (Rochester-IVI)
W85-06070

SCOUR AT CULVERT OUTLETS IN MULTIBED MATERIALS,
S. R. Abt, J. F. Ruff, and C. Mendoza.
Transportation Research Record, Vol. 948, p 55-62, 1984. 10 Fig, 4 Tab, 11 Ref.

Descriptors: *Scour, *River Beds, *Culverts, Sand, Gravel, Road construction, Erosion control.

Scour at culvert outlets was tested in two facilities using culverts ranging from 4-18 in in diameter. A uniform sand, a uniform gravel, a graded sand, a graded gravel, and a cohesive bed material, of residual Colorado expansive clay mixed with graded sand, were used. Test periods ranged from 316-1,000 min, and discharges ranged from 0.11-29.13 cu ft/sec. Scour holes observed after 75 scour tests with noncohesive materials were generally similar in geometric configuration and appearance: circular shapes prevailed at discharge intensity (DI) $<$ or $=$ 1, with elongation to an oval shape as DI exceeded 1. Scour holes formed in 12 tests with the cohesive SC soil showed the same relationship of shape to DI. Depth, width and length of scour holes, and volume of scour were correlated with bed materials, culvert, and discharge. Based on these relationships, equations were developed for estimating scour-hole dimensions at any finite time between 31 min and 316 or 1,000 min. Scour-hole dimensions in noncohesive materials reached approx 80% of the maximum after the initial 31 min of testing. The maximum scour depth was located at a point approx 0.3-0.4 times the maximum length of scour measured downstream of the culvert outlet. A headwall placed adjacent to the culvert outlet in the cohesive materials tests had little effect on scour-hole dimensions. It did, however, protect the embankment from undermining as the scour-hole extended as far as 0.2 times its length into the embankment for the no-headwall condition. With the SC cohesive soil, 70% of the maximum scour-hole dimensions was obtained after the initial 31 min of testing. The maximum scour depth was located at a point approx 0.35 times the maximum length of scour measured downstream of the culvert outlet. With noncohesive materials, the length of the area affected by scour was approx twice the length of the scour hole, and the width was approx 2-3 times the width of the scour hole, for culverts flowing full. In another test circular-shaped culverts were shown to yield more conservative scour-hole dimensions than square-shaped culverts of similar characteristic lengths. (Rochester-IVI)
W85-06071

FREEZE-THAW AND CONSOLIDATION EFFECTS ON STRENGTH OF A WET SILT LOAM,
Soil Conservation Service, Portland, OR.
G. E. Formanek, D. K. McCool, and R. I. Papendick.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1749-1752, November-December, 1984. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Freeze-thaw, *Frost, *Erosion control, *Silt loam, *Strength *Consolidation, Soil erosion, Frozen ground, Soil water, Soil properties.

Freeze-thaw cycles of wet, silty soils in the Pacific Northwest result in low water intake and a surface layer with very low erosion resistance. The effect of cycles of freeze-thaw with high soil moisture on the shear strength of a thawed silt loam were quantified as were shear strength changes as the thawed soil loses water without desaturating (soil water tension less than air entry value). The cohesional strength of a wet silt loam soil from a tilled, continuous fallow plot was reduced from an original value of 0.9 kPa to 0.4 kPa by one cycle of freeze-thaw in the laboratory. The cohesion was measured with a fall-cone device. Additional cycles reduced strength only slightly. Soil water tensions of less than 9 kPa, applied after thawing, resulted in cohesion of about 2.4 kPa. The soil regained cohesion in proportion to the logarithm of the consolidating soil water tension. Practices that cause frost discontinuity, reduce the number of cycles of freeze-thaw, of cause consolidation result in increased erosion resistance and reduce the opportunity for erosion, such practices are a means of erosion control in the Pacific Northwest and other regions where freeze-thaw commonly acts on wet, silty soils. (Collier-IVI)
W85-06082

PROBABILISTIC MODELING OF SOIL LOSS FROM SURFACE MINED REGIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
K. B. Rojiani, K. A. Tarbell, V. O. Shanholtz, and F. E. Woeste.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1789-1804, November-December, 1984. 5 Fig, 4 Tab, 25 Ref.

Descriptors: *Soil loss, *Model studies, *Surface mining, *Probabilistic process, Statistical analysis, Erosion, Sediment transport, Rainfall.

A probabilistic model for predicting the soil loss from surface mined areas is presented. The method is based on a combination of statistical analysis and simulation. Distributions of random variables were obtained from a statistical analysis of available data. Distributions of sediment yield were determined by coupling probabilistic models of rainfall variables with a deterministic model of the sediment yield process. To illustrate the application of the procedure, probability distributions of the total soil loss over a period of three years were determined for two separate soil types and for conditions representative of actual mining operations. The effect of the number of trials and the seed value on the results of the simulation also was investigated. (Collier-IVI)
W85-06090

MATERIAL AND SITE CONTROLS OF STREAM BANK VEGETATION,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2E.
W85-06095

CASE HISTORIES OF SCOUR PROBLEMS AT BRIDGES,
For primary bibliographic entry see Field 8A.
W85-06107

OVERVIEW OF FACTORS AFFECTING RIVER STABILITY,

R. E. Trent, and S. A. Brown.
Transportation Research Record, Vol. 950, No. 2, p 156-163, 1984. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *River beds, *Channel morphology, *Roads, Erosion, River mechanics, Sediment transport, Meanders.

Anticipating the potential for and recognizing the existence of channel instabilities is a critical aspect of locating and designing highways in river environments. Channel instabilities include oscillations in channel-bed elevation, variations in river orientation and location, and major river migrations or meanders. Factors affecting river stability have been classified as natural or accelerated. Natural instabilities result from changes in hydrometeorology whereas accelerated erosion is usually a result of man's activities within the watershed. Identifying channel instabilities requires an understanding of the geomorphic processes occurring within the watershed in question and an awareness of all activities that affect it. A thorough analysis of the stability of the river system should include consideration of past changes in the system and changes in progress, as well as a geomorphic analysis to predict future changes. (Collier-IVI)
W85-06108

ASSESSMENT OF CHANNEL STABILITY AT BRIDGES SITES,
For primary bibliographic entry see Field 8A.
W85-06109

EFFECT OF BRIDGE PIERS ON STREAMFLOW AND CHANNEL GEOMETRY,
For primary bibliographic entry see Field 2E.
W85-06110

USE OF SPURS AND GUIDEBANKS FOR HIGHWAY CROSSINGS,
For primary bibliographic entry see Field 8A.
W85-06111

COMPARISON OF PREDICTION EQUATIONS FOR BRIDGE PIER AND ABUTMENT SCOUR,
J. S. Jones.
Transportation Research Record, Vol. 950, No. 2, p 202-209, 1984. 9 Fig, 22 Ref.

Descriptors: *Predictions, *Mathematical equations, *Bridge piers, *Abutments, *Scour, Piers, Erosion, Sediment transport.

There are at least 10 prediction equations for bridge pier scour, and designers are often at a loss over which one to use. There are only three or four prediction equations for abutment scour, but these have not been highly publicized. The pier scour equations fall into three basic categories: those of the University of Iowa, those of the Colorado State University, and those based on foreign literature. The similarities among the pier scour equations and the range of data on which they are based are shown. FHWA sponsored several studies during the 1970's aimed primarily at comparing field data with the various equations to show which ones best predicted local scour for U.S. streams. These studies were somewhat inconclusive because of the many interrelated variables in the scour process, but they do show which equations are conservative and which are not. (Author's abstract)
W85-06113

RIPRAP STABILITY ANALYSIS,
M. A. Stevens, D. B. Simons, and E. V. Richardson.
Transportation Research Record, Vol. 950, No. 2, p 209-216, 1984. 9 Fig, 21 Ref.

Descriptors: *Riprap, *Stability analysis, *Stream flow, Erosion control, Bank protection, Design criteria.

In the absence of wave and seepage forces, the stability of rock riprap particles on a side slope is a function of the magnitude and direction of the stream velocity next to the particles, the angle of the side slope, and the characteristics of the rock, including the geometry, angularity, and density. A method of designing riprap was developed based on a functional relation among the variables. Rock particles on side slopes tend to roll rather than slide. Therefore, it is appropriate to consider the stability in terms of moments about a point of rotation. The functional relation has its basis in the balance of moments about a point of rotation at incipient motion between the forces trying to move the particle and the forces resisting movement. A safety factor was developed that is the ratio of the resisting moments tending to move the particle of riprap. This safety factor takes into consideration the side slope of the bank being protected; the size, density, and angle of repose of the rock; and the lift and drag forces of the following water. The method is described, examples of its use are given, and it is compared with other methods developed by the Bureau of Public Roads, U.S. Army Corps of Engineers, California Division of Highways, Bureau of Reclamation, the ASAE Task Committee on Sedimentation, and others. (Author's abstract)
W85-06114

ANALYSIS OF COMMONLY USED RIPRAP DESIGN GUIDES BASED ON EXTENDED SHIELDS DIAGRAM,
H. W. Shen, and S.-Y. Wang.
Transportation Research Record, Vol. 950, No. 2, p 217-221, 1984. 6 Fig, 2 Tab, 19 Ref.

Descriptors: *Riprap, *Design criteria, *Shields diagram, *Bank protection, Shore protection, Sediment transport, Rocks.

River and coastal engineers are often faced with the task of selecting the appropriate riprap size for bank protection. Several empirical formulae based on field and laboratory tests have been suggested for selecting the maximum size and gradation size distribution of the riprap. To facilitate riprap size selection, several commonly used riprap design guides presented by the U.S. Army Corps of Engineers (for shore protection), the U.S. Bureau of Reclamation (for bank protection), and the California Department of Transportation (for both shore and bank protection) as well as guides from projects sponsored by the FHWA (for energy dissipators related to both culverts and channels) are analyzed. It is found that all these design guides are compatible and agree with the extended Shields incipient motion diagram for large sediment sizes. (Author's abstract)
W85-06115

COMPUTER-BASED PREDICTION OF ALLUVIAL RIVERBED CHANGES,
F. M. Holly, T. Nakato, and J. F. Kennedy.
Transportation Research Record, Vol. 950, No. 2, p 229-237, 1984. 4 Fig, 27 Ref.

Descriptors: *Computer models, *Alluvial channels, *River beds, Model studies, Channel morphology, Sediment transport, Numerical analysis.

The sheer expense and space requirements of physical scale models generally disqualify them for simulation of long-term, large-distance riverbed reponse to the second type of perturbation. For these purposes, numerical, computer-based models, which can simulate both short- and long-term response, find their natural area of application. Recent investigations and research programs at the Iowa Institute of Hydraulic Research have involved both the analysis and development of computer-based simulation techniques for alluvial riverbed evolution. The primary use of such techniques is in the prediction of riverbed aggradation and degradation caused by perturbations in the river's equilibrium geometry and sediment inflow supply over extended reaches. The mathematical problem can be reduced to one of solving just a nonlinear partial-differential system in each time interval over which the water discharge is assumed to be nonvarying in time, be it for several hours during a rising flood hydrograph or several years if the effects of a single dominant discharge are of interest. No computer models presently available incorporate a general, adequate treatment of sorting and armoring processes. Nevertheless, some models attempt to simulate their effects on bed evolution; others ignore them completely. Another important distinguishing feature of computer-based models is the degree to which they incorporate sorting and armoring effects. The most important overall need is for better interpretation of physical processes and their incorporation in the numerical models. Numerical techniques for solution of the governing equations are now adequately developed for accurate prediction of alluvial river bed profiles if an accurate sediment-transport function and a bed-roughness predictor were available. (Collier-IVI)
W85-06117

MODELING GENERAL SCOUR AT BRIDGE CROSSINGS,
H. H. Chang.
Transportation Research Record, Vol. 950, No. 2, p 238-243, 1984. 8 Fig, 13 Ref.

Descriptors: *General scour, *Scour, *Bridge crossings, *Piers, *Model studies, Local scour, Sediment transport, Water surface profiles.

Local scour that occurs around bridge piers and abutments is caused by local obstructions to flow. General scour refers to the change in river-channel configuration provoked by sediment imbalance, due to natural or man-made factors. Because general scour at bridge crossings is related to the flow and sediment-transport processes of the adjacent river as a system, evaluation of such scour requires modeling of the river channel for water and sediment routing. General scour at bridge crossings was modeled using a mathematical model for water and sediment routing. For a given bridge configuration, general scour that results from imbalance in sediment supply and transport capacity of the river was evaluated based on river channel evolution reflecting the flow and sediment-transport processes. A river's adjustment in width in relation to power expenditure may also be explained based on the water-surface profile. If the energy gradient is approximated by the water-surface slope, the equal energy gradient is equivalent to the straight water-surface profile. A river reach undergoing changes usually has an uneven water-surface profile, but it constantly seeks to establish a straight profile through adjustments in channel geometry, roughness, and so forth subject to physical constraints such as abutments, rigid banks, and check dams. In the present model, the channel geometries are adjusted, subject to the constraints, so that they favor uniformity in the water-surface profile. Two case studies are presented, on the Santa Margarita River and on the San Dieguito River (California), to illustrate the prediction of general scour caused by man-made factors including sand mining and flow constriction by a bridge. Depth of general scour was found to be sensitive to channel width; therefore, width formation of the alluvial river plays an important role in scour development. (Collier-IVI)
W85-06118

MATHEMATICAL MODEL FOR ESTIMATING SCOUR THROUGH BRIDGE CROSSINGS,
D. B. Simons, R.-M. Li, and G. K. Cotton.
Transportation Research Record, Vol. 950, No. 2, p 244-251, 1984. 5 Fig, 9 Ref.

Descriptors: *Mathematical models, *Scour, *Bridge crossings, Model studies, River beds, Channel morphology, Hydraulics, Erosion.

Changes in bed level in alluvial channels are an important design consideration for bridge crossings. The general problem of scour at bridge crossings involves degradation, aggradation, and local scour. Three types of interrelated scour phenomena are found at bridges: (a) local scour caused by piers and abutments disturbing the flow, forming vortices and eddies; (b) scour due to contraction of the flow at the crossing, causing increased velocities in the contracted width; and (c) degradation or aggradation of a stream channel over relatively long reaches and over a long time due to bed-level

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controls, changes in sediment supply, and changes in river form. A model of these scour phenomena has been developed by Simons, Li and Associates using a known-discharge sediment-routing procedure called HEC2SR. The model determines scour in reaches of a river system based on available sediment supply, local hydraulic conditions, and sediment-transport capacity. Hydraulic conditions for the river are determined using the U.S. Army Corps of Engineers HEC-2 computer program. The procedure was designed to take advantage of the bridge hydraulic modeling routines in HEC-2. Output from the modeling procedure includes detailed hydraulic and sediment-transport data as well as cross-sectional information. Application of the model to a complex site is shown. The analysis procedure provides important information pertinent to the design of river-training measures used in conjunction with bridge crossings. (Author's abstract)
W85-06119

ROLE OF CALIBRATION IN APPLICATION OF HEC-6,
D. M. Gee.
Transportation Research Record, Vol. 950, No. 2, p 252-259, 1984. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Calibration, *Scour, *Channel morphology, *Model studies, *Bridge design, Design criteria, Mathematical models, Movable boundary models, Streambeds, Sediment transport.

Calibration, the process of adjusting model parameters so that model results conform with observed prototype behavior, is an essential ingredient of any modeling effort, be it physical or mathematical. Successful application of movable boundary models often require substantial effort to reproduce field observations. The key components of the calibration and verification process for movable boundary numerical modeling (i.e., HEC-6) applications are: comprehending the historical behavior of the stream system; developing representative geometric, sediment, and hydrologic data; and performing and verifying the calibration. The calibration is performed by (a) selecting calibration measures of changes in bed profile, changes in cross-sectional geometry, changes in volumes of sediment, rating curve shifts, and other characteristics that suit study level and objectives; (b) selecting the calibration time period; (c) identifying acceptable model performance; and (d) adjusting parameters. Calibration strategies vary widely depending on the type and availability of field data and study scope and objective. HEC-6 may be used in bridge design for prediction of long-term trends in streambed profile behavior; analysis can be made of the impacts of various scenarios regarding upstream and downstream actions. (Collier-IVI)
W85-06120

CONTEMPORARY LAKE TRANSPORT PROCESSES DETERMINED FROM SEDIMENTARY RECORDS OF COPPER MINING ACTIVITY,
Freshwater Biological Association, Ambleside (England).
W. Davison, J. Hilton, J. P. Lishman, and W. Pennington.
Enviromental Science and Technology, Vol. 19, No. 4, p 356-360, April, 1985. 5 Fig, 1 Tab, 19 Ref.

Descriptors: *Sediment transport, *Fate of pollutants, *Mining, *Coniston Water, *England, Copper, Iron, Magnesium, Calcium, Particulates, Lake sediments, Chalcopyrite, Organic carbon, Water depth.

In the recent past (ca. 1850) copper was mined in the catchment of Coniston Water in the English Lake District. Chemical analysis of sediment cores shows a clear record of this activity. Although the mining effluent entered the lake at one place, elevated concentrations of Cu, Fe, Mg, and Ca were observed at all five sites investigated, showing the domination of random transport processes in distributing sediment material. Other effects such as progressive downstream settling, which play a minor but significant role in the local copper loading, are identified. A constant excess Cu:S ratio of 2:1 indicated that Cu is present in the sediments as chalcopyrite and that it was transported from the mine workings in particulate form. Mn accumulation is mediated by redox processes, and so the final concentration in the sediment depends on the depth of the overlying water and the availability of organic carbon. (Author's abstract)
W85-06150

EVALUATION OF THE EROSION INDEX FOR THE PRAIRIES,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
R. G. Kachanoski, and E. de Jong.
Canadian Journal of Soil Science, Vol 65, No. 1, p 225-228, February, 1985. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Soil erosion, *Universal soil loss equation, *Prairies, Erosion, Mathematical equations, Rainfall, Storms, Saskatchewan.

The universal soil loss equation (USLE) has had limited use in the prairies due partly to the lack of information about the various equation parameters. Ateshian's equation, used to calculate the USLE rainfall erosion index (R) for Canada, appears to considerably overestimate the actual R value for Saskatchewan (calculated from 12 yr of tipping bucket rainfall data). An alternative equation derived using a generalized distribution curve for prairie rainstorms predicted an R value of 350 for Saskatoon which was close to the 12-yr average (R = 340) for Saskatoon. More R values need to be calculated from existing climatological data to determine which (if any) estimation equation is satisfactory. In addition, a method or index for estimating erosion potential due to snowmelt needs to be developed. (Moore-IVI)
W85-06153

SEDIMENTATION PROCESSES IN AN IMPOUNDMENT, UNION LAKE, NEW JERSEY,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Geological Sciences.
T. H. Calcagno, and G. M. Ashley.
Environmental Geology and Water Science, Vol. 6, No. 4, p 237-246, 1984. 8 Fig, 3 Tab, 30 Ref.

Descriptors: *Sedimentation, *Reservoirs, *Union Lake, *New Jersey, Maurice River, Organic matter, Cesium radioisotopes, Sand, Dy, Diatoms, Silt, Clay, Wind, Water circulation.

A small (3.75 sq km) impoundment, Union Lake, on the Maurice River in southern New Jersey contains fine-grained sediment and organic material being transported through the surface water system. Sedimentation is slow and rates calculated from Cs-137-dated cores indicate a decrease through time from 2.6 mm/yr to 0.57 mm/yr. Sediment from shallow areas (< 3 m) consists of winnowed preimpoundment fluvial sand, whereas sediment from deeper area (> 3 m) is dy composed of diatoms, organic matter, and silt- and clay-sized mineral grains. Sediment distribution is controlled by water moving from the river entrance southward toward the outlet and by wind-generated water motion from shallow areas fringing the shore toward deeper portions of the impoundment. (Author's abstract)
W85-06162

2K. Chemical Processes

PRESENCE OF TIN AND TUNGSTEN IN THERMAL WATERS CONNECTED WITH GRANITES OF SOME SELECTED REGIONS IN EUROPE,
Gdansk Technical Univ. (Poland).
For primary bibliographic entry see Field 2F.
W85-05857

ISOTACHOPHORETIC DETERMINATION OF ANIONIC AND CATIONIC SPECIES IN WELL AND SURFACE WATERS,
Karlova Univ., Prague (Czechoslovakia). Dept. of Physical Chemistry.
For primary bibliographic entry see Field 5A.
W85-05910

THEORY OF SOLUTE TRANSPORT IN SOILS FROM THE METHOD OF CHARACTERISTICS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2G.
W85-05937

PARTICLE SIZE DISTRIBUTION, CHEMICAL COMPOSITION AND CALCULATION OF STANDARD MINERALOGICAL COMPOSITION OF SUSPENDED SEDIMENT TRANSPORTED BY A STREAM IN OKINAWA ISLAND,
Okinawa Inst. of Physicachemical Research, Okinawa City.
For primary bibliographic entry see Field 2J.
W85-05996

DISTRIBUTION OF MINOR METALLIC ELEMENTS IN RIVER WATER OF GREEN TUFF REGION, YAMAGATA PREF.,
Yamagata Univ. (Japan). Dept. of Chemistry.
T. Iriye.
Japanese Journal of Limnology, Vol. 45, No. 4, p 260-268, October, 1984. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Heavy metals, *Chemical composition, *Rivers, *Yamagata Prefecture, *Japan, Granite, Tuff, Cadmium, Chromium, Copper, Manganese, Nickel, Lead, Zinc, Trace elements.

The concentrations of 7 minor heavy metallic elements (Cd, Cr, Cu, Mn, Ni, Pb and Zn) were determined by the atomic absorption spectrometry method in 116 river water samples, of which 13 samples were collected from the granitic region and others from the green tuff region in Yamagata Prefecture, Japan. High concentration areas of the metallic elements were found in the east, southeast and central part of the survey area. In consideration of their flow rate, the mean concentrations of the metallic elements in river water were obtained. The mean values of 0.35 ppb of Cd, 3.74 ppb of Cr, 6.92 ppb of Cu, 15.39 ppb of Mn, 3.32 ppb of Ni, 5.45 ppb of Pb and 17.26 ppb of Zn were found in the green tuff region. The mean values of these elements in the granitic region was lower than that of the green tuff region except for Cr. Since it can be considered that these river water sampling sites are not affected by human activities, these values, except for lead, represent the minor metal concentration in close to its natural state. (Author's abstract)
W85-05997

EFFECTS OF BENTHIC MACROINVERTEBRATES ON THE EXCHANGE OF SOLUTES BETWEEN SEDIMENTS AND FRESHWATER,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
G. Matisoff, J. B. Fisher, and S. Matis.
Hydrobiologia, Vol. 122, No. 1, p 19-33, March, 1985. 10 Fig, 1 Tab, 49 Ref. Ohio Sea Grant project R/ER-5, EPA contract R8057160, NOAA grant NA80RAD0036, NSF grant OCE8005103.

Descriptors: *Benthic fauna, *Invertebrates, *Sediments, *Solutes, Oligochaetes, Midges, Clams, Diagenesis, Ammonium, Bicarbonates, Silica, Iron, Phosphates, Nitrates, Diffusion, Solute transport, Sediment-water interfaces.

Infaunal macrobenthos (tubificid oligochaetes, chironomid larvae, and unionid bivalves) were studied in laboratory microcosms to determine their effects on freshwater sediment diagenesis and the exchange of solutes between sediments and water. Tubificids enhanced the flux of ammonium, bicarbonate, and silica from sediments. After the onset of anoxia, they decreased the flux of iron and phosphate. Chironomids increased the flux of nitrate, bicarbonate, and silica, but did not affect the flux of phosphate. Pore water concentrations were low within the irrigated burrowed zone for chemical species normally high in reduced sediments. Concentration gradients were less steep in the actively irrigated burrow zone, but radial diffusion to and from burrows, increased rates of organic de-

composition, and enhanced diatom frustule dissolution rates result in enhanced mass transport from sediments. Data from an experiment with unionid clams demonstrated the presence of radial diffusion gradients. These clams enhanced the chloride and nitrate flux from sediments, decreased the bicarbonate flux, but did not affect the flux of either phosphate or silicate. Although the clams did not actively irrigate their burrows, their effect on sediments was similar to that of chironomids. Comparison of direct and indirect flux estimates showed that both types of estimates could be highly variable. In general, indirect flux estimates were higher than direct flux estimates. (Author's abstract)
W85-06005

NITROGEN MIGRATION IN ZHUJIANG RIVER (IN CHINESE),
Academia Sinica, Guangzhou (China). South China Sea Inst. of Oceanology.
For primary bibliographic entry see Field 5B.
W85-06010

IDENTIFICATION OF WATER SOURCES USING NORMALIZED CHEMICAL ION BALANCES: A LABORATORY TEST,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
D. A. Woolhiser, W. E. Emmerich, and E. D. Shirley.
Journal of Hydrology, Vol. 76, No. 3/4, p 205-231, February, 1985. 2 Fig, 7 Tab, 18 Ref, 1 Append.

Descriptors: *Normalized chemical ion balance, *Water sources, Surface waters, Groundwater, Natural waters, Ion balance, Chemical composition, Streams.

A normalized chemical ion balance (NCIB) technique, that has been proposed to identify multiple surface and groundwater inflows to a reach of a stream, is tested using two sets of mixtures prepared in the laboratory. The first set consisted of 64 mixtures of from 2-8 natural waters selected from 10 source waters. A second set of 25 mixtures was prepared using 5 source waters. Each of the source waters and each mixture was analyzed for at least 8 ions. Proportions of source water in each sample were estimated using a quadratic programming solution to minimize the sum of squared error terms of normalized chemical ion-balance equations. Because PO4(3-) was present in very low concentrations, and was subject to significant error, it was found that better estimates could be obtained by omitting it from the analyses. For the first mixture set, the probability of failure to detect a source when it was present in the mixture was 0.23, and the probability of identifying a source when it was not present was 0.29. For the second set of mixtures, the probabilities were 0.0 and 0.33, respectively. Identification was improved by dividing each normalized ion-balance equation by the error variance for that ion. (Author's abstract)
W85-06045

DENITRIFICATION IN A MAJOR LIMESTONE AQUIFER,
Toronto Univ. (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W85-06048

INTERFLOW OF WATER AND TRACER CHEMICAL ON SLOPING FIELD PLOTS WITH EXPOSED SEEPAGE FACES,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W85-06050

ACID PRECIPITATION: NATURAL VERSUS ANTHROPOGENIC COMPONENTS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. N. Galloway, G. E. Likens, and M. E. Hawley.
Science, Vol. 226, No. 4676, p 829-831, November, 1984. 2 Fig, 15 Ref.

Descriptors: *Acid precipitation, *Monitoring, *Sulfates, Nitrates, Hydrogen ion, Acidity, Urban areas, Rural areas, Chemistry of precipitation, Water pollution sources.

Using data from the Global Precipitation Chemistry Project networks, three specific questions are addressed: what are the concentrations of sulfate, nitrate and hydorgen ions in precipitation in remote areas; how does the composition of precipitation in remote areas compare to that in eastern North America, and which ion is the most ecologically significant in assessing the magnitude of the change in precipitation composition due to anthropogenic activities. Concentrations of hydrogen, nitrate and sulfate ions were elevated in eastern North America precipitation as compared to remote areas. The sulfate ion appears to be a better indicator of change than the other two. It is misleading to use the hydrogen ion for comparison because remote areas have a different mixture of acids and bases than eastern North America and H(+) is therefore not a conservative tracer. In the case of nitrate ions, because of rapid uptake by biota in terrestrial and aquatic ecosystems, it does not promote longterm acidification of aquatic ecosystems as much as sulfate ions. Because the sulfate ion is conservative, does not vary significantly among the remote sites, and is the primary control on the acidification of aquatic ecosystems, it is suggested as the best indicator of changes in precipitation composition between remote areas and eastern North America. (Baker-IVI)
W85-06060

DETERMINATION OF SEVEN TRACE ELEMENTS IN NATURAL WATERS BY NEUTRON ACTIVATION ANALYSIS AFTER PRECONCENTRATION WITH 1-(2-PYRIDYLAZO)-2-NAPHTHOL,
Dalhousie Univ., Halifax (Nova Scotia). Trace Analysis Research Centre.
H. Bem, and D. E. Ryan.
Analytica Chimica Acta, Vol. 166, p 189-197, December, 1984. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Trace elements, *Neutron activiation analysis, *Preconcentration, Natural waters, Cadmium, Cobalt, Chromium, Copper, Manganese, Uranium, Zinc, Radioisotopes, Water analysis.

A procedure is described for the preconcentration of Cd(II), Co(II), Cr(III), Cu(II), Mn(II), U(VI) and Zn(II) from 800 ml of water and sea-water samples by coprecipitation with 1-(2-pyridylazo)-2-naphthol (PAN) prior to neutron activation. Chromium is reduced to Cr(III) by hydroxylammonium chloride at pH 4 before the preconcentration step. Coprecipitation of 30 mg of PAN was most effective at pH 9 with final recoveries of 76-91% for six elements and 50% for uranium. The scheme is based on double irradiation of the same samples. Short (10 min) irradiation followed by gamma-spectrometry counting for 10 min gives data for Cd (Cd-111m), Co, Cu, Mn and U(U-239). A second 16-h irradiation permits determination of zinc and uranium (Np-239) after a waiting time of 6 h, cadmium (Cd-115) after 24 h and chromium after a waiting period of 2 weeks followed by counting for 30 min. Detection limits are 0.04 ng/g for Co, 0.8 ng/g for Cd, 0.3 ng/g for Cu, 0.2 ng/g for Cr, 0.006 ng/g for Mn, 0.006 ng/g for U and 0.3 ng/g for Zn. A further decrease of the detection limit for chromium to 0.05 ng/g can be achieved by separation of interfering nuclides and scintillation counting of Cr-51 with a NaI(Tl) well-type detector. (Author's abstract)
W85-06165

2L. Estuaries

EFFECTS OF THE BLACK RIVER (CAPE, SOUTH AFRICA) ON THE DISTRIBUTION AND SURVIVAL OF MARINE PSAMMOFAUNA,
Texas A and M Univ., College Station. Dept. of Veterinary Anatomy.
A. D. Scarfe, A. B. Thum, and C. L. Wilke.
Marine Pollution Bulletin, Vol. 16, No. 2, p 69-75, February, 1985. 8 Fig, 2 Tab, 32 Ref.

Descriptors: *Black River, *South Africa, *Water pollution effects, *Coastal waters, Species composition, Marine environment, Dredging, Benthos.

The physicochemistry of the Black River and adjacent marine beach - in terms of tidal, daily and seasonal fluctuations of temperature and salinity - presents a highly stressed environment exacerbated by canalization of the river mouth. Riverine pollution further stresses this environment, producing low densities and diversities of marine infauna adjacent to the river. No fauna were found in the river mouth where typical estuarine conditions exist only during high tide. Tolerance of the dominant marine species, Cerebratulus fuscus, to temperature, salinity and river water combinations showed that mortality was more rapid after exposure to river water dilutions than after exposure to distilled water dilutions. Computer-generated models suggested that this species should survive conditions closer to the river than were observed. This confirmed additional stress due to pollution carried in the river from urban and industrial drainage. Lower river water temperatures during winter appear to ameliorate pollution stress, enhancing survivability of the infauna. (Author's abstract)
W85-05861

CATASTROPHIC ANOXIA IN THE CHESAPEAKE BAY IN 1984,
Johns Hopkins Univ., Baltimore, MD. McCollum-Pratt Inst.
H. H. Seliger, J. A. Boggs, and W. H. Biggley.
Science, Vol. 228, p 70-73, April, 1985. 2 Fig, 18 Ref. NSF grant OCE-8208745.

Descriptors: *Chesapeake Bay, *Anoxic conditions, Streamflow, Climate, Dissolved oxygen, Pycnocline, Stratification, Hydrogen sulfide, Estuarine environment, Temperature effects, Shellfish.

In 1984, four climatic sequences combined to produce what may be a major anoxic castastrophe in the northern Chesapeake Bay, sufficient to severely threaten the major benthic species. These sequences are (i) the highest late-winter streamflow on record from the Susquehanna River watershed; (ii) streamflows from the Susquehanna River for the consecutive months of June, July, and August that are higher by 2 standard deviations than the respective monthly mean values measured over the last 34 years; (iii) a stationary high in August off Atlantic Coast; and (iv) and absence of strong storm events in summer. An empirical equation is proposed for the prediction of the monthly trend of dissolved oxygen decrease in terms of a temperature-dependent subpycnoclinal respiration and a modified estuarine Richardson number. As of 23 August 1984, the summer pycnocline of the northern bay had eroded upward from its historically recorded depth below 10 meters to an abnormally shallow 5 meters, with higher stratification than in earlier years. Dissolved oxygen concentrations directly below the pycnocline decreased to zero during June, 2 months earlier than for previous wet years. At present, oxygen-deficient waters containing significant concentrations of hydrogen sulfide have penetrated into Eastern Bay and the Choptank and Potomac rivers. Because most remaining shellfish-spawning and seed-bed areas in these tributaries are located at depths between 4 and 8 meters, the continued absence of major destratifying events will prolong the present anoxic trend and may result in high benthic mortalities. (Author's abstract)
W85-06159

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

REVERSE OSMOSIS MEMBRANE FOULING AND PRETREATMENT CONSIDERATIONS,
S. F. Rak.
Industrial Water Engineering, Vol. 21, No. 4, p 12-

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15, August, 1984. 3 Fig, 3 Ref.

Descriptors: *Reverse osmosis, *Desalination, *Membrane processes, *Water treatment, Scaling, Suspended solids, Membrane fouling, Suspended solids, Colloids, Metal oxides, Oil, Grease.

The type of solutes and foreign substances that can foul reverse osmosis membranes are reviewed. General guidelines for avoiding the problems associated with foulants are discussed. Unless pointed out to the contrary, the information applies to cellulose acetate and composite polyamide membranes. In general, hollow fiber modules are more inclined to foul than spiral modules. Types of fouling most commonly encountered are: scale formation, biological slime formation, suspended solids fouling, colloidal fouling, metal oxide deposition, and oil and grease deposition. Generally speaking, if it is determined that the solubility limit of a sparingly soluble salt will be exceeded, one or more of the following measures must be taken: reduce the product water recovery ratio to avoid exceeding solubility limits, soften the water by ion exchange to remove the polyvalent metal ions, feed acid such as hydrochloric and sulfuric to reduce the pH and the bicarbonate/carbonate level, and add scale inhibitors such as sodium hexametaphosphate for sulfates. Experience has proven that many years of service can be obtained from reverse osmosis membrane modules if sufficient attention is paid to the quality of the feed water. The likelihood of failure is almost 100% if one chooses to ignore reverse osmosis pretreatment. (Baker-IVI)
W85-05993

3B. Water Yield Improvement

SOLAR EARTH-WATER DISTILLATION FOR WET SAND,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W85-06073

3C. Use Of Water Of Impaired Quality

EFFECT OF SODIUM AND BICARBONATE IRRIGATION WATERS ON SODIUM ACCUMULATION AND ON MAIZE AND WHEAT YIELDS IN NORTHERN INDIA,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
For primary bibliographic entry see Field 2I.
W85-05921

SALT TOLERANCE OF CORN IN THE SACRAMENTO-SAN JOAQUIN DELTA OF CALIFORNIA,
Agricultural Research Service, Riverside, CA. Salinity Lab.
G. J. Hoffman, E. V. Maas, T. L. Prichard, and J. L. Meyer.
Irrigation Science, Vol. 4, No. 1, p 31-44, April, 1983. 6 Fig, 5 Tab, 6 Ref.

Descriptors: *Salt tolerance, *Corn, *Sacramento-San Joaquin Delta, *California, Irrigation water, Saline water, Water management, Water stress, Water quality, Soil properties, Crop yield, Electrical conductivity.

A field trial was conducted in the Sacramento-San Joaquin Delta of California to determine the salt tolerance of corn in organic soil. Threshold values were obtained which were similar to those published for mineral soils. Neither the climate nor the organic soil in the Delta significantly altered the salt tolerance threshold. The salt tolerance slopes obtained for this field trial were more than twice as steep as published values. Water management prevented any water stress in sprinkled treatments and very little water stress, if any in the subirrigated treatments. Good agreement was found among measurements of the electrical conductivity of soil water from suction cups, four-electrode salinity probes, and soil samples. Because of high water holding capacity of the soil and high leaching, the electrical conductivity of the soil water was never more than several dS/m higher than the electrical conductivity of the applied water. Plant yields were high on nonsaline treatments but were reduced when soil salinity exceeded 3.7 dS/m. Excess salinity reduced yields by reducing kernel mass and, to a lesser extent, ear density. Root density measurements indicated a root zone depth of 90 cm. The method of irrigation did not affect the salt tolerance of corn significantly. (Baker-IVI)
W85-05925

EFFECT OF HIGH SODIUM IRRIGATION WATER ON SOIL SALINITY AND YIELD OF MATURE GRAPEFRUIT ORCHARD,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Environmental Physiology.
H. Bielorai, J. Shalhevet, and Y. Levy.
Irrigation Science, Vol. 4, No. 4, p 255-266, December, 1983. 2 Fig, 6 Tab, 23 Ref.

Descriptors: *Grapefruit trees, *Irrigation water, *Saline water, *Saline soils, *Crop yield, Chlorides, Sodium, Exchangeable sodium percentage, Infiltration.

Citrus is considered to be specifically sensitive to chloride and sodium, yet little data exist to show the effect of these ions on yield. An experiment was started in 1978 to study to effect of sodic irrigation water on yield. The treatments were SAR (sodium adsorption ratio) of the irrigation water of 2.8-(L), 5.5-(M), and 10.3-(H) (mol/cu m) to the 1/2 (SAR = Na(+)/square root Ca(++) + Mg(++)/2). The experiment follows a study on the same plots using irrigation water of variable chloride concentration and a uniform SAR of 4.2 (mol/cu m) to the 1/2. The high SAR, high Cl water resulted in a yield reduction of 9% from the control treatment. This reduction was similar to the reduction observed when only Cl was a variable. Total water uptake was reduced as salt concentration in the soil increased. The average water uptake for the four irrigation seasons 1978 to 1981 was 1025 mm, 953 mm and 823 mm for the L, M and H treatments, respectively. Soil ESP (exchangeable sodium percentage) was increased as a result of sodium accumulation in the soil profile in the M and H treatments, while Cl and EC remained relatively constant with time during the experiment. After four years of irrigation the infiltration capacity values were 0.26, 0.17 and 0.16 cm/h for the L, M and H treatments, respectively. Fruit quality was not affected by the treatments. No specific toxicity symptoms were observed when the Na concentration in the soil saturation extract was 16 mol/cu m and the ESP was 8.0. The results lead to the conclusion that within the range used in this experiment the high ESP did not specifically affect yield and that yield response was due to the total salt concentration in the soil. (Author's abstract)
W85-05935

3D. Conservation In Domestic and Municipal Use

CALCULATING EFFECTIVENESS OF WATER CONSERVATION MEASURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 6F.
W85-06021

IMPACT OF CONSERVATION ON RATES AND OPERATING COSTS,
Dauphin Consolidated Water Supply Co., Harrisburg, PA.
For primary bibliographic entry see Field 6C.
W85-06031

3F. Conservation In Agriculture

EFFECT OF LAND SURFACE UNIFORMITY ON SOME ECONOMIC PARAMETERS OF IRRIGATION IN SODIC SOILS UNDER RECLAMATION,
Central Soil Salinity Research Inst., Karnal (India).
N. K. Tyagi.
Irrigation Science, Vol. 5, No. 3, p 151-160, October, 1984. 5 Fig, 4 Tab, 15 Ref.

Descriptors: *Irrigation, *Economic aspects, *Sodic soils, Soil management, Irrigation practices, Infiltration, Crop yields, Land reclamation, India, Water application.

One requirement of a good irrigation system is uniform water application throughout the field, but for all irrigation sytems, water application is nonuniform to some degree. Increasing the average application depth until all portions of the field receive sufficient water to maximize crop yield can have detrimental effects on sodic soils which have poor internal drainage and low oxygen diffusion rates. The effect of leveling uniformity measured in terms of mean deviation from the desired plane and designated as leveling index on some irrigation quality parameter such as water application and distribution was investigated in sodic soils irrigated by graded borders. For exploiting full yield potential on sodic soils, a high frequency application and low magnitude irrigation practice is recommended. The water application depth in surface irrigation ensuring full irrigation, is not a management controlled variable, but is greatly influenced by the quality of leveling. Higher application depths which are associated with poor leveling, do not permit frequent applications. For the soils at Karnal, which are representative of the alkali soils in the Indo-Gangetic plains in India, both irrigation efficiencies and crop production can be maximized if the system application depth are within 4-5 cm. For ensuring the desired system application depths to maximize net income, the leveling quality has to be such that the average deviation from the desired level is within 3 cm. (Baker-IVI)
W85-05917

WATER USE EFFICIENCY OF NARROW ROW COTTON,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
T. A. Howell, K. R. Davis, R. L. McCormick, H. Yamada, and V. T. Walhood.
Irrigation Science, Vol. 5, No. 3, p 195-214, October, 1984. 10 Fig, 7 Tab, 50 Ref.

Descriptors: *Irrigation, *Crop yield, *Cotton, *Water use efficiency, *San Joaquin Valley, *California, Evapotranspiration, Water use, Soil water, Leaf temperature, Transpiration, Water stress, Row spacing.

A field experiment was conducted on the west side of the San Joaquin Valley in California to determine water use, crop growth yield and water use efficiency of Acala (SJ-2) cotton grown in 0.5 m spaced rows on a Panoche clay loam soil. Evapotranspiration was determined by water balance techniques using neutron soil moisture measurements. The dry matter production of cotton grown in narrow rows was directly related to both measured evapotranspiration and estimated transpiration determined from a soil water balance model. This biological production can be maximized by irrigation management resulting in minimum crop water stress. The water use efficiency across widely varying cropwater stress levels was largely explained by a model using leaf temperature inferred from canopy temperature measurements taken by infrared thermometry. The lint production of cotton grown in narrow rows was related to evapotranspiration. The lint production was directly related to estimated transpiration. The lint production of cotton in narrow rows can be maximized by irrigation management or minimize direct soil water evaporation while minimizing water deficit effects on crop transpiration. The imposition of crop water deficits through irrigation management of narrow row cotton reduced the crop growth rates; the effects of the water deficits only marginally affected both net assimilation and relative growth rates. The important practical significance is related to partitioning of the dry matter production. Although the dry matter partitioning of the

cotton in this experiment was remarkably similar for considerable water deficit differences, the results indicate that moderate water stress prior to flowering can result in larger boll partitioning and an increased harvest index. (Baker-IVI)
W85-05918

MICROCLIMATE AND CROP RESPONSES TO CENTER PIVOT SPRINKLER AND TO SURFACE IRRIGATION,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
J. L. Steiner, E. T. Kanemasu, and D. Hasza.
Irrigation Science, Vol. 4, No. 3, p 201-214, August, 1983. 6 Fig, 6 Tab, 19 Ref.

Descriptors: *Sprinkler irrigation, *Surface irrigation, *Microclimate, Diurnal variation, Seasonal variation, Evapotranspiration, Water stress, Crop yields.

Analyses of seasonal and diurnal microclimatic responses to sprinkler and surface irrigation indicate that sprinkler irrigation can provide cooling during stress periods. Part of the advantage of sprinkler irrigation may be the increased frequency of irrigation compared to surface irrigation methods. When evaporative demand is high, as is commonly found in the southern High Plains, frequently applied water will be held at a high soil water potential near the surface and will be readily extractable by the plant. During nonstress periods of crop growth, microclimatic and plant responses to sprinkler irrigation are much less than are seen during stress periods of the crop growth. (Baker-IVI)
W85-05922

MODIFICATION OF IRRIGATION REQUIREMENT OF WHEAT THROUGH MULCHING AND FOLIAR APPLICATION OF TRANSPIRATION SUPPRESSANTS,
Indian Agricultural Research Inst., New Delhi. Div. of Agronomy.
R. De, D. V. S. Bhujanga Rao, Y. Y. Rao, L. G. Giri Rao, and M. Ikramullah.
Irrigation Science, Vol. 4, No. 3, p 215-223, August, 1983. 4 Fig, 4 Tab, 8 Ref.

Descriptors: *Wheat, *Irrigation requirements, *Mulching, *Antitranspirants, Water loss, Evapotranspiration, Soil properties, Kaolin, Alachlor, Soil texture, Crop yield, Water stress.

Field experiments on wheat for 2 years showed a beneficial effect of organic mulch (rice straw), reflective transpiration suppressant (kaolin) or metabolic antitranspirant (alachlor) by decreasing the evapotranspiration losses of soil water, increasing grain yield and thus water use efficiency. The effect of mulching and/or antitranspirant application on available soil water status was hardly discernible at flowering or at maturity stage on the loamy-sand soil where only 2 irrigations had been given. This was not so on the clay-loam soil where even under relative stress situation the soil moisture conservation effect through evapotranspiration control was noticeable up to the grain filling or grain maturity stage. While mulching was more effective than antitranspirant on a clay loam soil, this was not the case for the loamy-sand soil. The reasons for these observed differences on a heavy and coarse textured soil are not currently understood. (Baker-IVI)
W85-05923

NONUNIFORM SPRINKLER IRRIGATION AND CROP YIELD,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
J. Stern, and E. Bresler.
Irrigation Science, Vol. 4, No. 1, p 17-29, April, 1983. 6 Fig, 5 Tab, 14 Ref.

Descriptors: *Sprinkler irrigation, *Crop yield, Irrigation practices, Plant growth, Corn, Soil water, Soil hydraulic properties, Water application, Soil texture.

The influence of nonuniform water application by sprinkler on the variability of soil water content and corn yield was studied on two experimental plots differing in their texture and hydraulic characteristics. The yield and the water content were treated as random variables depending indirectly on the spatial coordinates and directly on the volume of water applied, on soil hydraulic properties, and on other factors. The trend of soil water content and crop yield appears to be caused by the trend in water application. Soil properties of both experimental plots may be considered as homogeneous so that the responses of soil water content and in turn of crop yield resulted mainly from the nonuniformity of water application. Redistribution of soil water after irrigation caused crop yield to be more uniform in the plot where the soil hydraulic properties led to more significant water flow. Dry matter yield response to net water application, as measured in collection cans, was fitted to the Mitscherlich's model - the law of diminishing returns. Using normal distribution to characterize the probability density function of water application and the Christiansen coefficient to characterize the uniformity criteria in the fitted Mitscherlich's model enabled relative crop yield to be expressed as a function of Christiansen coefficient and the total amount of irrigation water. (Baker-IVI)
W85-05924

SALINATION OF ORGANIC SOILS IN THE SACRAMENTO-SAN JOAQUIN DELTA OF CALIFORNIA,
California Univ., Stockton. Cooperative Extension Service.
T. L. Prichard, G. J. Hoffman, and J. L. Meyer.
Irrigation Science, Vol. 4, No. 1, p 71-80, April, 1983. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Irrigation water, *Saline water, *Saline soils, *Organic soils, *Sacramento-San Joaquin Delta, *California, Soil physical properties, Salt tolerance, Water management, Soil water.

The Delta is an important agricultural area containing organic soils that are threatened by salinity. To aid in water allocation and management decisions, the maximum salinity level in irrigation water that preserves agricultural production was estimated from data gathered in a field trial to establish the salt tolerance of corn. All of the physical properties measured indicated that the soil at the field trial was typical of organic soils in the Delta and elsewhere. Organic matter content increased from 45% near the soil surface to nearly 60% in the subsoil. Bulk density decreased with depth from 0.7 Mg/cu m to about 0.2 Mg/cu m. Volumetric water content at saturation increased from 0.64 cu m/cu m at the 30-cm depth to 0.90 cu m/cu m below 1 m. Differences in sample preparation techniques were found to influence measurements of soil salinity in subsoil samples. Measurements of electrical conductivity on samples brought to saturation without either grinding or drying agreed best with more direct measures of soil salinity. Rainfall during the winter had a significant impact on soil salinity. Above average rainfall combined with water table control rainfall effectively leached the upper soil profile. The ratio between the salinity of the irrigation water and the resultant soil salinity was a function of the salinity of the irrigation water and not constant for the organic soils of the Delta. (Baker-IVI)
W85-05927

DESIGN OF DRIP IRRIGATION LATERAL LENGTH ON UNIFORM SLOPES,
Hawaii Univ., Honolulu. Dept. of Agricultural Engineering.
I. P. Wu, C. A. Saruwatari, and H. M. Gitlin.
Irrigation Science, Vol. 4, No. 2, p 117-135, June, 1983. 7 Fig, 2 Tab, 11 Ref.

Descriptors: *Design criteria, *Irrigation design, *Lateral length, *Drip irrigation, Slopes, Mathematical equations, Maximum pressure difference.

A design procedure is presented which will determine the design of drip irrigation lateral length directly for a given design criterion. When a lateral line is designed for a uniform slope situation, a dimensionless design parameter can be used to determine the pressure profile and maximum pressure difference along the line. Graphical solutions and mathematical equations were derived for determining the maximum pressure difference. A design length can be determined directly by using the developed design charts. The developed design procedure can also be used for upslope situations. The design lateral line length obtained from an ideal design may not be accepted if its maximum pressure difference is larger than the design criterion. An ideal design can still be made by adjusting the length lateral line size, or the specific discharge. When an ideal solution cannot be accepted, a new design length can be determined based on an allowable maximum pressure difference. The developed method offers a direct determination of lateral line length for a given design criterion. The design procedure can be used for both downslope and upslope but it is not applicable for zero slope. For a zero slope situation, design can be made by simply using a friction drop equation such as the commonly used Williams and Hazen formula. (Baker-IVI)
W85-05929

ESTIMATING WATER APPLICATION EFFICIENCY IN IRRIGATION CHECKS,
Central Soil Salinity Research Inst., Karnal (India).
S. K. Gupta, R. N. Pandey, and R. K. Batta.
Irrigation Science, Vol. 4, No. 2, p 137-146, June, 1983. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Check irrigation, *Estimating, *Water application efficiency, Percolation, Water loss, Water management, Mathematical equations.

Irrigation in checks consists in dividing the area to be irrigated into square or rectangular plots with the minimum possible slope along the plot length. The plot size is governed by the water supply and infiltration characteristics of the soil. Equations to predict the percolation loss and water application efficiency in irrigation checks have been derived assuming the advance of the water front to be of a specified form. Simple equations based on water distribution geometry in irrigation checks have been suggested for situations where the advance function is not known. The observed field data and the comparison with exact solution indicate that elliptic and parabolic geometry of intake profiles give a better prediction accuracy compared to the straight line intake profile previously used. (Baker-IVI)
W85-05930

EFFECT OF WATER STRESS AT THREE GROWTH STAGES ON THE YIELD AND WATER-USE EFFICIENCY OF DWARF WHEAT,
Haryana Agricultural Univ., Hissar (India). Dept. of Agronomy.
T. Singh, and D. S. Malik.
Irrigation Science, Vol. 4, No. 4, p 239-245. December, 1983. 4 Tab, 15 Ref.

Descriptors: *Water stress, *Wheat, *Crop yield, *Water use efficiency, Plant growth, Plant water potential, Leaves, Soil water, Irrigation scheduling.

The responses of dwarf wheat (Triticum aestivum L.) to three levels of water stress at three growth stages, planting to jointing, jointing to flowering and flowering to maturity was studied under field conditions over two seasons at Hissar, India. At each of these stages, plants were subjected to three levels of water stress viz. -0.5, -1.0 and -1.5 MPa mid-day leaf water potential; during the remaining growth period, the plants were irrigated at 50% available soil moisture (ASM). Thus mild, moderate and severe stress treatments were compared with a no stress control (irrigation at 50% depletion of available soil water). A maximum grain yield of 5.20 tons/ha was recorded with no water stress treatment. All levels of water stress except -0.5 MPa during flowering to maturity reduced the grain yield significantly compared to the no stress treatment. The greatest effect of water stress on grain yield was observed during the planting to jointing stage. At this stage the highest reduction in grain yield (33.5%) was observed with -1.5 MPa

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plant water stress. Similar plant water stress during jointing to flowering and flowering to maturity reduced the grain yield by 26.0 and 22.6% respectively. During flowering to maturity, the effect of water stress on straw yield was not well marked. During planting to jointing and jointing to flowering stages, mild, moderate and severe water stress decreased the number of ear-bearing culms, whereas number of grains per ear reduced with all water stress levels at all the stages except -0.5 MPa water stress during flowering to maturity. Maximum reduction in 1000-grain weight was observed with all stress levels imposed during flowering to maturity stage. Water-use efficiency was highest with no water stress (13.9 kg/ha mm) and lowest with -1.5 MPa plant water stress (11.2 kg/ha mm) imposed during planting to jointing stage. Results indicate that the wheat crop should be irrigated at 50% depletion of available soil water (ASW). (Author's abstract)
W85-05933

IRRIGATION SYSTEM UNIFORMITY FUNCTION RELATING THE EFFECTIVE UNIFORMITY OF WATER APPLICATION TO THE SCALE OF INFLUENCE OF THE PLANT ROOT ZONES,
Louvain Univ. (Belgium). Dept. of Agricultural Engineering.
O. G. Cogels.
Irrigation Science, Vol. 4, No. 4, p 289-299, December, 1983. 9 Fig, 7 Ref.

Descriptors: *Irrigation systems, *Uniformity function, *Scale of influence, *Root zone, Simulation, Mathematical studies, Sampling, Water application, Irrigation.

A uniformity function which takes into account the horizontal scale of influence of individual plant root-zones is derived from both measured and simulated sprinkler water application depths. A new mathematical tool for the analysis of the spatial variability of measurements, the 'scalogram', is introduced for the computation of the uniformity function. The effect of the density of the sampling pattern and of the local randomness on the shape of the uniformity function is studied with simulated water application depths. It is shown that the function is practically independent of the sampling density if equal or higher than the recommended one and that local randomness, i.e. measurement errors, only affects the shape of the function for small scales of influence of plant root-zones. (Author's abstract)
W85-05938

PERFORMANCE OF LOW PRESSURE CENTER PIVOT SYSTEMS,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
L. G. James, and S. K. Blair.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1753-1757 and 1762, November-December, 1984. 6 Fig, 8 Ref.

Descriptors: *Center pivot irrigation, *Irrigation practices, *Sprinkler irrigation, Computer models, Model studies, Water use efficiency, Terrain, Energy, Water pressure.

Many sprinklers that operate at pressures as low as 140 kPa are being used with center pivot irrigation systems. These sprinklers normally wet a smaller area and have higher average application rates than do the high pressure impact sprinklers which have been traditionally used with center pivot systems. A computer simulation model was used to compare the effect of sprinkler spacing and terrain on the theoretical performance of six center pivots. Equations for computing sprinkler discharge from nozzle diameter and operating pressure and for computing wetted radius were added to an existing model, as were shape functions for representing the application patterns of low pressure impact sprinklers and fixed head spray sprinklers. Systems with impact sprinklers and low pressure fixed head spray sprinklers had the highest uniformities for constant spacings of 12 and 1.5 m, respectively. Energy use was highest on upward sloping terrains. Terrain had little, if any, effect on the uniformity and adequacy of application or peak application rates for a particular center pivot system. Spray systems used 30% less energy and had higher mean and peak application rates than a system with impact sprinklers. (Collier-IVI)
W85-06083

PREDICTING SEDIMENT DEPOSITION PATTERNS IN PIPES WITH DIMINISHING FLOW,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
L. G. James, and B. A. King.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1758-1762, November-December, 1984. 5 Fig, 1 Tab, 8 Ref.

Descriptors: *Sedimentation, *Pipelines, *Low flow, *Irrigation practices, Conveyance structures, Sprinkler irrigation, Trickle irrigation, Model studies.

Deposition of particulate material often occurs in submain lines and laterals in sprinkler and trickle irrigation systems because of the stepwise decrease in velocity from the upstream to downstream end of the pipe due to lateral and sprinkler (or emitter) discharge. The design of irrigation systems which use water high in suspended sediments which cannot be economically removed by filtration should consider the transport and depostion of particulate materials. A model was developed to predict the spatial and temporal accumulation of sediment in pipes with diminishing flow, such as submains and laterals. Sediment accumulation patterns predicted with the model were compared to data from field experiments involving 12.7 and 14.7 mm diameter trickle laterals with vortex-type emitters and sediment inflow concentrations of 65 and 260 mg/L. The model was found to satisfactorily predict the spatial and temporal accumulation of sediment for these combinations of lateral diameters and sediment inflow concentrations. Inflow rate, particle size and density, pipe lengths, bulk density of the deposited sediment, and number of emitters were constant. Satisfactory agreement was found between measured and model predicted sediment deposition patterns. (Collier-IVI)
W85-06084

WATER MANAGEMENT FOR GUAYULE RUBBER PRODUCTION,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. A. Bucks, F. S. Nakayama, and O. F. French.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 7, p 1763-1770, November-December, 1984. 7 Fig, 3 Tab, 14 Ref.

Descriptors: *Guayule, *Water management, *Arizona, Evapotranspiration, Canopy temperatures, Rubber, Irrigation, Crop production, Water stress.

Guayule used water for the first two years in response to soil water availability and environmental demands at Mesa, Arizona. Evapotranspiration determinations for three cultivars from May 1981 through December 1982, averaged 3000, 2410, 2040, 1720, 1470, and 1520 mm (118, 95, 80, 68, 58, and 60 in.) in decreasing order of water applications for six irrigation treatments. Plant canopy temperatures as measured by an infrared thermometer showed a progressive increase in stress behavior as irrigation water applications decreased. Plant temperatures as high as 8 C (14 F) above air temperatures were recorded during the summer months on the dry treatment without plant death; whereas, plant temperatures on the wet treatment were seldom more than 1 C (1.8 F) above air temperature. Rubber yields were significantly higher on the wetter than drier treatments because of the greater biomass on the wetter treatments. Although guayule can withstand long periods of drought, optimum production will not be achieved in a short period without using an extremely wet irrigation schedule. (Author's abstract)
W85-06085

HYDRAULIC RAM USE FOR SPRINKLE IRRIGATION,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
K. Kitani, and L. S. Willardson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1788-1791, November-December, 1984. 4 Fig, 6 Ref.

Descriptors: *Hydraulic rams, *Sprinkler irrigation, *Irrigation, Pumping plants, Water hammer, Energy.

Hydraulic rams work on the principle that a large volume of water with a low head can be used to pump a smaller volume of water to a higher head using the water hammer effect. Hydraulic rams have not been widely used for irrigation, and, particularly, have not been used for application to sprinkler irrigation. Direct hydraulic ram use for sprinkle irrigation was studied on a 24.3 ha (60 acre) farm near Cornville, Arizona. Results indicated that hydraulic rams could be effectively used for direct sprinkle irrigation. Operation costs are low and hydraulic rams can be installed where outside energy is difficult to obtain. The least head ratio, the ratio of delivery head to supply head, is an important design factor for continuous hydraulic ram operation for sprinkle irrigation. Pressure fluctuations inherent in a hydraulic ram pumping system are not expected to seriously affect water distribution patterns. If a suitable installation site is available, use of hydraulic rams may be the most economical pumping system for sprinkler irrigation. (Collier-IVI)
W85-06088

NUMERICAL ANALYSIS OF IRRIGATION TREATMENTS OF BARLEY WITH RESPECT TO DRAINAGE LOSSES AND CROP RESPONSE,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Agronomy.
R. K. Mahey, J. Feyen, and G. Wyseure.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1805-1810 and 1816, November-December, 1984. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Numerical analysis, *Irrigation practices, *Barley, *Drainage, *Crop yield, Soil water balance, Model studies, Transpiration, Irrigation efficiency.

A numerical analysis of a barley field experiment conducted during 1974-1975 and 1975-1976 with different irrigation treatments was done to determine the drainage losses and crop response with respect to the irrigation management. To evaluate the obtained experimental results, a numerical soil water balance model, SWATRE, was used to estimate the actual transpiration. There is a close agreement between the measured and simulated moisture depths, after calibration of the SWATRE model, during both of the growing seasons of the crop. The calculated actual transpiration was used as a major input in the growth model, CROPR, in order to verify crop response in the irrigation treatments applied. The CROPR model, under the given agricultural practices, was able to simulate grain yield. Both SWATRE and CROPR models are useful tools in the re-orientation, optimization and reduction of field research related to the effect of irrigation scheduling on crop yield and field irrigation efficiency. (Author's abstract)
W85-06091

BORDER IRRIGATION MODEL SELECTION,
Concepcion Univ. (Chile). Dept. of Agricultural Engineering.
E. A. Holzapfel, M. A. Marino, and J. Chavez-Morales.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1811-1816, November-December, 1984. 5 Fig, 3 Tab, 23 Ref.

Descriptors: *Border irrigation, *Model studies, *Irrigation practices, Soil types, Kinematic wave theory, Mathematical analysis, Volume balance models, Zero inertia models.

The capability of zero-inertia, kinematic-wave, and volume-balance models to predict advance and recession phases in free-end border irrigation were compared to field data for different values of border width and discharge in a loamy and sandy loam soil. All models give very good predictions of the advance. An excellent estimation of the recession times was obtained with the zero-inertia model. The kinematic-wave model predicted the advance of the water front well, but its estimates of recession times were not as good. The volume-balance model estimated the recession times well by using an algebraic method. The final volume of infiltrated water and its longitudinal distribution depend on the opportunity time. If the opportunity time is large, errors in the advance or recession curves will have a small effect in the computed infiltration depth, because infiltration rates are small at large times. Reasonable estimation of the advance of the water front and recession times are important in determining the quality of the irrigation. The time ratio (ratio of time irrigation cutoff to time when the water front reaches the end of a run) plays an important role in design and management of border irrigation systems. (Author's abstract)
W85-06092

DESIGNING FURROW-IRRIGATION SYSTEMS FOR IMPROVED SEASONAL PERFORMANCE,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
T. K. Gates, and W. Clyma.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 3, p 1817-1824, November-December, 1984. 2 Fig, 6 Tab, 30 Ref. AID contract AID/DSAN-C-0058.

Descriptors: *Irrigation practices, *Furrow irrigation, *Irrigation design, Seasonal variation, Crop yield, Design criteria, Soil infiltration, Colorado.

Furrow irigation system design using a quasi-rational procedure was evaluated to determine its effect on the seasonal performance of typical farmer-managed system. The infiltration characteristics of the soil and the required depths of application at the times of each of five different irrigations through a season were determined for a farmer-managed field in northern Colorado. A design process that does not account for seasonal variations in field conditions results in poor seasonal performance for situations similar to the case study. The inadequacy of the design is primarily due to the failure to account for the higher intake rate and shallower root zone depth occurring at the beginning of the season. Thus, the traditional design approach based upon conditions during the period of peak consumptive use is unacceptable from an operational stand point because it results in unacceptable system performance. A design strategy that involved an early season design to account for the distinct hydraulic and crop constraints characteristics of the system during the early part of the irrigation season was evaluated. Design of system capability and hydraulic structures should allow for management and operational flexibility to cope with seasonal variations in field conditions. (Baker-IVI)
W85-06093

DROP SIZE DISTRIBUTIONS FOR A LOW PRESSURE SPRAY TYPE AGRICULTURAL SPRINKLER,
South Dakota State Univ., Brookings. Dept. of Plant Science.
R. A. Kohl, and D. W. DeBoer.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1836-1841, November-December, 1984. 12 Fig, 12 Ref.

Descriptors: *Irrigation practices, *Sprinklers, *Spray irrigation, Fluid drops, Center pivot irrigation, Design criteria.

Drop size distributions from agricultural irrigation sprinklers are of interest because: (1) wind velocities can distort application patterns and smaller drops are more sensitive to wind; and (2) the influence of drop size on drop kinetic energy and its subsequent impact on the soil surface can modify the infiltration characteristics of a soil. Droplet distributions were derived for a 360 deg spray nozzle with nozzle sizes ranging from 4.8 to 9.5 mm and pressure ranging from 50 to 200 kPa. Smooth and serrated spray plates were also used. Smaller nozzles used on the inner half to two-thirds of the center pivot, are less likely to cause crusting because their distributions tended toward smaller drop size classes and their application rates are lower; little or no runoff should occur in this area. Even if wind drift would be significant, the drift from these smaller nozzles would not likely pass beyond the wetted area of the sprinkler system and be a loss to the field. The larger nozzles are used at the outer end of the system where application rates are high, where soil crusting and runoff can be a problem, and where drift has an opportunity to fall beyond the irrigated field. The geometry of the spray plate surface is the dominant parameter that influences drop size distribution when compared to nozzle size and water pressure. The smooth plate produced the smallest droplets and the coarse grooved plate produced the largest. Additional data on the effects of impingement plate design on drop size distribution is needed. (Collier-IVI)
W85-06096

WATER USE EFFICIENCY OF WHEAT IN A MEDITERRANEAN-TYPE ENVIRONMENT. I THE RELATION BETWEEN YIELD, WATER USE AND CLIMATE,
South Australia Dept. of Agriculture, Adelaide.
R. J. French, and J. E. Schultz.
Australian Journal of Agricultural Research, Vol. 35, No. 6, p 743-764, 1984. 7 Fig, 8 Tab, 60 Ref.

Descriptors: *Water use efficiency, *Wheat, *Crop yield, *Climate, Evaporation, South Australia, Australia, Grains, Sowing, Timing, Soil water.

The relations between wheat yield and water use were determined from field measurements in South Australia. Highest production of dry matter was 37 kg/ha per mm of water use and of grain was 12.7 kg/ha per mm. More than 70% of the total water use occurred by anthesis. Time of sowing and soil water content at sowing had a big influence on yield. The loss of water by direct evaporation was estimated to be 110 mm, equal to about one-third of the water use. The maximum efficiency of water transpired was 55 kg/ha/mm for dry matter and 20 kg/ha/mm for grain. The efficiencies of most of the crops were below this level. Yield (Y), water use (W) and evaporation (Ep) could be fitted to the de Wit formula $Y = mW/Ep$, but the m factor varied with the proportion of water use that was lost by direct evaporation. (Author's abstract)
W85-06099

TRIADIMEFON REDUCES TRANSPIRATION AND INCREASE YIELD IN WATER STRESSED PLANTS,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
For primary bibliographic entry see Field 2I.
W85-06104

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

WATER MANAGEMENT FOR SMALL URBANIZING WATERSHED,
Iowa State Univ., Ames. Dept. of Civil Engineering.
R. L. Rossmiller.
Journal of Water Resources Planning and Management, Vol. 111, No. 2, p 123-136, April, 1985. 6 Fig, 7 Tab, 13 Ref.

Descriptors: *Water management, *Urban watersheds, *Ames, *Iowa, Artificial recharge, Quarries, Water quality, Water supply, Recreation, Flood control, Drought.

In 1976 and 1977, the city of Ames, Iowa had to ration water due to a locally severe drought. Some relief was obtained by artifically recharging the depleted aquifer by pumping water from a nearby sand and gravel quarry. Since the drought, city engineering and Iowa State University personnel have conducted studies to make the quarry a permanent part of the city's sources of water supply. These studies have included both water quantity and water quality studies. The results of these studies with emphasis given to the water quantity studies and results are explored. This account of how one city turned the solution of a water supply problem into an opportunity to incorporate water quality, flood control, and recreation considerations into a more complete over-all solution can serve as a model for other cities to use as they strive to find solutions to their own unique water-related problems. (Author's abstract)
W85-06026

IRRIGATION SYSTEM STUDY IN INTERNATIONAL BASIN,
Indian Inst. of Tech., New Delhi. Dept. of Applied Mechanics.
For primary bibliographic entry see Field 6A.
W85-06027

OPTIMAL OPERATION OF CALIFORNIA AQUEDUCT,
California State Dept. of Water Resources, Sacramento.
M. H. Sabet, J. Q. Coe, H. M. Ramirez, and D. T. Ford.
Journal of Water Resources Planning and Management, Vol. 111, No. 2, p 222-237, April, 1985. 5 Fig, 3 Tab, 14 Ref, 1 Append.

Descriptors: *California Aqueduct, *Optimization, *Energy, *Operating costs, Pumping, Peak demand, Linear programming, Water demand, Hydroelectric power, California State Water Project, Model studies, Computer models.

The goals and objectives of operation of the California State Water Project (SWP) changed significantly on March 31, 1983, when long-term, low-cost contractual agreements for energy purchase for the Project terminated. Now energy required for pumping must be purchased at a substantially increased cost. However, energy generated in the Project can be sold with maximum revenues at times of peak electrical demand. To determine the most efficient operation schedules for the SWP, a coordinated set of models was developed for execution in 'real time.' This set of models includes network flow programming models, a number of other simulation models, and a large-scale linear programming (LP) model designed to determine optimal flows throughout the California aqueduct system, given the energy demands for pumping, energy generation capabilities and water demands. This LP model may be executed with a weekly or daily time step. Solution of the LP problem is accomplished with the nonproprietary XMP package, using the dual-simplex capability to accelerate solution. (Author's abstract)
W85-06033

EVALUATING SUBSURFACE DRAINAGE BENEFIT ESTIMATION FROM SHORT-TERM CROSS-SECTION DATA,
Guelph Univ. (Ontario). School of Agricultural Economics and Extension Education.
W. van Vuuren, and H. Jorjani.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1719-1723, November-December, 1984. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Subsurface drainage, *Crop yield, Drainage, Evaluation, Economic aspects, Corn, Precipitation, Cost analysis.

An estimation procedure for the change in corn yield caused by subsurface drainage was examined. Long term series of annual yield data provide the

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ideal data set, but are virtually nonexistent. The conditions under which short-term data provide a good proxy for the average annual yield increase over the lifetime of the drainage system are examined. Data in this case was obtained from observations covering four years and a large number of farms in a region with variable precipitation. A condition that must be met in order to make these short term cross section data reliable proxies for long term data is that the precipitation regime over the short term over a region with variable precipitation is the same as the precipitation regime over the long term at any site in the region. For the four years under consideration, average precipitation was considerably higher during two specific periods than over the long term. In general, caution is needed in using the short term cross section data for an investment analysis of subsurface drainage. Calculation of the break even yield provides some subjective indication about economic viability. If the average yield on which the analysis is based far exceeds the break even yield, the investment is probably economically sound, although the judgement is subjective. (Baker-IVI)
W85-06077

UTILITY APPROACH TO COMPREHENSIVE STORMWATER MANAGEMENT,
Fort Collins Dept. of Public Works, CO. Engineering Services.
M. Engemoen, and R. E. Krempel.
Public Works, Vol. 116, No. 4,p 68-71, 92, April, 1985. 2 Fig, 1 Tab.

Descriptors: *Storm runoff, *Water management, *Fort Collins, *Colorado, Utilities, Urban runoff, Financing.

In 1980 Fort Collins established a stormwater utility by bringing drainage activities together in a single program. These activities include routine operations, maintenance and administration of the existing drainage system, and the engineering and development of a comprehensive capital improvements program. To fund operations, maintenance, and administration, the City began charging property owners a monthly utilities fee, based on the property's area and land use characteristics, which amounted to about $1 per month for single family residences. Almost a year later additional fees were instituted for storm drainage capital improvements in three of nine drainage basins. The framework of the Fort Collins stormwater management program was established in the storm drainage ordinance of 1976. In this ordinance two important drainage principles were delineated: that all real property within a drainage basin will be benefited by the installation of an adequate storm drainage system; and that the cost of installing an adequate drainage system should thus be assessed against the real property in a basin. The storm drainage ordinance of 1976 emphasized the importance of individual drainage basins. The city was divided into nine major basins, and over a three year period, developed storm drainage master plans for each one. Each master plan evaluated the basin hydrology under existing conditions to identify existing drainage problems. Each plan identified the system of improvements needed to provide safe and effective storm drainage within the basin. The financing plan used by the city is described. (Baker-IVI)
W85-06125

SOIL SALINITY STATUS AND ITS RELATION TO SOME OF THE SOIL AND LAND PROPERTIES OF THREE IRRIGATION DISTRICTS IN SOUTHERN ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Research Station.
C. Chang, G. C. Kozub, and D. C. Mackay.
Canadian Journal of Soil Science, Vol. 65, No. 1, p 187-193, February, 1985. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Saline soils, *Irrigation effects, *Alberta, Soil texture, Electrical conductivity, Water table, Clay, Slope, Soil properties.

A detailed soil salinity survey was carried out in three of the 13 irrigation districts in southern Alberta. About 30 quarter-sections in each district were randomly selected for soil sampling. The location, distance from water supply ditches, slope of the land, and depth to till and water table at each site were recorded. Soil texture and electrical conductivity of extracts of soil samples were determined in the laboratory. The extent of the area with a soil salinity level of 4 dS/m or more is 5% of the total surveyed land in the Western Block of the St. Mary River Irrigation District (WSMRID), 6% in the Lethbridge Northern Irrigation District (LNID) and 9% in the Taber Irrigation District (TID). These values are not as high as others have previously estimated. The salinity level of the soil at each site was found to vary with its location and distance from water supply ditches in the WSMRID and LNID, clay content in the 0- to 120-cm depth in the WSMRID and TID, and water table level in the TID. (Author's abstract)
W85-06151

4B. Groundwater Management

WATER MANAGEMENT FOR SMALL URBANIZING WATERSHED,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W85-06026

CONJUNCTIVE UTILIZATION OF SURFACE WATER AND GROUNDWATER TO ARREST THE WATER-LEVEL DECLINE IN AN ALLUVIAL AQUIFER,
National Geophysical Research Inst., Hyderabad (India).
C. P. Gupta, S. Ahmed, and V. V. S. Gurunadha Rao.
Journal of Hydrology, Vol. 76, No. 3/4, p 351-361, February, 1985. 10 Fig, 3 Tab, 4 Ref.

Descriptors: *Groundwater, *Alluvial aquifers, *Conjunctive use, *Daha region, *India, Canals, Irrigation, Water demands, Water supply development, Water resources development, Groundwater recharge, Groundwater recession.

The groundwater regime in the Daha area of the Krishni and Hindon interstream region in Uttar Pradesh, India has been very extensively exploited, causing an appreciable decline of groundwater levels. The area is underlain by unconsolidated fluviatile deposits, which are thick and porous. The aquifer zone extends up to 100 m below ground surface and has a saturated thickness ranging between 22 and 50 m. The entire system was regarded as interconnected in view of the observed interfingering of sand and clay lenses. For model construction purposes the area of about 300 sq km was divided into 79 node points with a uniform grid spacing of 2 km. The groundwater flow equation was transformed into a finite-difference form using the backward difference approximation. The interpolated transmissivity pattern based on field estimates was the starting point for model construction. During the dynamic phase of modeling it was found that the rivers, which were initially effluent in nature, have gradually been becoming influent as a result of declining groundwater levels. The trend of water level decline due to over exploitation of groundwater in this area could possibly be offset considerably by conjunctive utilization of surface and groundwater, particularly during the surplus period. A possible approach in this regard is to construct a network of unlined canals in the area. The variation in the aquifer response as a result of the introduction of the proposed canal network was computed. The effect of the canal on the aquifer system will be two-fold: pumpage from the aquifer will be reduced as water for irrigation will also be drawn from the canals; and there will be an additional recharge to the aquifer due to seepage in the unlined canals. (Baker-IVI)
W85-06053

ARKANSAS GROUNDWATER MANAGEMENT VIA TARGET LEVELS,
Arkansas Water Resources Research Center, Fayetteville.
R. C. Peralta, and A. W. Peralta.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1696-1703, November/December, 1984. 6 Fig, 15 Ref.

Descriptors: *Groundwater management, *Arkansas, *Pumping, Riparian rights, Groundwater level, Resources management, Boussinesq equation.

An approach to groundwater management by maintaining 'target' groundwater elevations was developed. A finite difference form of the Boussinesq equation was proposed as a means of determining the groundwater withdrawals that will maintain those levels in the long term. This spatially distributed pumping can represent a sustained yielding pumping strategy. A sample pumping strategy was presented for the Arkansas Grand Pairie. Such a strategy is applicable under a variety of legal systems. It represents an especially attractive alternative for riparian rights states (like Arkansas) where effective groundwater management without radical changes in the basic water rights system is desired. (Author's abstract)
W85-06074

4C. Effects On Water Of Man's Non-Water Activities

HIGHWAY IMPACTS ON WETLANDS: ASSESSMENT, MITIGATION, AND ENHANCEMENT MEASURES,
M. H. Thrasher.
Transportation Research Record, Vol. 948, p 17-20, 1984. 7 Ref.

Descriptors: *Wetlands, *Environmental effects, *Highways, *Construction, Water pollution sources, Soil properties, Land management, Conservation, Legal aspects.

General wetland types and their basic functions and values are identified, and highway construction impacts, impact assessment, and mitigation and enhancement procedures are discussed. Special emphasis is given to the reconstruction of wetlands affected by highway construction. Wetlands are characterized by the periodic or permanent presence of water in a sufficient amount to make it the dominant factor in determining the nature of soil development and the types of plant communities living in it or on its surface. Most wetlands are important to fish, shellfish, waterfowl, and other wildlife, although specific values differ. Highway construction in wetlands is regulated by federal and state laws. The unavoidable adverse impact on wetlands by a proposed highway construction activity may be permitted provided that such construction is judged to be in the public interest and an acceptable plan to mitigate wetland losses is implemented. A central component of the mitigation plan is compensating or offsetting unavoidable weland losses. The objectives are basically of two kinds: the mitigation of adverse impacts and the enhancement of wetlands. (Baker-IVI)
W85-06065

HYDROGEOCHEMICAL ASPECTS OF SURFACE MINE RECLAMATION IN THE NORTHERN GREAT PLAINS,
North Dakota Mining and Mineral Resources Research Inst., Grand Forks.
G. H. Groenewold, and R. D. Koob.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1711-1718, November-December, 1984. 3 Fig, 2 Tab, 20 Ref. Bureau of Mines contract J0275020, EPA grants R-805939 and R-805459.

Descriptors: *Coal mining, *Strip mines, *North Dakota, *Great Plains, *Geochemistry, *Land reclamation, Hydrogeology, Hydrologic models, Sodium, Sulfate, Mineralization, Groundwater pollution.

Surface coal mining activities in the Northern Great Plains have generated considerable concern with respect to potential impacts on postmining

plant growth success and groundwater quality. Studies of several coal-mining sites in western North Dakota resulted in the development of a hydrogeochemical model which accounts for the observed chemical characteristics of subsurface water in undisturbed settings. Recent refinements in the hydrogeochemical model focused on the sulfur cycle and determination of the applicability of the model to postmining landscapes. Field activities included detailed groundwater instrumentation of undisturbed and spoils areas at two geologically distinctive mine sites in western North Dakota. Refinement of the model included analyses of the texture, bulk mineralogy, clay mineralogy, sufide abundance, and sulfur concentration in overburden core samples. Lab experiments were designed to determine the source and mechanisms of sulfate salt production from overburden samples. The model is equally applicable to undisturbed and spoils landscapes and the major species of concern in this region are sodium and sulfate. The major source of sulfate is sulfides in the overburden and the solubility of sulfate in groundwater in these settings is largely controlled by the sodium/calcium ratio. The negative hydrogeochemical impacts resulting from surface mining in the Northern Great Plains will include increased mineralization of groundwater and sodic and salt effects on plants. The degree of these impacts will be dependent on site-specific hydrogeological, geochemical, and mineralogical variables. A consideration of these non-soils aspects of surface-mined lands thus is essential to proper surface mine reclamation design in this region. (Baker-IVI)
W85-06076

4D. Watershed Protection

URBAN SEDIMENT AND STORMWATER CONTROL: THE MARYLAND EXPERIENCE,
Maryland Water Resources Administration, Annapolis.
R. E. Benner.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 72-75, January-February, 1985.

Descriptors: *Maryland, *Water pollution control, *Urban runoff, *Storm water, Nonpoint pollution sources, Runoff, Sediments, Erosion control, Construction, Legislation.

Five decades ago Marylanders realized that soil and water resources must be conserved and they set out to develop rural and urban control programs for sediment and for stormwater runoff. For three decades, state efforts focused solely on sediment problems in rural areas. Then in the fourth decade urban development resulted in the ruling that silt discharged into the waters of the state from land clearing or development operations was legally subject to regulatory control by the state agency. In 1977 Maryland put into effect an interim watershed management policy directing that all state-financed or state-constructed projects be reviewed for stormwater management. About 1982, officials decided that the most rational, effective approach to stormwater management was maintaining as nearly as possible natural runoff flow characteristics. As the stormwater management effort gained momentum, a State Stormwater Management Law was passed in 1982. This law requires each county and municipality to adopt a stormwater management ordinance based on the state criteria. As the sediment control program emerged in the 1970s the state's administrative costs totalled $72,000 per year and remained at that level for the entire decade. But the sediment control program has grown, especially with emphasis on cleaning up the Chesapeake Bay. The state's current commitment to the sediment and stormwater management program including the $1.7 million for local programs, approaches the $3 million mark. (Baker-IVI)
W85-05951

SEDIMENT DEPOSITS IN DRAINAGE DITCHES: A CROPLAND EXTERNALITY,
Ohio State Univ., Columbus.
For primary bibliographic entry see Field 2J.
W85-05965

SUBSIDY AND TAX EFFECTS OF CONTROLLING STREAM SEDIMENTATION IN SOUTH CAROLINA,
Mississippi State Univ., Mississippi State. School of Forestry.
R. D. Seale, J. W. Hubbard, and E. H. Kaiser.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 144-148, January-February, 1985. 1 Fig, 8 Tab, 6 Ref.

Descriptors: *Subsidies, *Taxes, *Sediment control, *Streams, *South Carolina, Conservation tillage, Crop production, Soil conservation, Economic aspects, Costs, Sedimentation.

A model consisting of a farm enterprise budget generator, a hydrologic model, and a matrix generator was used to address several questions in a specific watershed: the subsidy required to induce farmers to adopt conservation tillage crop production systems; the tax on conventional crop production systems required to render those systems less profitable than systems that conserve more soil or create less stream pollution; how adoption of conservation tillage practices would offset stream sedimentation; the effects restricting stream sedimentation from farming operation would have on income; the potential tradeoffs between stream pollution and farm income. Subsidies, taxes, and the imposition of sediment restrictions all could reduce stream pollution, but there would be large differences among these approaches in costs, stream pollution, soil loss, and farm incomes. Because of the difficulty of designing and enforcing a scheme to restrict stream sedimentation to predetermined levels, subsides and tax potentials have greater potential. At all levels of subsidies and taxes from $5/acre to $50/acre, the tax program resulted in a 10 to 11% greater reduction in sediments than the subsidy program. Farmers suffered more under the taxing scheme than under the subsidy program. (Moore-IVI)
W85-05966

RUNOFF, SOIL, AND NUTRIENT LOSSES FROM RANGELAND AND DRY-FARMED CROPLAND IN THE SOUTHERN HIGH PLAINS,
Agricultural Research Service, Bushland, TX. Conservation and Production Research Lab.
For primary bibliographic entry see Field 5B.
W85-05970

BEST MANAGEMENT PRACTICES FOR CONTROLLING NONPOINT-SOURCE POLLUTION ON FORESTED WATERSHEDS,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 5G.
W85-05971

PLANT NUTRIENT LOSSES BY SOIL EROSION AND MASS MOVEMENT AFTER WILDFIRE,
Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
For primary bibliographic entry see Field 2J.
W85-05972

SOIL EROSION STUDY OF EXPOSED HIGHWAY CONSTRUCTION SLOPES AND ROADWAYS,
B. A. Anderson, and D. B. Simons.
Transportation Research Record, Vol. 948, p 40-47, 1984. 9 Fig, 1 Tab, 9 Ref.

Descriptors: *Erosion control, *Highways, *Slopes, *Construction, Design criteria, Design criteria, Model studies, Soil erosion,.

The sediment generated during and after highway construction is often excessive unless proper erosion control measures are taken. The quantities of sediment produced from construction slopes and roadways are determined, and a methodology to assist in the determination of these quantities is presented. The data collection program was conducted on 10 representative soils in the study area and included testing of cut slopes, fill slopes, road surfaces, and undisturbed sites above the roadway. The data were analyzed and used as input to a simple mathematical model. Additional input parameters were estimated and the model was calibrated. After the calibration, a procedural guide and an interactive program were developed. These can both be used to assist the planner in determining the sediment produced from different roadway design alternatives. Both the procedural guide and the interactive method are limited regionally to the soils tested and the sites evaluated during this study. The interactive program and procedural guide are limited to assessing the erosion from relatively simple road geometries. Even so, with an expanded field data collection program, improved methodologies similar to those presented in this paper could be produced for any selected geographic region. (Baker-IVI)
W85-06069

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

POLLUTION MONITORING USING THE NEMATODE/COPEPOD RATIO, A PRACTICAL APPLICATION,
Napier Coll., Edinburgh (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W85-05860

HYDROCARBONS AND HALOGENATED HYDROCARBONS IN COASTAL WATERS OF THE ENGLISH CHANNEL AND THE NORTH SEA,
IFREMER, Brest (France).
M. Marchand, and J. C. Caprais.
Marine Pollution Bulletin, Vol. 16, No. 2, p 78-81, 1985. 1 Fig, 6 Tab, 5 Ref.

Descriptors: *Coastal waters, *Water pollution control, *Pollutant identification, *Hydrocarbons, *Polychlorinated biphenyls, *Lindane, *English Channel, *North Sea, Sampling, Water analysis, Chemical analysis, Industrial wastes.

The quality of coastal marine waters is monitored in France within the framework of Reseau National d'Observation, a program financed by the Ministry of the Environment. In October of 1983 the first campaign to measure hydrocarbons and halogenated hydrocarbons in the English Channel and North Sea was undertaken. A total of 50 sampling stations were selected. Two major sources of total hydrocarbons and PCBs and lindane were found in the Seine estuary and the Calais-Dunkirk industrial and urban zone in the North Sea. Significant correlations were found between all the parameters measured, hydrological (salinity, turbidity, suspended matter), and organic pollutant (hydrocarbons, PCBs, lindane) parameters in the coastal strip influenced by the Seine. A coefficient of decreasing concentrations of total hydrocarbons and PCBs approximately the same as that of suspended matter was found between the two limit conditions, the estuary and the typically marine region. On the other hand, the coefficient for lindane is quite different, of the order of 20, and nearer to that of salinity. Both the observations show that for total hydrocarbons and PCBs extractable compounds which are easily adsorbed into particulate matter, the behavior and process of dispersion at the mouth of the estuary is essentially linked to sedimentary mechanisms. Conversely, the distribution process of lindane, a compound which is more soluble, is primarily linked to water mass movements. (Baker-IVI)
W85-05862

USE OF THE AURELIA METAMORPHOSIS TEST SYSTEM TO DETECT SUBTLE EFFECTS OF SELECTED HYDROCARBONS AND PETROLEUM OIL,
Eastern Virginia Medical School, Norfolk, VA. Dept. of Pathology.

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For primary bibliographic entry see Field 5C.
W85-05890

DEVELOPMENT OF A RAPID, SENSITIVE AND QUANTITATIVE TEST FOR THE ASSESSMENT OF THE EFFECTS OF XENOBIOTICS ON REPRODUCTION IN FISH,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
T. T. Chen, and R. A. Sonstegard.
Marine Environmental Research, Vol. 14, No. 1-4, p 429-430, 1984.

Descriptors: *Water pollution effects, *Xenobiotics, *Pollutant identification, *Vitellogenin, *Fish, Trout, Water quality control, Monitoring, Immunoelectrophoresis.

A rocket immunoelectrophoresis procedure was developed as a rapid quantification of the levels of vitellogenin in serum samples. The method measures quantitatively the presence of vitellogenin in serum at a concentration as low as 0.5 micro-g/10 micro-l. Upon treatment of juvenile rainbow trout with estradiol at 20 micro-g/100 g body weight, the production of vitellogenin was readily induced within 6 days at 15 C. Fish of 50 g body weight were fed a diet contaminated with 3, 30, or 300 ppm of PCBs, or with 0.5, 5, or 50 ppm Mirex, or with a mixture of PCBs (30 ppm) and Mirex (5 ppm) for 6 months. Results indicate the production of vitellogenin induced by estradiol was greatly reduced by PCB, Mirex and a mixture of the two. A molecular hybridization assay was developed to increase the accuracy and sensitivity of assaying the production of vitellogenin in fish. Results indicate that MFO inducers reduce synthesis of vitellogenin mRNA. The production of vitellogenin induced by estradiol can thus be used as a sensitive test for evaluating the potential effects of xenobiotics on fish reproduction. (Baker-IVI)
W85-05895

ALTERATIONS IN TISSUE WATER BALANCE AND ADENYLATES OF BLUEGILL (LEPOMIS MACROCHIRUS) EXPOSED TO COPPER,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W85-05898

HISTOPATHOLOGY OF MERCENARIA MERCENARIA AS AN INDICATOR OF POLLUTANT STRESS,
Delaware Univ., Newark. School of Life and Health Sciences.
For primary bibliographic entry see Field 5C.
W85-05899

ISOTACHOPHORETIC DETERMINATION OF ANIONIC AND CATIONIC SPECIES IN WELL AND SURFACE WATERS,
Karlova Univ., Prague (Czechoslovakia). Dept. of Physical Chemistry.
J. Vacik, and I. Muselasova.
Journal of Chromatography, Vol. 320, No. 1, p 199-203, February, 22, 1985. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Water analysis, *Pollutant identification, *Isotachophoresis, Well waters, Natural waters, Chlorides, Nitrates, Sulfates, Potassium, Sodium, Calcium, Magnesium, Chemical composition.

Electrolyte systems and the conditions for the isotachophoretic determination of anions (chloride, nitrate and sulfate) and cations (potassium, sodium, calcium, and magnesium) in well and surface waters are described. The results of isotachophoretic determinations on practical samples are compared with those obtained by classical methods. A typical isotachopherogram of a mixture of the anions is shown. The results for five different water samples are also displayed and compared with results obtained by classical metods. Chloride and sulfate were determined titrimetrically and nitrate photometrically, after reaction with sodium salicylate, potassium and sodium were determined by flame photometry and magnesium and calcium ions were titrated cheloatometrically. An isotachopherogram of a mixture of the cations is depicted and the results are tabulated. The electrolyte system used does not allow the separation of ammonium from potassium ions or the separation of barium from sodium ions. (Baker-IVI)
W85-05910

ISOTACHOPHORESIS OF CATIONIC HERBICIDES IN WATERS AND SOILS,
Palacky Univ., Olomouc (Czechoslovakia). Dept. of Analytical and Organic Chemistry.
Z. Stransky.
Journal of Chromatography, Vol. 320, No. 1, p 219-231, February, 1985. 7 Fig, 7 Tab, 34 Ref.

Descriptors: *Pollutant identification, *Isotachophoresis, *Herbicides, Soil analysis, Water analysis, Agricultural chemicals, Organic compounds, Path of pollutants.

A method for the determination of quaternary cationic herbicides (diquat and paraquat) and triazine herbicides in water and soil extracts by capillary isotachophoresis is proposed. More basic triazines (atratone, or prometryne) can be determined directly using enforced isotachophoresis. Very weak triazine bases (atrazine, or simazine, for example) have to be derivatized by nucleophilic substitution of chlorine by electron-donor or quaternary ammonium groups. Recoveries from soils are 70-80% of quaternary and 90-95% of triazine herbicdes. The limit of determination with both the types of herbicides is about 10 micro-g/kg of sample. Capillary isotachophoresis can be used as a rapid method for monitoring the composition of commercial formulations. The formation of ion associates could also be used for the concentration of quaternary herbicides from aqueous solution. Ion associates of bivalent cations are not completely extractable into organic solvents. The distribution ratios are too low for satisfactory isolation. The stable ion associates formed between dodecyl sulfate and the semi-reduced cation radical can be extracted almost quantitatively by one-step extraction. This fact simplifies the determination of herbicides in waters where extraction can replace the concentration of an ion exchanger and thus it increases the sensitivity of both isotachophoretic and spectrophotometric determinations at the 10 micro-g/liter level. The isotachophoretic determination is more reproducible. The spectrophotometric determination has the disadvantage of easy re-oxidation of the cation radical which occurs during the measurement and decreases the precision of the method. (Baker-IVI)
W85-05911

COLIFORMS AS AN INDICATOR OF WATER QUALITY IN WILDLAND STREAMS,
Malheur National Forest, John Day, OR.
C. C. Bohn, and J. C. Buckhouse.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 95-97, January-February, 1985. 1 Fig, 32 Ref.

Descriptors: *Indicator organisms, *Coliforms, *Streams, Animal wastes, Bacteria, Water quality, Water pollution control, Nonpoint pollution sources, Giardia.

With renewed interest in nonpoint pollution sources and the growing interest in riparian zone management, land management agencies have increased the number of monitoring and research programs on wildland streams. While the cause remains unknown, coliform populations exhibit daily and annual cycling. Regardless of the specific peak periods, the implication of these fluctuations to management and research programs is clear: individual samples represent the sanitary status of a stream only at the time of sampling. Coliforms enter streams with overland flow during the runoff season. They may also enter streams from groundwater flow following storms. The final and most obvious source of fecal coliforms in surface water is direct contamination from animals defecating into the water. Coliform counts are a valid indication of the sanitary status of a body of water only if pathogens respond to these situations in the same way as the coliform bacteria, which is a question to be answered. Coliforms are not satisfactory indicators for the protozoan Giardia spp., which is a growing concern in wildland waters. Fecal coliform and the salmonella species behave very much alike in natural waters. But both may die off while other pathogens remain viable. (Baker-IVI)
W85-05958

INORGANIC CARBONATE ELIMINATION FROM WATER SAMPLES FOR DISSOLVED ORGANIC CARBON ANALYSIS,
Yamagata Univ. (Japan). Dept. of Chemistry.
Y. Satoh, H. Tokairin, and M. Itoh.
Japanese Journal of Limnology, Vol. 45, No. 4, p 318-321, October, 1984. 2 Fig, 2 Tab, 2 Ref.

Descriptors: *Chemical analysis, *Organic carbon, *Dissolved solids, *Carbonates, Wet combustion, Sampling, Carbon dioxide, Water analysis.

Wet combustion is a widespread method for determining dissolved organic carbon (DOC) in both fresh and sea water. When water samples for DOC analysis are sealed into ampules in the field, a method is needed to eliminate inorganic carbonate. In this method, inorganic carbonate is eliminated by passing CO2 and organic free air through acidified samples for DOC analysis. The air is supplied from a manual rubber air pump by way of two gas washing bottles containing concentrated sulfuric acid and 1N-NaOH and a soda lime tube. The precision of the present method is the same as that of the standard method using nitrogen gas from a high pressure nitrogen gas tank. The method is especially useful in remote areas such as alpine lakes. The system can supply CO2-free air with a flow rate of about 200 ml/min for at least 31 hr. (Moore-IVI)
W85-06002

LOCATING CONTAMINANTS IN A GROUNDWATER SYSTEM BY DIRECT CURRENT RESISTIVITY TECHNIQUE,
Kwara State Coll. of Technology, Ilorin (Nigeria). School of Mines.
D. A. Alao.
Bulletin of the Association of Engineering Geologists, Vol. 22, No. 1, p 95-100, February, 1985. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Electrical resistivity, *Groundwater pollution, *Michigan, Copper mines, Conductivity, Mine wastes, Hydrogeology, Water pollution sources, Mines.

Water is being tapped from a mine shaft at Champion Mine (Painesdale, Michigan) to serve a growing population in the Michigan Copper District. The aims of this project are: to locate groundwater aquifers below piles of mine waste at the abandoned copper mine; to confirm the existence of chemical pollution of groundwater by the mine waste and other possible sources; to achieve the foregoing objectives by means of resistivity studies and application of computer models. Reconnaissance, resistivity measurement (using the Schlumberger Configuration) in the field, and interpretation was supplemented with conductivity data of water samples collected at different sites. Apart form station 2 where there is little or no interference due to potential from extraneous sources, data from other stations were erratic, possibly due to buried conduits, concrete slabs, iron and steel junk, an old railroad which passes through the mine, and site topography. The good sounding data from resistivity station 2 was modelled with a microcomputer. Ground-water pollution would be expected to be indicated by high conductivities and low resistivities; in fact both high values of conductivity and low resistivity are seen at stations 2 and 3. The technique of resistivity and water chemistry has been found suitable for investigating this engineering geology problem. (Moore-IVI)
W85-06015

EFFECT OF ORGANIC SUBSTANCES ON THE RESULTS OF ANODIC STRIPPING VOLTAMMETRY DETECTION OF METAL IONS IN AQUEOUS MEDIA,

Sverdlovsk Inst. of National Economy (USSR).
Kh. Z. Brainina, R. M. Khanina, and L. I. Roitman.
Analytical Letters, Vol. 18, No. A2, p 117-134, February, 1985. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Metals, *Anodic stripping voltammetry, *Organic compounds, Pollutant identification, Water analysis, Natural waters, Fulvic acids, Humic acids, Enzymes, Polyethylene glycol, Lead, Copper, Cadmium.

The d.c. anodic stripping voltammetry method has been used to investigate the effect of organic substances simulating the composition of natural waters on the results of determination of concentration levels of copper, lead and cadmium. The response, sensitivity and concentration (the latter determined by the standard additions method) have been used as sources of information. In the presence of enzymes, fulvic acids, humic acids and polyethylene glycol all these three parameters change in the case of determination of copper and lead, making the results unreliable. The determination of cadmium concentration is not hampered by the organic substances. The change in the response does not provide sufficient grounds to judge the complexation in natural media. These results also indicate that the determination of metal ion concentration in natural waters necessitates the preliminary breakdown of organic components, especially in cases of determination of lead and copper. The analysis of the initial natural water provides information on the concentration level of the labile electroactive metal ion form. (Baker-IVI)
W85-06056

OPTIMIZATION AND EVALUATION OF REDUCTION-AERATION/AMALGAMATION FOR THE ANALYSIS OF MERCURY IN DRINKING-WATER BY COLD-VAPOUR ATOMIC ABSORPTION SPECTROMETRY (CVAAS),
Ghent Rijksuniversiteit (Belgium). Inst. voor Nukleaire Wetenschappen.
E. Temmerman, R. Dumarey, and R. Dams.
Analytical Letters, Vol. 18, No. A2, p 203-216, February, 1985. 4 Fig, 3 Tab, 9 Ref.

Descriptors: *Drinking water, *Mercury, *Reduction-aeration, *Atomic absorption spectrometry, Water analysis, Water quality control, Heavy metals, Pollutant identification, Absorption.

A reduction-aeration method is optimized for the analysis of mercury at the ng/l level in drinking water. The accuracy of the procedure was controlled by spiking samples with known amounts of mercury. The mean recovery for 14 tests, performed with mercury spikes betwen 1 and 8 ng, was 98.8%. In some cases the mercury is not quantitatively recovered from the solution, probably because Hg(2+) is adsorbed by the precipitate formed on the wall of the aeration flasks. After reduction-aeration with SnCl2, the mercury is collected on gold-coated quartz-sand. Next, the absorbing tube is connected to a second absorber which is continuously linked up with the spectrometer. The mercury is transferred to the second trap by electrothermally heating the first absorbing tube. Final determination is performed by thermal desorption of the second absorber. The procedure can be used directly to analyze mercury in drinking water. Application to other types of water requires a preliminary filtration step in the analytical scheme. (Baker-IVI)
W85-06057

ACID PRECIPITATION: NATURAL VERSUS ANTHROPOGENIC COMPONENTS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2K.
W85-06060

ACID RAIN: CRITICAL REVIEW OF MONITORING BASELINES AND ANALYSES,
V. Smil.
Power Engineering, Vol. 89, No. 4, p 59-63, April, 1985. 6 Fig.

Descriptors: *Acid rain, *Monitoring, *Reviews, Acidity, Precipitation, Water analysis, Chemical analysis, Sulfates, Nitrates.

Major milestones of the acid rain matter are reviewed for the purpose of showing where it currently stands and where it is heading. Measurement problems have always existed in this area as assessments of regional acidification must be based on comparisons of current data with historical data. Changes in sampling techniques, advanced technologies enabling determination at smaller and smaller quantities, and other developments have caused problems in determining a base line. Another problem has been the interpolation of data across distances of hundreds of miles. The acidity of solutions themselves is a complicated issue with the degree of acidity being determined not simply by the concentrations of sulfates and nitrates, but the complex influences of many cations and anions as well. (Baker-IVI)
W85-06126

DETERMINATION OF THE CONCENTRATION OF MALTOSE- AND STARCH-LIKE COMPOUNDS IN DRINKING WATER BY GROWTH MEASUREMENTS WITH A WELL-DEFINED STRAIN OF A FLAVOBACTERIUM SPECIES,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
D. Van Der Kooij, and W. A. M. Hijnen.
Applied and Environmental Microbiology, Vol. 49, No. 4, p 765-771, April, 1985. 7 Fig, 4 Tab, 10 Ref.

Descriptors: *Chemical analysis, *Maltose, *Starches, *Drinking water, *Bacterial physiology, *Flavobacterium, Coagulants, Water treatment.

The growth kinetics of Flavobacterium sp. strain S12 specialized in the utilization of glycerol, and a number of oligo- and polysaccharides were determined in batch-culture experiments at 15 C in pasteurized tap water supplied with very low amounts of substrates. K(sub s)s for the growth on maltotriose, maltotetraose, maltopentaose, and maltohexaose were 0.03 micro M or less and below those for glucose (1.5 micro M) and maltose (0.16 micro M). K(sub s)s for starch, amylose, and amylopectin were 8.4, 25.6, and 11.0 micro g of C per liter, respectively. A yield of 2.3 x 10 to the 7th power CFU/micro g of C on the oligo- and polysaccharides was calculated from the linear relationships observed between maximum colony counts in pasteurized tap water and the concentrations (usually below 25 micro g of C per liter) of supplied compounds. The maximum colony counts of strain S12 grown in various types of raw water and tap water revealed that raw water contained only a few micrograms of maltose- and starch-like compounds per liter; in tap water the concentrations were all below 1 micro g of C and usually below 0.1 micro g of C per liter. The application of starch-based coagulant aids gave increased concentrations of maltose- and starch-like compounds in the water during treatment, but these concentrations were greatly reduced by coagulation and sedimentation, rapid sand filtration, and slow sand filtration. (Author's abstract)
W85-06139

EFFECTS OF BENTONITE CLAY SOLIDS ON POLIOVIRUS CONCENTRATION FROM WATER BY MICROPOROUS FILTER METHODS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. D. Sobsey, and T. Cromeans.
Applied and Environmental Microbiology, Vol. 49, No. 4, p 795-798, April, 1985. 3 Tab, 20 Ref. EPA grant R806677.

Descriptors: *Bentonite clay, *Clays, *Poliovirus, *Microporous filters, *Viruses, *Filtration, Water treatment, Suspended solids.

To determine whether suspended solids interfere with enteric virus recovery from water by microporous filter methods, the effects of bentonite clay solids at a concentration of 10 nephelometric turbidity units on the recovery of poliovirus type 1 from seeded, activated carbon-treated, filtered tap water were studied. Volumes (500 ml) of virus-laden water at pH 5.5 or 7.5, with and without 50 mM MgCl2, were filtered through 47-mm-diameter, electropositive (Virosorb 1MDS) and electronegative (Filterite) filters that had been pretreated with Tween 80 to minimize direct virus adsorption to filter surfaces. Bentonite solids enhanced virus retention on both types of filters, even under conditions in which viruses were not solids associated. However, bentonite solids also interfered with elution of retained viruses when eluting with 0.3% beef extract-50 mM glycine (pH 9.5). Under some conditions, overall virus recoveries were lower from water with bentonite solids than from solids-free control water. The results of this study indicate that clay turbidity can interfere somewhat with virus recovery by current microporous filter methods. (Author's abstract)
W85-06141

FLUOROMETRIC DETERMINATION OF THE DNA CONCENTRATION IN MUNICIPAL DRINKING WATER,
California Univ., Irvine.
W. F. McCoy, and B. H. Olson.
Applied and Environmental Microbiology, Vol. 49, No. 4, p 811-817, April, 1985. 4 Fig, 6 Tab, 29 Ref.

Descriptors: *Deoxyribonucleic acid, *Drinking water, *Bacterial analysis, Chemical analysis, Water analysis, Fluorimetry.

DNA concentrations in municipal drinking water samples were measured by fluorometry, using Hoechst 33258 fluorochrome. The concentration, extraction, and detection methods used were adapted from existing techniques. The method is reproducible, fast, accurate, and simple. The amounts of DNA per cell for five different bacterial isolates obtained from drinking water samples were determined by measuring DNA concentration and total cell concentration (acridine orange epifluorescence direct cell counting) in stationary pure cultures. The relationship between DNA concentration and epifluorescence total direct cell concentration in 11 different drinking water samples was linear and positive; the amounts of DNA per cell in these samples did not differ significantly from the amounts in pure culture isolates. Significant linear correlations between DNA concentration and colony-forming unit concentration were found, as well as between epifluorescence direct cell counts and colony-forming unit concentration. DNA concentration measurements of municipal drinking water samples appear to monitor changes in bacteriological quality at least as well as total heterotrophic plate counting and epifluorescence direct cell counting. (Author's abstract)
W85-06142

METHOD OF DETERMINING AND REMOVING SULPHIDE TO ALLOW THE DETERMINATIONS OF SULPHATE, PHOSPHATE, NITRITE AND AMMONIA BY CONVENTIONAL METHODS IN SMALL VOLUMES OF ANOXIC WATERS,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Marine Labs.
D. Airey, G. Dal Pont, and G. Sandars.
Analytica Chimica Acta, Vol. 166, p 79-92, December, 1984. 4 Fig, 3 Tab, 30 Ref.

Descriptors: *Sulfides, *Sulfates, *Phosphates, *Nitrites, *Ammonia, *Water chemistry, Anaerobic conditions, Spectrophotometry, Water analysis, Interstitial water.

Mercury(II) chloride is used to precipitate free sulfides from < 10-ml samples of anoxic water. The sulfide-free supernatant solution can be used for estimation of sulfide by measuring the concentration of unreacted mercury(II) ion and for determinations of sulfate, inorganic, phosphate, ammonia and nitrite by spectrophotometric methods which normally cannot be used because of sulfide interference. Concentrations that can be determined lie within the ranges: sulfide 0.5-180,000

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micro-g S/l, sulfate 0.024-2.77 g S/l, ammonia 1-70,000 micro-g N/l, nitrite 1-3000 micro-g N/l, norganic phosphate 1-4000 micro-g P/l. Interstitial waters from estuarine sediments, tidal flats, mangrove swamps, and an anoxic estuarine basin were examined. (Author's abstract)
W85-06163

DETERMINATION OF TOTAL PHTHALATE ESTERS IN WASTEWATERS BY DIFFERENTIAL PULSE POLAROGRAPHY,
Kanto Gakuin Univ., Yokohama (Japan). Faculty of Engineering.
K. Tanaka, and M. Takeshita.
Analytica Chimica Acta, Vol. 166, p 153-161, December, 1984. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Phthalate esters, *Wastewater analysis, *Differential pulse polarography, Polarography, Phthalic acid,.

A reliable procedure for the determination of total phthalate esters as phthalic acid in environmental samples is based on differential pulse polarography (d.p.p.). The phthalate esters are extracted from the sample water with hexane; concentrated sulfuric acid/hexane partitioning provides effective removal of organic interferences. The individual phthalate esters are hydrolyzed by refluxing with 10 M potassium hydroxide to phthalic acid, which is extracted with ethyl acetate followed by evaporation of the extract. This procedure gives recoveries of 83-90%. The residue is dissolved in 0.1 M acetic acid/0.1 M potassium chloride for d.p.p. The optimal conditions for polarography are discussed. The calibration graphs are linear over the range 0.000002 x 0.0001 M and the detection limit for phthalic acid is 0.0000005 M. The method was successfully applied to determine total phthalate esters over the range 0.3-30 micro-g/l in crude and treated wastewaters. (Author's abstract)
W85-06164

LEAD AND CADMIUM IN WADERS FROM THE DUTCH WADDEN SEA,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
For primary bibliographic entry see Field 5C.
W85-06170

5B. Sources Of Pollution

EFFECTS OF A SEWAGE LAGOON EFFLUENT ON THE WATER QUALITY OF THE RECEIVING STREAM,
Ife Univ. (Nigeria). Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W85-05851

HYDROCARBONS AND HALOGENATED HYDROCARBONS IN COASTAL WATERS OF THE ENGLISH CHANNEL AND THE NORTH SEA,
IFREMER, Brest (France).
For primary bibliographic entry see Field 5A.
W85-05862

SULFUR DISTRIBUTION IN LAKE SEDIMENT PROFILES AS AN INDEX OF HISTORICAL DEPOSITIONAL PATTERNS,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
M. J. Mitchell, M. B. David, and A. J. Uutala.
Hydrobiologia, Vol. 121, No. 2, p 121-127, February, 1985. 2 Fig, 2 Tab, 36 Ref. NSF grant DEB-18-10641.

Descriptors: *Sulfur, *Lake sediment, *Paleolimnology, *Acidic deposition, *Sedimentation, *South Lake, *New York, *Ledge Pond, *Maine, Seston, Isotope studies, Radioisotopes, Sulfur radioisotopes, Lead radioisotopes, Acid lakes.

There has been no previous attempt to link the sulfur budget of a lake to paleolimnological information on S in sediment. Changes in S concentration in sediment profiles from South Lake (Adirondack region, New York) and Ledge Pond (western Maine) indicated an increased input of S beginning 1850. This S was probably derived from anthropogenic sources. The present pH of South Lake ranges from 4.9-5.4. A sediment core was obtained from South Lake by divers on July 5, 1982 from a depth of 18 m. The activity of Pb-210 and total S content were determinded for each interval above 20 cm and select intervals below this depth. Pb-210 was determined via its granddaughter isotope, Po-210. Sediment traps were installed in April 1981 at three depths which were in the epilimnion, metalimnion, and hypolimnion of mid-summer. Samples were collected every 3-4 weeks from April to November during 1981-82. The S budget of South Lake indicated that sedimentation of seston rich in S (approximately 0.9% dry mass) accounts for most of the input of S in sediment. Sulfur in both seston and sediment is primarily organic (57 and 22% ester sulfate, 32 and 52% carbon-bonded S, respectively). The transformation and translocation of organic S constitutes a major pathway of S flux in South Lake. For South Lake with a turnover of 0.5/a and a volume of 2.63 x 10 to the 10th power L, 670,000 mol S/a would be exported from the lake if uniform S concentration is assumed. If S deposition is extrapolated for the entire lake, sedimentation would account for 34,000 mol S/a which would equal 5% of the S input to the lake. Increased understanding of those factors which affect S sedimentation will enhance understanding of freshwater systems since changes in this process, as reflected in the S profile in sediment, may serve as indices of important limnological phenomena such as acidification. (Collier-IVI)
W85-05865

CONCEPTUAL MODEL OF UNIT-MASS RESPONSE FUNCTION FOR NONPOINT SOURCE POLLUTANT RUNOFF,
Padua Univ. (Italy). Faculty of Engineering.
F. Zingales, A. Marani, A. Rinaldo, and G. Bendoricchio.
Ecological Modelling, Vol. 26, No. 3/4, p 285-311, December, 1984. 16 Fig, 46 Ref.

Descriptors: *Runoff, *Nonpoint pollution sources, *Model studies, *Mathematical studies, *Venice Lagoon, *Italy, Rainfall-runoff relationships, Path of pollutants.

A conceptual mathematical model of unit-mass response function (UMRF) of nonpoint source pollutants (NPSP) was developed. The physical aspects of the mathematics involved yield explanation of some basic mechanisms observed in nature for various environmental responses, like inherent hysteretical effects (rising-falling flow dependence) and linear pollutant load/discharged water volume correlations. The mathematical model substantiates screening or planning modelling techniques proposed in the literature, provided that reference weighted pollutant concentrations in the runoff are used. A conceptual form of such an average concentration arises also from the mass transfer and balance relationships investigated. The model is designed to portray consistent NPSP balances (with interphase mass transfer) via an extension of Nash's conceptual scheme of rainfall-runoff transformations. The limited number of parameters and their clear physical meaning make this approach suitable to NPSP simulation and forecasting. The derived form of UMRF is simple, thus calling for microcomputer software applications. Although the proposed model structure consists of lumped parameter formulation, the approach may serve as an alternative to empirical routing procedures often implemented in distributed parameter codes. The techniques adopted make use of standard mathematics of hydrological and chemical models, and therefore the related high degree of sophistication developed for simulation and forecasting can be exploited by the present approach for ecological modeling. Results of applications to the case study of the Venice Lagoon (Italy) are presented and discussed. (Author's abstract)
W85-05872

EFFECT OF IRRIGATION PRACTICES IN THE BREE RIVER VALLEY ON THE SALT CONTENT OF A SMALL RIVER,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
J. H. Moolman, P. C. van Rooyen, and H. W. Weber.
Irrigation Science, Vol. 4, No. 2, p 103-116, June, 1983. 3 Fig, 6 Tab, 20 Ref.

Descriptors: *Irrigation-return flow, *Salinity, *Bree River Valley, *South Africa, Water pollution sources, Total dissolved solids, Vineyards, Computer models, Solute transport, Leaching, Irrigation practices.

The effect of varying irrigation return flow volumes as a possible explanation for the fluctuations in the mean monthly baseflow total dissolved solids (TDS) content of the Poesjesnel River, a tributary in the Bree River Valley, South Africa, was investigated. A conceptual computer model was used to simulate the movement of water and solutes in 769 ha of soil in an area where vineyards are irrigated intensively. Important input requirements of the model are the physical and chemical properties of the irrigated soils, consumptive use data, and root distribution patterns. The computer model predicts that the present system of irrigation in the Poesjesnel River Valley results in significant amounts of salts being leached out of the soil during the early stages of the irrigation season from August to November. This period of high leaching coincides with an increase in the observed TDS content of the receiving river. When peak water demand sets in, very little leaching takes place and soluble salts accumulate in the soil. In dry years it is possible for this salt buildup stage to continue until May. The period of salt accumulation in the soil again concides with a decrease in the observed TDS content of the river. Therefore, irrigation return flow plays an important role in the mineralization of the Poesjesnel River. On a semi-annual time basis, the model was able to simulate and quantify the mineralization processes to a fair degree of accuracy. (Baker-IVI)
W85-05928

PRIMER ON NONPOINT POLLUTION,
Wisconsin Univ.-Madison. Dept. of Soil Science.
G. Chesters, and L.-J. Schierow.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 9-13, January-February, 1985. 2 Fig, 13 Ref.

Descriptors: *Nonpoint pollution sources, *Reviews, Legislation, Agricultural chemicals, Animal wastes, Pesticides, Nutrients, Eutrophication, Sediments, Metals.

Research was initiated on the causes and consequences and control of nonpoint pollution in response to passage of the Water Pollution Control Act Amendments of 1972. Interest in nonpoint pollution seemed to wane after 1979, possibly due to a belief that sufficient pollution control could be achieved by managing only point sources; an understanding that pollutant load reductions could be achieved more economically by controlling point sources; or a decrease in federal funding for research on management techniques. A recent resurgence of interest has been noted. Nonpoint pollution enters the environment from diffuse sources. Sources vary among geographic regions. From all sources of nonpoint pollution, sediment comprises the greatest volume by weight of materials transported. Other than sediment, the pollutants of greatest concern from rural sources are plant nutrients, which are responsible for lake and stream eutrophication. The dynamics of nonpoint pollution discharges are as equally important as the sources of water pollution. The magnitude of nonpoint pollution is considered including sediment, nutrients, pesticides, toxic metals, livestock and sewage wastes, land conversion, and atmospheric pollutants. (Baker-IVI)
W85-05939

NONPOINT SOURCES OF WATER POLLUTION,
Environmental Protection Agency, Washington, DC. Nonpoint Sources Branch.
C. F. Myers, J. Meek, S. Tuller, and A. Weinberg.

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Journal of Soil and Water Conservation, Vol. 40, No. 1, p 14-18, January-February, 1985. 1 Tab, 11 Ref.

Descriptors: *Nonpoint pollution sources, *Reviews, Highways, Construction, Farming, Mining, Forestry, Agriculture, Pesticides, Urban runoff, Water pollution sources, Land use.

Among the important sources of nonpoint pollutants nationally are agricultural, mining, urban, construction, and silvicultural sources. As is the case with most types of nonpoint source pollution, agricultural nonpoint source pollution relates directly to the way in which land is used. Sediment from cropland is a major potential cause of water pollution. Even so, agricultural pollution reduction is achievable. Substantial water quality benefits can be achieved by carefully targeting resources to land areas and activities that are the source of agriculturally generated pollution problems. In the field of mining, each mineral has its own set of nonpoint source problems. Mining nonpoint sources include discharges from inactive mining operations as well as runoff from inactive road networks and old tailings and spoil piles. Urban nonpoint sources include rainwater running off roofs, lawns, streets, industrial sites, and other areas. On a national basis, the nonpoint source water pollution resulting from construction activities is not nearly as great as that caused by other major nonpoint sources. Where construction activities are intensive, the localized impacts on water quality may be severe because of the high unit loads involved. Highway construction and other heavy development account for most of this type of nonpoint source. Forestry management activities, which are of a local nature, can be a real problem where they are part of the industry of the region. (Baker-IVI)
W85-05940

SALINITY POLLUTION FROM IRRIGATED AGRICULTURE,
World Resources Inst., Washington, DC.
M. T. El-Ashry, J. Van Schilfgaarde, and S. Schiffman.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 48-52, January-February, 1985. 2 Fig, 24 Ref.

Descriptors: *Salinity, *Agriculture, *Water pollution sources, *Irrigation practices, Crop yields, Water pollution control, Semiarid regions.

Progress in regional salinity control has been disappointing. The delay in implementing control measures, where they have been planned, is not because of the lack of technically feasible or cost-effective measures. It is primarily because of political opposition from those who contribute the most to downstream salinity. Potentially effective salinity control measures have been skirted because those who would pay for them do not envision any benefits for themselves in return. Irrigation-related salinity is the major water quality problem in the semiarid western states, where significant quantities of salts occur naturally in rocks and soils. In all affected river basins, salinity as progressively increased as water resources have been developed and put to use. The water in these rivers also becomes increasingly saline from the headwaters to the mouths. Many technologies and techniques for reducing salinity exist at varying costs. These involve increases in the efficiency of irrigation water application, reductions in irrigation water losses from conveyance systems through seepage, disposal of saline agricultural return flows, or desalination of saline drainage water. Legal, institutional factors involved in the problem are briefly considered. (Baker-IVI)
W85-05945

REGIONAL WATER QUALITY IMPACTS OF INTENSIVE ROW-CROP AGRICULTURE: A LAKE ERIE BASIN CASE STUDY,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
D. B. Baker.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 125-132, January-February, 1985. 6 Fig, 5 Tab, 39 Ref.

Descriptors: *Lake Erie Basin, *Water pollution sources, *Crop production, Water quality management, Conservation tillage, Phosphorus, Nitrates, Herbicides, Agricultural runoff, Potable water.

Intensive row-crop agriculture dominates land use in the northwestern Ohio River basins draining into Lake Erie. Detailed, long-term studies of water quality in these rivers reveal high unit-area P loads entering Lake Erie, even though gross erosion rates are relatively low. Concentrations of nitrate-N and currently used herbicides are also high from May through July, both in surface waters and in public water supplies derived therefrom. To reduce P loading to Lake Erie, water quality management agencies are advocating adoption of conservation tillage. Conservation tillage could increase nitrate and herbicide contamination of area waters. This region's detailed baseline nutrient and herbicide data provide an opportunity to evaluate the effects of conservation tillage on a variety of water quality parameters. To separate weather-related from management-related effects, an ecosystem approach is advocated. (Author's abstract)
W85-05962

DISSOLVED NITROGEN AND PHOSPHORUS IN RUNOFF FROM WATERSHEDS IN CONSERVATION AND CONVENTIONAL TILLAGE,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit.
E. E. Alberts, and R. G. Spomer.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 153-157, January-February, 1985. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Agricultural runoff, *Tillage, *Iowa, Conservation tillage, Agricultural watersheds, Fertilizers, Storm seepage, Surface flow, Water pollution sources.

Dissolved N and P concentrations in surface and subsurface flows were measured from three corn-cropped watersheds in southwestern Iowa from 1974 through 1983. One watershed was tilled conventionally while the other two were till-planted, all on the contour. One of the till-planted watersheds was terraced, with underground pipe drains to remove excess water from the terrace channels. Each of the watersheds was fertilized at recommended N and P levels for optimum corn production. Losses of NO3-N, NH4-N, and PO4-P in surface runoff were low, representing less than 2% of the annual fertilizer application. However, NO3-N and NH4-N concentrations in surface runoff from the till-planted watersheds sometimes exceeded water quality standards. PO4-P in surface runoff from each of the watersheds always exceeded the water quality standard, and was especially high from the till-planted watersheds. NO3-N losses in subsurface flow represented more than 85% of the total NO3-N losses in both subsurface and surface flows. The highest annual NO3-N loss in subsurface flow was 74.4 kg/ha (66.4 pounds/acre) from the nonterraced, till-planted watershed in 1983. NO3-N concentrations in subsurface flow from this till-planted watershed have exceeded the water quality standard since 1977. (Author's abstract)
W85-05968

CONSERVATION PRACTICE EFFECTS ON PHOSPHORUS LOSSES FROM SOUTHERN PIEDMONT WATERSHEDS,
Agricultural Research Service, Watkinsville, GA.
G. W. Langdale, R. A. Leonard, and A. W. Thomas.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 157-161, January-February, 1985. 1 Fig, 4 Tab, 30 Ref.

Descriptors: *Soil conservation, *Phosphorus, *Piedmont, *Water pollution sources, Nonpoint pollution sources, Tillage, Conservation tillage, Agricultural runoff, Crop production.

Conservation and conventional tillage systems were used on small, upland watersheds in the Southern Piedmont to determine P contributions to nonpoint-source water pollution. Six tillage/cropping systems were studied on three watersheds over a 10-year period. Each tillage/cropping system was repeated every 2 to 4 years over a range of conservation practices and related to both C and P factors of the USLE. Total P runoff losses varied from 0.1 to 4.0 kg/ha/yr and consistently related to soil loss within each tillage system, irrespective of watershed landscape and the conservation practice imposed. The soluble-P fraction, PO4-P, and total dissolved P increased dramatically from about 10% to 40% of total P as multiple cropping and the use of conservation tillage intensified with respect to crop residue cover. Although higher concentrations of both soluble P and total P were usually associated with conservation tillage, total P losses declined 50% or more while soluble P losses were nearly equal to or less than those measured for conventional tillage. These reductions in total P were the result of lower runoff volume with conservation tillage. (Author's abstract)
W85-05969

RUNOFF, SOIL, AND NUTRIENT LOSSES FROM RANGELAND AND DRY-FARMED CROPLAND IN THE SOUTHERN HIGH PLAINS,
Agricultural Research Service, Bushland, TX. Conservation and Production Research Lab.
O. R. Jones, H. V. Eck, S. J. Smith, G. A. Coleman, and V. L. Hauser.
Journal of Soil and Water Conservation, Vol. 40. No. 1, p 161-164, January-February, 1985. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Rangeland, *Cropland, *Soil erosion, *Nutrients, *Runoff, High Plains, Conservation tillage, Terracing, Nitrogen, Phosphorus, Fallowing, Contours, Agricultural watersheds.

The erosion potential of rainfall in the semiarid Southern High Plains is much less than in more humid area, but large, intense storms have the potential to cause severe erosion on cropland and to contribute to nonpoint-source pollution. A study site was selected which has climate, topography, and soils representative of about 4.8 million ha of cropland and rangeland in the Southern High Plans. Runoff was measured on two rangeland and three adjacent cultivated watersheds. With conservation tillage on the contour and graded terraces, erosion was less than the soil loss tolerance (T) during all years of the study. Even in 1978, with more than 51 mm (2.0 inches) of runoff from a single storm and with total annual runoff of 152 mm (6.0 inches), soil loss was only 6.5 t/ha (2.9 tons/acre), well under the T value of 11.2 t/ha (5 tons/acre). Runoff was from three to five times greater from cultivated watersheds than from range watersheds. Annual nitrate-N losses were less than 2 kg/ha for any treatment. The highest total annual Kejldahl N loss was only 11 kg/ha. P losses were also minimal, with a maximum loss of 4.2 kg/ha for the fallow watershed in 1978. N and P losses were much lower than from cultivated watersheds. On the cultivated watersheds, such soil-conserving practices as terracing, contour tillage, and conservation tillage kept sediment and nutrient losses low. (Moore-IVI)
W85-05970

EFFECTS OF LIVESTOCK WASTES AND AGRICULTURAL DRAINAGE ON WATER QUALITY: AN ONTARIO CASE STUDY,
Ontario Ministry of the Environment, London.
S. Thornley, and A. W. Bos.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 173-175, January-February, 1985. 6 Fig, 1 Tab, 2 Ref.

Descriptors: *Animal wastes, *Drainage water, *Water quality, *Ontario, Water pollution sources, Bacteria, Nutrients, Farms, Attitudes, Economic aspects.

An evaluation of livestock waste management impacts on water quality was carried out in a southwestern Ontario watershed in response to frequent downstream beach closures and fish kills. The 90-

square-mile study site contained more than 300 livestock farms. These farms average 80 animal units per farm. The watershed is immediately upstream from the Gordon Pittock Reservoir, a man-made water conservation area. Bacteria and nutrient levels far exceeded provincial water quality quidelines and objectives at most sampling points. Even in headwater areas, effluent from underground drainage systems showed bacterial and chemical characteristics comparable to domestic sewage. Although the sources or causes of the poor quality water in the tile drains were unknown, illegal connections were suspected as a contributing factor. Such connections may have been occurring in both rural municipalities and the agricultural community in general. A survey of 98 basin farmers showed that ignorance of the problem and economic pressures on livestock producers were major contributing factors. In many cases, rectifying the problem will require large capital expenditures for improved storage and handling facilities. (Moore-IVI)
W85-05973

CHANGE IN PCB (CLOPHEN A 50) COMPOSITION WHEN TRANSPORTED FROM SEDIMENT TO AIR IN AQUATIC MODEL SYSTEMS,
Lund Univ. (Sweden). Limnological Inst.
P. Larsson.
Environmental Pollution (Series B), Vol. 9, No. 2, p 81-94, 1985. 7 Fig, 1 Tab, 37 Ref.

Descriptors: *Fate of pollutants, *Polychlorinated biphenyls, *Sediments, *Air pollution, Volatilization, Jet drop transport, Sediment-water interfaces, Air-water interfaces, Chlorinated hydrocarbons, Bubbles.

The contaminated sediment of lakes and watercourses may act as a source of polychlorinated biphenyls (PCBs) to the atmosphere. A total of 24.8 mg of Clophen A 50 was added to the sediment of each laboratory model system, composed of 9 kg of sediment, 32 liters water, benthic macroinvertebrates and fish. Part of the PCBs left the sediment and a concentration of 0.2-0.7 micro-g/l was obtained in the water. The transport of PCBs from water to air includes at least two processes: volatilization and jet drop transport. Volatilization resulted in a transport of 0.2-1.0 micro-g PCBs a week to air. Less chlorinated PCBs were transported to the air to a greater extent than more chlorine-substituted PCBs. Transport of PCBs by jet drops from bursting bubbles was of the same magnitude as volatilization, but the proportion of PCB compounds volatilized was identical with that in sediment and water. Thr transport of PCBs by jet drops from water to air was probably dominated by a transport of subsurface water and particles. The continuous mixing of the water by microbubbles is important for the volatilization transport of PCBs for the water phase to the air. The limiting process in the transport of PCBs from sediment to air is probably the transfer of PCBs from sediment to water. (Moore-IVI)
W85-05974

FIXATION AND MOBILIZATION OF ANTIMONY IN SEDIMENTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
J. M. Brannon, and W. H. Patrick, Jr.
Environmental Pollution (Series B), Vol. 9, No. 2, p 107-126, 1985. 4 Fig, 7 Tab, 21 Ref.

Descriptors: *Antimony, *Path of pollutants, *Sediments, Sediment-water interfaces, Leaching, Aerobic conditions, Anaerobic conditions, Volatile compounds.

The mobility of sediment antimony (Sb) during sediment-water interactions was studied. Emphasis was placed on the fixation of native and added Sb by sediment, long-term (6 months) releases of Sb and sediment properties that affect the mobilization of Sb. Sequential selective extraction procedures revealed that most native and added sediment Sb was associated with relatively immobile iron (Fe) and aluminum (Al) compounds. In sediments amended with Sb, concentrations of interstitial water and exchangeable phase Sb were also high. Initial and long-term releases of Sb were much higher from Sb-amended sediments than from sediments containing no added Sb, apparently a result of Sb concentrations in more mobile sediment phases. In most sediments, the largest amount of Sb release occurred early in the leaching experiment. These results suggest that Sb release from contaminated sediments is more likely to occur during the first few months of sediment-water interaction. During aerobic leaching, Sb moved into a more unavailable sediment phase, decreasing the potential for further releases. Sediment Fe and CaCO3 equivalent concentrations were found to affect releases of added Sb. Evolution of volatile Sb compounds was also noted from sediments under anaerobic conditions. (Author's abstract)
W85-05975

CHARACTERISTICS OF HEAVY METAL DISTRIBUTION IN BOTTOM MUD OF URBAN RIVERS (IN JAPANESE),
Takasaki Coll. of Economics, Gumma (Japan).
F. Tada, J. Suzuki, and S. Suzuki.
Japanese Journal of Limnology, Vol. 45, No. 4, p 296-303, October, 1984. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Heavy metals, *Rivers, *Urban areas, *Bottom sediments, Mud, Copper, Zinc, Cadmium, Lead, Nickel, Chromium, Particle size, Organic matter, Fate of pollutants.

In order to clarify the distribution pattern of heavy metals contained in the bottom mud of urban rivers, the metals were fractionated by extraction with 2N CH3COONH4 and 0.5N HCl. The total metal content was determined after the decomposition with HNO3-H2O2. A part of the Cu, Zn, and Cd in the bottom mud of urban rivers was extracted with 2N CH3COONH4, but the Pb, Ni and Cr were unextractable. This result indicated that the forms of metals in bottom mud differed from one another. The metal content increased in the lower reaches of the urban river, and the amount of the increased metals was approximately equal to those of the metals extracted with 0.5N HCl. The increase of metals downstream was also correlated to the grain size and the organic matter content of bottom mud. These results suggested that a significant part of the metals in the bottom mud of urban rivers were weakly bound to fine grain size sand and organic matter. (Author's abstract)
W85-06000

NITROGEN MIGRATION IN ZHUJIANG RIVER (IN CHINESE),
Academia Sinica, Guangzhou (China). South China Sea Inst. of Oceanology.
Z. Lin, J. Zheng, and J. Jhu.
Oceanologia et Limnologia Sinica, Vol. 15, No. 6, p 515-520, November, 1984. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Nitrogen, *Zhujiang River, *China (Peoples Republic), Nutrients, Nitrates, Nitrites, Ammonium, Water pollution sources, *Path of pollutants, Industrial wastes, Fertilizers, Decomposition.

The Zhujiang River (The Pearl River) is the only tropic-subtropical river of considerable magnitude in China. The study of the variation and migration of nitrogen as a nutrient is one of the approaches to the understanding of substance exchange at the river-sea interface. Measurements of the three states of N (NO3-N, NO2-N and NH4-N) in the Zhujiang River basin from Guangzhou to Shanbanzhou Sandbank at the Zhujiang River mouth were for first carried out in summer, 1982. Results were obtained on N content variation and distribution patterns, the relationship of N with environmental factors, as well as the correlation and transformation between different states of N. Nitrogen content in the Zhujiang River water is relatively high. Dissolved inorganic N and NO3-N are 5.2 and 8.9 times those of the world rivers on an average, respectively. It is estimated that flux of the 3 states of N passing through the Humen Mouth might be 15.8 kg/s (by NO3 weight). The main sources of N are soil, industrial effluents, rotten crops and agricultural fertilizers. (Author's abstract)
W85-06010

LAKE ACIDIFICATION IN GALLOWAY: A PALAEOECOLOGICAL TEST OF COMPETING HYPOTHESES,
University Coll., London (England). Palaeoecology Research Unit.
R. B. Battarbee, R. J. Flower, A. C. Stevenson, and B. Rippey.
Nature, Vol. 314, No. 6009, p 350-352, March, 1985. 3 Fig, 2 Tab, 33 Ref.

Descriptors: *Acidification, *Acid precipitation, *Paleoecology, *Galloway, *Scotland, Water pollution sources, Acid rain, Reforestation, Heathland, Pollen analysis, Heavy metals, Copper, Lead, Zinc.

Possible causes of lake acidification in Britain include acid precipitation, heathland regeneration, afforestation and post-glacial natural acidification (long-term change). In Galloway, south-west Scotland, several lakes with non-afforested catchments have been acidified by approximately 1 pH unit since about 1840, which clearly precludes long-term change and afforestation as causes of the present acidity, but does not discriminate between the possible effects of heathland regeneration and acid precipitation; it could be argued that a decline in upland farming in this area led to an increase in acid heathland communities capable of promoting lake acidification during this period of time. Pollen analysis is used to show that there is no evidence for an increase in Calluna vulgaris, the most important heathland species, over the past 200 yr or so, and the acid precipitation hypothesis is substantiated by demonstrating substantial increases of the heavy metals Pb, Cu and Zn in the sediment since about AD 1800. (Author's abstract)
W85-06013

PILOT STUDY OF TRACE METAL MOVEMENT IN SOILS ON HILLSLOPES IN THE COAST RANGES, CALIFORNIA,
Bureau of Reclamation, Sacramento, CA. Mid-Pacific Regional Office.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol. 22, No. 1, p 87-94, February, 1985. 7 Fig, 7 Ref.

Descriptors: *Copper, *Zinc, *Lead, *Leaching, *Coast Ranges, *California, Acid rain, Path of pollutants, Trace metals, Soil chemistry, Slopes, Herbicides.

Due to the buffering action of carbonates, areas underlain by calcareous deposits are in general considered not to be susceptable to acid precipitation. A study initially aimed at establishing the fate of herbicide copper introduced into Solano Reservoir on Putah Creek produced results which indicate that this area may be more susceptible to acid precipitation than previously thought. Chemical testing was carried out on three-normal hydrochloric acid leachates of some 275 grab samples of surface soils, colluvium and alluvium from the rugged forest-chaparral covered watershed of Putah Creek; 17 grab samples of topsoil from the vicinity of Lodoga; and 8 samples of topsoil from the vicinity of Stony Gorge Reservoir in the California Coast Ranges. After detection of possible leaching and downslope migration of copper in soils, the study was extended to three other areas: the divide between Thompson and Bray canyons; the vicinity of Lodoga; and the Stony Gorge Reservoir area. Zinc and lead determinations were added during this stage. There was a general minor increase in copper and lead content in the downslope direction, particularly on smooth, undissected slopes. Zinc content frequently appeared to be erratic. The data indicate the existence of minor regional leaching of such trace metals as copper and lead by natural precipitation. An increase of such leaching by acid rain is conceivable with possible future regional increases of population and pollution. (Moore-IVI)
W85-06014

METAL DISTRIBUTION AND CONTAMINATION IN SEDIMENTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
K. D. White, and M. E. Tittlebaum.
Journal of Environmental Engineering, Vol. 111, No. 2, p 161-175, April, 1985. 3 Fig, 5 Tab, 5 Ref.

Descriptors: *Sediment contamination, *Heavy metals, *Louisiana, Waterways, Lake sediments, Statistical methods, Relative atomic variation, Particle size, Fate of pollutants.

Heavy metals analysis were performed on the sediments from various south Louisiana waterways. Objectives of the study were to determine vertical heavy metal distributions, to evaluate a proposed statistical method used to make qualitative assessments of cultural contamination based on trace metal-conservative metal relationships, and to attempt to determine heavy metal contamination in sampled sediments. Cores were obtained from three distinct areas in south Louisiana. Area 1 consisted of waterways located in heavily industrialized areas. Area 2 consisted of a 110 m deep core obtained just off the present Mississippi River delta. Area 3 samples were obtained from a shallow urban lake. The vertical metal concentration distribution of the deep core revealed very consistent concentrations for metals throughout the entire depth. The relative atomic variation (RAV) method, used to reduce the grain size effects on heavy metal accumulations in sediments by correlating element pairs, was evaluated. The evaluation of the method in this study uncovered serious limitations. Metal contamination was determined by comparing both absolute concentrations and trace metal-conservative metal concentration ratio values to their respective deep core background values. (Author's abstract)
W85-06019

1-D POLLUTANT MIGRATION IN SOILS OF FINITE DEPTH,
University of Western Ontario, London. Faculty of Engineering Science.
R. K. Rowe, and J. R. Booker.
Journal of Geotechnical Engineering, Vol. 111, No. 4, p 479-499, April, 1985. 13 Fig, 25 Ref. Natural Sciences and Engineering Research Council of Canada grants A1007 and G0921.

Descriptors: *Clay, *Liners, *Path of pollutants, *Solute transport, Dispersion, Advection, Geochemistry, Soil properties, Landfills, Groundwater movement, Groundwater pollution, Water pollution control.

A technique for the analysis of 1-D pollutant migration through a clay layer of finite depth includes dispersive and advective transport in the clay as well as geochemical reactions. The technique permits consideration of the depletion of contaminant in the landfill with time as well as the effect of a flushing velocity in a permeable stratum beneath the clay layer. The technique requires minimal data preparation, is accurate, and is computationally very efficient compared with alternative techniques. A limited parametric study illustrates the effect of considering these factors in the analysis. If the base velocity is greater than zero, the concentration of pollutant in the groundwater beneath the liner will reach a maximum value at some time and will decrease for greater times. This maximum value can be used in clay liner design to ensure that the contamination of the groundwater never exceeds a specified level. The magnitude of the peak concentration and the time required for it to occur are highly dependent upon the mass of contaminant within the landfill and the sorption capacity of the clay. The thickness of the clay layer, advection velocity (relative to the dispersivity), and the ground-water flow velocity in any permeable strata beneath the clay layer are also important factors. The maximum base concentration can be decreased by increasing clay liner thickness. The design of the liner may be optimized by also considering the effects of leachate height, base velocity and any geochemical reaction. (Moore-IVI)
W85-06024

NITROGEN AND PHOSPHORUS EXPORTATION IN THE GARONNE BASIN (FRANCE),
Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
J. L. Probst.
Journal of Hydrology, Vol. 76, No. 3/4, p 281-305, February, 1985. 14 Fig, 8 Tab, 66 Ref.

Descriptors: *Garonne Basin, *Girou Basin, *France, *Nitrogen, *Phosphorus, Cycling nutrients, Nutrients, Fetilizers, Agricultural watersheds, Suspended sediments, Water pollution sources, Nonpoint pollution sources, Storm seepage.

Nitrogen balance was determined in two basins of the southwest of France: the Garonne (52,000 sq km) and one of its tributaries, the Girou (520 sq km). Phosphorus balance was estimated only in the Girou watershed. Water samples were collected from 1971 through 1981. The nitrogen and phosphorus export from the two agricultural watersheds depend on two main factors: the quantity and the origin of the inputs in the watersheds; and the annual rainfall height, the intensity of the surface runoff and soil leaching. The greater these two factors are, the more the export rate increases. The annual discharge-concentration relationships and the behavior of the concentrations during storm events show that nitrogen and phosphorus are both of superficial origin. The separation of the three components in the storm hydrograph and the application of the mixing models yields an estimate of 130 mg/l for nitrate concentration in subsurface waters during wintertime and 60 mg/l during summer. The phosphorus concentration in the surface waters is about 0.5 mg/l TP. The dilution factor appears the same for nitrogen as for phosphorus. The annual nitrate contributions of the subsurface flow have been estimated at about 50-60% of the annual stream flux. The surface flow represents only 15% of the annual streamflow and occurs during a relatively short period of time, 50 days a year. The phosphorus losses from agricultural lands are mainly transported by the surface runoff which represents only 8.6% of the total annual streamflow. In the river waters, there is a good relationship between the phosphorus concentrations and the suspended sediments. The export rate of nonpoint source pollution is lower than 1%. The phosphorus fertilizers applied are accumulated in the soil. The annual contributions of the different phosphorus sources to the river export are estimated at 7% from natural biogeochemical processes, 32% from nonpoint pollution and 61% from point pollution. (Baker-IVI)
W85-06049

INTERFLOW OF WATER AND TRACER CHEMICAL ON SLOPING FIELD PLOTS WITH EXPOSED SEEPAGE FACES,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
O. R. Lehman, and L. R. Ahuja.
Journal of Hydrology, Vol. 76, No. 3/4, p 307-317, February, 1985. 4 Fig, 5 Tab, 11 Ref.

Descriptors: *Soil water, *Seepage, *Path of pollutants, Infiltration, Porosity, Soil properties, Tracers, Agricultural chemicals, Storm seepage, Interflow, Temperature effects.

Four experimental field plots, each 1.8 m wide and 80 m long on 6-8% slopes, were isolated from each other and the surrounding area by sheet metal plates extending from 0.15 m above to 0.9 m below the surface of a Typic Paleudults soil. An open soil face about .7 m deep, divided into three natural horizons, formed the lower end of each plot in a runoff monitoring pit. The plots were used to measure water and tracer chemical flows when simulated rainfall was applied at rates of 1.5 - 2.5 cm/hr to soil that was initially either nearly saturated, or initially near the wilting point for the grass cover. Potassium bromide solution was used to trace the face of a surface applied mobile chemical. The plot surface area contributing to the interflow of water and subsurface transport of agricultural chemicals was located near the outflow face. This suggests that chemical transport in interflow and runoff might be substantially reduced by appropriate management of relatively small soil surface and volumes. The steady interflow rates for water were not appreciably affected by initial soil moisture conditions. Initially dry soil moisture conditions resulted in rapid deep infiltration of most surface applied bromide, and markedly less total bromide was transported in runoff and interflow as compared with initially saturated conditions. In one particular experiment, the initial soil moisture was at saturation and temperature of the water regime was about 11 C cooler than for the other experiments. There was markedly less infiltration and a higher runoff rate that transported more total bromide. Under certain conditions, the temperature of the water regime may be an important factor in models predicting the potential interflow of water and chemicals. (Baker-IVI)
W85-06050

IMPACT OF BRIDGING ON FLOODPLAINS,
For primary bibliographic entry see Field 6G.
W85-06067

PESTICIDE POLLUTION PROBABILITIES,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
W. C. Mills, and R. A. Leonard.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1704-1710, November-December, 1984. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Pesticides, *Path of pollutants, *Probabilities, Mathematical studies, Model studies, Rainfall-runoff relationships, Source of pollutants.

A procedure for obtaining probabilities for pesticide pollution of water was developed. Central in the development of this procedure is the derivation of a stochastic pesticide state model in the form of a probability density function for amount of pesticide on crop foliage or soil available for runoff upon the occurrence of significant rainfall. A recursive algorithm derived from generating functions was proposed for coupling the stochastic pesticide state model to stochastic models for rainfall and watershed state and deterministic models for event runoff of water, sediment, and pesticide and environmental damage. Associated risk evaluations are discussed. (Author's abstract)
W85-06075

LONG-TERM SURVIVAL OF HUMAN ROTAVIRUS IN RAW AND TREATED RIVER WATER,
Ottawa Univ. (Ontario). Dept. of Microbiology and Immunology.
R. A. Raphael, S. A. Sattar, and V. S. Springthorpe.
Canadian Journal of Microbiology, Vol. 31, No. 2, p 124-128, February, 1985. 2 Fig, 1 Tab, 35 Ref.

Descriptors: *Rotavirus, *Fate of pollutants, *Viruses, Microorganisms, Infection, Survival.

This study was aimed at assessing the role of water as a vehicle for rotavirus spread by determining how well these viruses survive in the water environment. A cell culture adapted strain of human rotavirus subgroup 2, grown in MA-104 cells, was used as a model. Virus survival was tested in the following types of water samples, derived from the Ottawa River, at two different times of the year: (i) raw water (RW), (ii) municipally treated tap water (TW), and (iii) raw water that had been filtered (FW) through a membrane (0.22 micro m). The water samples, with approximately 50,000 plaque-forming units (PFU) of the virus, were held at either 4 or 20 C and tested for infectious virus over a period of 64 days. The TW samples had a total and free chlorine content of 0.05 and < 0.05 mg/L, respectively. The chlorine in these samples was not neutralized before virus contamination. Irrespective of the holding temperature, the virus titer in FW remained essentially unaltered throughout the test period. In TW held at 4 C, there was no significant drop in the virus in the titer even after 64 days, whereas at 20 C the titer in TW was reduced by about 2 log over the same period. Even though the loss of virus infectivity was most rapid

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n RW held at 20 C, it took about 10 days for a 99.0% reduction in the plaque titer of the virus. These findings, therefore, indicate that rotaviruses can survive for several days in raw and treated river water thus making recreational and potable waters potential vehicles for the transmission of rotavirus infections. (Author's abstract)
W85-06137

COMETABOLISM OF LOW CONCENTRATIONS OF PROPACHLOR, ALACHLOR, AND CYCLOATE IN SEWAGE AND LAKE WATER,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
N. J. Novick, and M. Alexander.
Applied and Environmental Microbiology, Vol. 49, No. 4, p 737-743, April, 1985. 6 Fig, 4 Tab, 25 Ref.

Descriptors: *Metabolism, *Propachlor, *Alachlor, *Cycloate, *Wastewater, *Lakes, *Pesticides, Mineralization, Fate of pollutants, Microorganisms.

Low concentrations of propachlor (2-chloro-N-isopropylacetanilide) and alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide) were not mineralized, cycloate (S-ethyl-N-ethylthiocyclohexanecarbamate) was slowly or not mineralized, and aniline and cyclohexylamine were readily mineralized in sewage and lake water. Propachlor, alachlor, and cycloate were extensively metabolized, but the products were organic. Little conversion of propachlor and alachlor was evident in sterilized sewage or lake water. The cometabolism of propachlor was essentially linear with time in lake water and was well fit by zero-order kinetics in short periods and by first-order kinetics in longer periods in sewage. The rate of cometabolism in sewage was directly proportional top propachlor concentration at levels from 63 pg/ml to more than 100 ng/ml. Glucose but not aniline increased the yield of products formed during propachlor cometabolism in sewage. No microorganism able to use propachlor as a sole source of carbon and energy was isolated, but bacteria isolated from sewage and lake water metabolized this chemical. During the metabolism of this herbicide by two of the bacteria, none of the carbon was assimilated. Our data indicate that cometabolism of these pesticides takes place at concentrations of synthetic compounds that commonly occur in natural waters. (Author's abstract)
W85-06138

VIRUS PERSISTENCE IN GROUNDWATER,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
M. V. Yates, C. P. Gerba, and L. M. Kelley.
Applied and Environmental Microbiology, Vol. 49, No. 4, p 778-781, April, 1985. 3 Tab, 19 Ref.

Descriptors: *Viruses, *Groundwater pollution, *Fate of pollutants, Infection, Microorganisms, Poliovirus, Echovirus, Coliphage, Source of pollutants, Physicochemical properties.

More than 50% of the outbreaks of waterborne disease in the United States are due to the consumption of contaminated groundwater. An estimated 65% of the cases in these outbreaks are caused by enteric viruses. Little, however, is known about the persistence of viruses in groundwater. The purpose of this study was to determine whether measurable chemical and physical factors correlate with virus survival in groundwater. Groundwater samples were obtained from 11 sites throughout the United States. Water temperature was measured at the time of collection. Several physical and chemical characteristics, including pH, nitrates, turbidity, and hardness, were determined for each sample. Separate water samples were inoculated with each of three viruses (poliovirus 1, echovirus 1, and MS-2 coliphage) and incubated at the in situ groundwater temperature; selected samples were also incubated at other temperatures. Assays were performed at predetermined intervals over a 30-day period to determine the number of infective viruses remaining. Multiple regression analysis revealed that temperature was the only variable significantly correlated with the decay rates of all three viruses. No significant differences were found among the decay rates of the three viruses, an indication that MS-2 coliphage might be used as a model of animal virus survival in groundwater. (Author's abstract)
W85-06140

COPPER-BINDING CHARACTERISTICS OF EXOPOLYMERS FROM A FRESHWATER-SEDIMENT BACTERIUM,
California State Univ., Long Beach. Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W85-06144

BIODEGRADATION OF (14C)PHENOL IN SECONDARY SEWAGE AND LANDFILL LEACHATE MEASURED BY DOUBLE-VIAL RADIORESPIROMETRY,
Oklahoma Univ., Norman, Environmental and Ground Water Inst.
G. M. Deeley, P. Skierkowski, and J. M. Robertson.
Applied and Environmental Microbiology, Vol. 49, No. 4, p 867-869, April, 1985. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Phenol, *Isotope studies, *Biodegradation, *Leachate, *Radiorespirometry, *Wastewater, Microorganisms, Aquifers, Fate of pollutants.

Double-vial radiorespirometry was used to estimate the biodegradation rates of C-14-labeled phenol in a landfill leachate and a secondary treated domestic wastewater. Rates were found to be comparable for each material at each of the three concentrations tested. Sewage microorganisms immediately began biodegrading the (C-14)phenol; landfill leachate microorganisms required a lag period before maximum biodegradation of the (C-14)phenol. The apparent rate of (C-14)phenol biodegradation was 2.4 times faster in the sewage than in the landfil! leachate. Double-vial radiorespirometry was shown to be an effective method for screening biodegradation rates in aquifers. (Author's abstract)
W85-06145

GROUNDWATER CONTAMINATION BY VOLATILE HALOGENATED ALKANES: ABIOTIC FORMATION OF VOLATILE SULFUR COMPOUNDS UNDER ANAEROBIC CONDITIONS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
R. P. Schwarzenbach, W. Giger, C. Schaffner, and O. Wanner.
Environmental Science and Technology, Vol. 19, No. 4, p 322-327, April, 1985. 5 Fig, 5 Tab, 29 Ref.

Descriptors: *Groundwater pollution, *Halogenated alkenes, *Halogenated hydrocarbons, *Hydrogen sulfide, *Chemical reactions, Fate of pollutants, Sulfides.

Under highly reducing conditions in the presence of hydrogen sulfide in groundwater, certain volatile bromo- and chloroalkanes may undergo second-order nucleophilic substitution reactions leading to the formation of persistant and hazardous sulfur-containing compounds, including dialkyl sulfides. The data originate from the investigation of groundwater contamination caused by a leaking wastewater tank of a chemical plant. Rate constants determined in the laboratory indicate that these nucleophilic substitution reactions may compete with hydrolysis, even at the low hydrogen sulfide concentrations typically encountered in the aquatic environment. The majority of environmentally important halogenated hydrocarbons have aromatic, vinylic, or geminal-polyhalogenated structures and are therefore less susceptible to nucleophilic substitution reactions. (Collier-IVI)
W85-06148

REACTION OF DISSOLVED CHLORINE WITH SURFICIAL SEDIMENT: OXIDANT DEMAND AND PRODUCTION OF TRIHALOMETHANES,
Maryland Univ., Solomons. Chesapeake Biological Lab.
A. D. Uhler, and J. C. Means.
Environmental Science and Technology, Vol. 19, No. 4, p 340-344, April, 1985. 8 Fig, 4 Tab, 24 Ref.

Descriptors: *Chlorine, *Sediments, *Trihalomethanes, *Chemical reactions, Fate of pollutants, Salinity, Organic carbon.

Reactions between dissolved HOCl and surficial sediments from the Potomac River, MD, are reported. All sediments samples showed a tendency to react with HOCl under a range of pH (5-10) and salinity (0-30 mg/L) conditions. At pH 7.0 and 0% salinity, the average HOCl demand was approximately 0.07 mol of HOCl/mol of adsorbed organic carbon. The only purgeable organic compounds produced by the chlorination of these sediments were trihalomethanes. The speciation and yield of trihalomethanes were found to be a sensitive function of salinity. Along the salinity gradient 0-30% at pH 7.0, trihalomethane production reached a maximum at about 5% salinity and then rapidly fell off with increasing salinity. Increasing salinity alters the reactivity of adsorbed organic matter, resulting in a less reactive material at high salinities. (Author's abstract)
W85-06149

CONTEMPORARY LAKE TRANSPORT PROCESSES DETERMINED FROM SEDIMENTARY RECORDS OF COPPER MINING ACTIVITY,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2J.
W85-06150

BEHAVIOR OF RADIONUCLIDES IN RIVERS AS DEMONSTRATED IN THE CASE OF CO 60 FROM THE NUCLEAR POWER STATION WURGASSEN/WESER (UBER DAS VERHALTEN VON RADIONUKLIDEN IN FLIESSGEWASSERN AM BEISPIEL VON CO 60 AUS DEM KERNKRAFTWERK WURGASSEN/WESER),
Bundesanstalt fuer Gewaesserkunde, Coblenz (Germany, F.R.).
H. Mundschenk.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 5/6, p 134-145, December, 1984. 16 Fig, 2 Tab, 26 Ref.

Descriptors: *Radioactive wastes, *Nuclear powerplants, *Fate of pollutants, *Dredging, *Weser, *Germany (Federal Republic), Cobalt radioisotopes, Suspended solids, Sedimentation, Spoil banks, Land disposal, Radioisotopes.

Radionuclides released from the nuclear power plant Wurgassen (KWW) can be detected in suspended matter and sediment in the river Weser (Federal Republic of Germany) even at large distances from the point of discharge using Co-60 as a tracer. The contamination of sediment is increasing downstream with increasing distance from the emitter. The main fraction of Co-60 ($>$ or $=$ 57%) is adsorbed and transported by suspended matter into the estuary. A smaller fraction ($<$ or $=$ 43%) accumulated in suspended matter contaminates the sediment phase by sedimentation along the watercourse. The part dissolved in water is estimated to be less than 10%. In order to maintain the feasibility of shipping traffic, sediment have to be continuously removed by dredging, especially in the lower part of the river. Because of the contamination of Weser river sediments, workers are exposed to radiation by handling and depositing the contaminated material on land sites. The potential external radiation exposure derived from values measured between 1979 to 1983 amounts to 0.5 mrem/1000 h in the case of Co 60. The dose resulting from all radionuclides released by KWW is estimated to be approximately 1 mrem/1000 h, far below the whole body dose limits in the German Radiological Protection Ordinance (30 mrem/a). This area must be considered as a so-called critical impact area according to sect. 45 of the German Radiolog-

ical Protection Ordinance, especially, if sediment is dredged and deposited on land as is the case of the lower part of the river. (Moore-IVI)
W85-06155

ASBESTOS IN LAKE AND RESERVOIR WATERS OF STATEN ISLAND, NEW YORK: SOURCE, CONCENTRATION, MINERALOGY, AND SIZE DISTRIBUTION,
Rutgers - The State Univ., Newark, NJ. Dept. of Geology.
G. P. Maresca, J. H. Puffer, and M. Germine.
Environmental Geology and Water Science, Vol. 6, No. 4, p 201-210, 1984. 4 Fig, 2 Tab, 63 Ref. Project A-067-NJ.

Descriptors: *Asbestos, *Water pollution sources, *Staten Island, *New York, Silver Lake Reservoir, Lakes, Reservoirs, Mineralogy, Serpentinite, Chrysotile.

In view of the hazards of asbestos exposure and the numerous occurrences of asbestos-bearing bedrock on Staten Island (New York), a study was undertaken to examine water supplies for influx of asbestos from bedrock sources. In the Silver Lake Reservoir in Staten Island, where chrysotile from serpentinite bedrock exposures is a potential source of contamination, chrysotile asbestos levels of 15 to 86 million fibers per liter (MFL) were measured, with an average of 53 MFL. Much lower levels (average 0.3 MFL) were observed in small lakes and ponds with clayey bottoms on the Staten Island Serpentinite. Silver Lake Reservoir is currently a part of the New York Parks and Recreation Department and its water is not used for drinking. Decisions pertaining to future uses of Silver Lake should clearly consider the high concentration of asbestos in the reservoir water. The potentially high degree of asbestos contamination from bedrock sources should also be considered in site selection for reservoirs on asbestos-bearing bedrock, particularly serpentinites. (Moore-IVI)
W85-06160

5C. Effects Of Pollution

SURVEY OF SODIUM DODECYL SULPHATE (SDS) RESISTANCE AND ALKYLSULPHATASE PRODUCTION IN BACTERIA FROM CLEAN AND POLLUTED RIVER SITES,
University Coll., Cardiff (Wales). Dept. of Biochemistry.
G. F. White, N. J. Russell, and M. J. Day.
Environmental Pollution, Vol. 37, No. 1, p 1-11, 1985. 2 Tab, 12 Ref.

Descriptors: *Sodium dodecyl sulfate, *Alkylsulfatase, *Bacteria, *Water pollution effects, Enzymes, Sulfates, Surfactants.

A survey of riverine bacteria showed that the ability to grow in the presence of the surfactant sodium dodecyl sulfate (SDS) was widespread but the proportion of SDS-resistant isolates was significantly greater at a polluted site, as compared with clean source water. Bacteria containing the alkylsulfatases that initiate SDS degradation were also widespread. The polluted site yielded significantly more alkylsulfatase-containing strains than the clean site, and this difference was due to a greater number of strains at the polluted site bearing constitutive rather than inducible enzymes. In addition, the incidence of strains containing multiple alkylsulfatases was much higher at the polluted than at the clean site. (Author's abstract)
W85-05848

EFFECTS OF COPPER ON THE COMPETITIVE INTERACTIONS OF TWO SPECIES OF CLADOCERA,
EG and G Bionomics, Wareham, MA.
G. A. LeBlanc.
Environmental Pollution, Vol. 37, No. 1, p 13-25, 1985. 6 Fig, 1 Tab, 26 Ref.

Descriptors: *Copper, *Cladocera, *Daphnia, *Toxicity, Crustaceans, Animal behavior, Water pollution effects.

The influence of copper on the competitive interactions between Daphnia magna and Daphnia pulex was assessed. Prior studies indicated that D. magna could develop tolerance to the toxic effects of copper whereas D. pulex could not. Although D. pulex is generally a superior competitor over D. magna, it was hypothesized that the presence of copper may lend competitive superiority to D. magna, thus ensuring its survival under this environmental condition. D. magna and D. pulex were cocultured during this study: (1) in the absence of exogenous copper; (2) after temporary exposure to a sublethal copper concentration (10 micro g/liter); (3) after temporary exposure to a copper concentration lethal to a portion of the exposed population (30 micro g/liter); and (4) after temporary exposure to successive treatments of 10 and 30 micro g/liter copper. D. pulex populations consistently exceeded D. magna populations when cocultured in the absence of copper or after temporary exposure to 10 micro g/liter copper. Exposure to 30 micro g/liter or sequential treatments of 10 and 30 micro g/liter copper severely reduced the initial population growth of D. pulex whereas D. magna were unaffected. Although the D. magna populations were dominant by day 14 under these conditions, they did not suppress growth of the D. pulex populations. D. pulex subsequently gained population dominance and inhibited further growth of the D. magna populations. The reduced size of the D. magna suggested that D. pulex was outcompeting D. magna for available food. This study, in conjunction with others, suggests that D. magna population growth is augmented by the presence of low levels of copper. In addition, the inhibiting effect of copper on D. pulex population growth relieves D. magna of the competitive inhibition experienced when these species are together. (Author's abstract)
W85-05849

EFFECTS OF TEMPERATURE, FEEDING AND ACRIDINE ON REPRODUCTION OF THE CALANOID COPEPOD, DIAPTOMUS CLAVIPES SCHACHT,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. D. Cooney, and C. W. Gehrs.
Environmental Pollution, Vol. 37, No. 1, p 53-70, 1985. 3 Fig, 4 Tab, 28 Ref. Office of Health and Environmental Research, US DOE contract W-7405-eng-26.

Descriptors: *Toxicity, *Water temperature, *Acridine, *Copepods, *Reproduction, Water pollution effects, Azaarenes, Life cycles.

Chronic toxicity determinations (using changes in reproduction as an index of toxicant stress) were performed on adults of the freshwater calanoid copepod, Diaptomus clavipes, at temperatures of 16, 21 and 26 C. Adults were paired and then exposed for 15 days to five concentrations (0.32-3.2 mg/liter) of the azaarene, acridine, in a renewal system. Two control groups (methanol control and well water control) were also used. Four reproductive criteria (number of eggs per clutch, number of clutches per female per day, number of eggs per female per day and percentage egg hatch) were evaluated. Mean clutch size was significantly reduced in acridine-exposed animals only at 21 C. Rate of clutch production was a more sensitive indicator of acridine stress than clutch size in all temperatures tested. Rate of egg production yielded results similar to those for clutch size. Egg viability was not affected by either temperature or acridine concentration, with more than 84% of the eggs hatching in most cases. No reproduction occurred at the highest acridine concentration tested (3.2 mg/liter) at all three temperatures; copepods at the next highest acridine concentration (1.8 mg/liter) produced only 2.5% of the total 1127 clutches produced in all exposure conditions. (Author's abstract)
W85-05850

EFFECTS OF A SEWAGE LAGOON EFFLUENT ON THE WATER QUALITY OF THE RECEIVING STREAM,
Ife Univ. (Nigeria). Dept. of Microbiology.
N. Okoronkwo, and O. Odeyemi.
Environmental Pollution, Vol. 37, No. 1, p 71-86, 1985. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Wastewater lagoons, *Water pollution effects, *Ife-Ife, *Nigeria, *Bacteria, Coliforms, Hydrogen ion concentration, Wastewater pollution, Water pollution sources.

The water quality of an actively used small stream receiving the University of Ife (Ife-Ife, Nigeria) sewage lagoon effluent was assessed down to 10 km below the pollution source. Fecal coliforms, total coliforms and heterotrophic bacteria were enumerated and the pH and dissolved oxygen values determined. Fecal coliform numbers in the region of the stream used to irrigate vegetables and farm crops in the dry season ranged from 100,000 to 1,000,000/100 ml while populations as high as 100 to 10,000/100 ml were obtained in the parts of the stream used for various domestic activities. Total coliform density ranged from 1000 to 10,000,000/100 ml in the actively used zone of the receiving stream. Furthermore, the total heterotrophic bacterial population of the receiving stream was raised from 100,000 to 10 to the 8th power/ml after mixing with the lagoon effluent, and was only reduced to about 100,000/ml at 10 km downstream of the mixing point. The dissolved oxygen of the receiving stream dropped from 7.6 mg/liter to values less than 2 mg/liter on mixing with the effluent. The dissolved oxygen sag continued to 8 km downstream, after which detectable reaeration of the stream began. The various data strongly suggest that serious public health hazards could result from the use of this stream into which undisinfected sewage lagoon effluent is discharged. (Author's abstract)
W85-05851

UPTAKE OF DIQUAT BY FOUR AERO-AQUATIC HYPHOMYCETES,
Waterloo Univ. (Ontario). Dept. of Biology.
A. Fronda, and B. Kendrick.
Environmental Pollution, Vol. 37, No. 3, p 229-244, 1985. 4 Fig, 1 Tab, 23 Ref.

Descriptors: *Aquatic fungi, *Aquatic plants, *Diquat, *Herbicides, Water pollution effects, Pesticides, Fungi.

The effects of xenobiotics on fungi colonizing leaf-litter and the consequences for the organisms which eat them have not been studied previously. Cultures of pond-dwelling fungi were challenged with various levels of the aquatic herbicide, diquat dibromide. The fungi used belong to the aero-aquatic hyphomycetes group which produce 'bubble trap propagules' which entrap air and float. Growth of Helicoon elegans, Hormiactis ontariensis, and Beverwykella pulmonaria was shown to be strongly inhibited by diquat dibromide. Pseudoaergerita matsushimae was little affected by the herbicide in concentrations of up to 10 micro g/ml. The former three species absorbed diquat; extraction from P. matsushimae was unsuccessful. Preliminary feeding studies suggest that small invertebrates such as snails (Lymnaea sp.), when provided with a choice of mycelia of the four fungal species grown in media containing diquat, prefer to graze on P. matsushimae, rather than on any of the other three fungi investigated. Fungi such as P. matsushimae, which do not accumulate the pollutants inside their cells, and thus represent uncontaminated food sources for invertebrates, might be regarded as elements favorable to the reestablishment of homeostasis in the pond system following its contamination. (Collier-IVI)
W85-05852

CARDIO-RESPIRATORY RESPONSES OF RAINBOW TROUT DURING RECOVERY FROM ZINC TREATMENT,
Bristol Univ. (England). Research Unit for Comparative Animal Respiration.
G. M. Hughes, and L. Tort.
Environmental Pollution, Vol. 37, No. 3, p 255-266, 1985. 6 Fig, 21 Ref.

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Descriptors: *Trout, *Fish physiology, *Zinc, Water pollution effects, *Toxicology, Animal physiology, Respiration, Metals.

Rainbow trout Salmo gairdneri were subjected to zinc treatment (20 mg/liter for 120 min and 20 mg/liter for 150 min) during which ventilatory and coughing frequencies were recorded. A third group of untreated fish formed a control group. After treatment, the fish were transferred to zinc-free water for 30 min, after which they were placed in a closed circulation system for seven days. Mortality, ventilatory, and coughing frequencies were recorded; plotting the position of each ECG in a ventilatory cycle made it possible to calculate the percentage coupling and phase angle. The treated groups showed a similar mortality rate during the recovery period, reaching 50% mortality (with respect to controls) after 12 days; mortality was more common during the first days of recovery. 120 min-treated fish recover normal values for ventilation, ECG and coughing after 5-6 days, while a longer period is required following treatment for 150 min. Percentage coupling is higher only during the first day, no significant differences being observed from day 2. The phase angles are concentrated in the third quadrant in treated fishes. About 40% of the zinc entering a fish would be retained and the effects of zinc would remain. Zinc responsible for the main cardio-respiratory parameters, such as ventilation, coughing, and ECG, could be washed out during the first few days and recovery of zinc-damaged gill structure enables the fish to survive and recover normal values. Other impairments at an internal level could more easily disappear following transfer of the fish to zinc-free water and the consequent cessation of the continuous uptake of the metal. Additional protective mechanisms at a cellular or molecular level may also be involved. (Collier-IVI)
W85-05853

POLLUTION MONITORING USING THE NEMATODE/COPEPOD RATIO, A PRACTICAL APPLICATION,
Napier Coll., Edinburgh (Scotland). Dept. of Biological Sciences.
G. M. Shiells, and K. J. Anderson.
Marine Pollution Bulletin, Vol. 16, No. 2, p 62-68, February, 1985. 5 Fig, 4 Tab, 12 Ref.

Descriptors: *Pollution monitoring, *Nematodes, *Copepods, *Bioindicators, *Firth of Forth, *Scotland, Aquatic animals, Water pollution effects, Species composition, Benthos.

Results of a study of the influence of sewage pollution on the benthic ecology of the Firth of Forth coastline bordering the city of Edinburgh, Scotland, carried out during the period 1977-1981 included data on distribution of the nematode and harpacticoid copepod fauna. The practical application of the nematode/copepod ratio in a pollution monitoring study was investigated. Ratios from polluted sites were much higher than from a clean site, but there is considerable evidence which casts doubt on the credibility of the ratio as a tool to detect organic pollution. Nematodes and copepods exhibited differing degrees of contagion. Seasonal patterns of variation of the ratio were shown to vary geographically and at some sites the seasonal range was great. For the N/C ratio to be considered useful as an indicator of pollution, values would be expected to vary predictably along sewage contamination gradients; the ratio was shown to vary in an inconsistent manner along sewage pollution gradients in time and space. A possible improvement to the ratio would be to include interstitial forms in the calculation. (Collier-IVI)
W85-05860

EFFECTS OF THE BLACK RIVER (CAPE, SOUTH AFRICA) ON THE DISTRIBUTION AND SURVIVAL OF MARINE PSAMMOFAUNA,
Texas A and M Univ., College Station. Dept. of Veterinary Anatomy.
For primary bibliographic entry see Field 2L.
W85-05861

SEPARATION OF SOLUTE AND PARTICULATE VECTORS OF HEAVY METALS UPTAKE IN CONTROLLED SUSPENSION-FEEDING EXPERIMENTS WITH MACOMA BALTHICA,
Geological Survey, Menlo Park, CA.
R. W. Harvey, and S. N. Luoma.
Hydrobiologia, Vol. 121, No. 2, p 97-102, February, 1985. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Water pollution effects, *Clams, *Mollusks, *Heavy metals, Radioisotope studies, Bacteria, Suspended solids.

An easy-to-use filter-chamber device was used to separate solute metal uptake from uptake of metals associated with suspended bacteria, in radioisotope labelling experiments with the estuarine clam, Macoma balthica. Solute uptake contributed a majority of the 14-day total body burdens of Zn-65 and Cd-109, whereas Co-57 uptake largely resulted from ingestion of isotope-laden bacteria. In contrast to those for Cd-109 and Zn-65, Co-57 tissue distributions at 3 weeks differed significantly ($p < 0.05$) between feeding and non-feeding clams (housed within filter chambers). The solute vector must be accounted for in any investigations of food source contribution to heavy metal accumulation in benthic invertebrates. The importance of solute uptake depends, in part, upon the particular metal. (Collier-IVI)
W85-05863

GROWTH RESPONSE OF ANACYSTIS NIDULANS TO SODIUM AND PHOSPHATE AVAILABILITY,
State Univ. of New York Coll. at Brockport. Dept. of Biological Sciences.
J. C. Makarewicz, and D. A. McKellar.
Hydrobiologia, Vol. 121, No. 2, p 129-137, February, 1985. 6 Fig, 1 Tab, 47 Ref.

Descriptors: *Chlorophyta, *Algae, *Sodium, *Phosphates, *Nutrients, Water pollution effects, Potassium.

Indirect evidence has suggested that blue-green algal populations may be enhanced by increasing sodium concentrations of allochthonous origin. The growth response of Anacystis nidulans to sodium and phosphate was studied in batch cultures under controlled laboratory conditions. Sodium (range = 0-10 mg/l) significantly enhanced growth, most notably, after sodium and phosphate starvation. The magnitude of the increase in growth was dependent on the initial cell density, external concentrations of phosphate, sodium, and potassium, and the nutritional status of the algal inoculum. With a lower potassium concentration, the growth response to sodium was smaller. This suggests that the potassium requirement of the algae must be met for maximum effect of increasing sodium concentrations. Sodium may influence phosphate uptake and storage and growth. In the green alga Chlamydomona, no sodium stimulation of growth occurred as was observed with A. nidulans, which suggests that increased sodium levels in lakes would favor at least a non-nitrogen fixing blue-green algae. The increase in ambient sodium levels in many lakes may provide a competitive advantage to some blue-green algae. (Collier-IVI)
W85-05866

CHANGES IN OXYGEN CONSUMPTION AND NITROGEN METABOLISM IN THE DRAGONFLY SOMATOCHLORA CINGULATA EXPOSED TO ALUMINUM IN ACID WATERS,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
M. Correa, R. A. Coler, and C.-M. Yin.
Hydrobiologia, Vol. 121, No. 2, p 151-156, February, 1985. 5 Tab, 34 Ref.

Descriptors: *Toxicity, *Aluminum, *Hydrogen ion concentration, *Dragonflies, *Acidic water, Animal physiology, Metabolism, Water pollution effects.

The impact of low pH and sublethal aluminum concentrations on respiration rate and ammonia accumulation and excretion was studied in different nymphal stages of the dragonfly Somatochlora cingulata. Oxygen consumption, ammonia excretion and changes in O:N ratios were measured in four nymphal growth stages, relative to aluminum concentrations and low pH. Very significant differences were found between controls and experimental animals exposed to low pH and to sublethal aluminum concentrations plus low pH. Sublethal aluminum concentrations were as toxic as low pH alone. Aluminum did not provoke a significant change in the respiratory rate compared to low pH alone. A differential reduction in respiration and ammonia excretion rates resulted in an increase in O:N ratios for all nymphal stages. The earlier stages, however, were the most sensitive. The ratios obtained were indicative of a decreased dependence on protein reserves and increased utilization of carbohydrates or lipid reserves. Also observed was an increase in the hemolymph pH and glutamate levels with a concomitant accumulation of tissue ammonia. S. cingulata partially compensates for the disruption of its excretory processes, induced by exposures by Al and low pH, by reducing the quantity of accumulated metabolites; this is accomplished through depressed oxygen consumption, restricted utilization of protein as fuel, and shifting intermediate metabolism toward the synthesis of glutamate. (Collier-IVI)
W85-05867

CHIRONOMIDAE IN A PENNINE STREAM SYSTEM RECEIVING MINE DRAINAGE AND ORGANIC ENRICHMENT,
Freshwater Biological Association, Wareham (England). River Lab.
P. D. Armitage, and J. H. Blackburn.
Hydrobiologia, Vol. 121, No. 2, p 165-172, February, 1985. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Midges, *Acid mine drainage, *Water pollution effects, *Species composition, *Organic wastes, *River Nent, *England, Species diversity, Benthos, Biomonitoring, Bioindicators, Zinc, Metals, Alkaline water.

A survey was made of Chironomidae found at 17 sites in the River Nent of northern England which receives heavy metal inputs and organic enrichment. In its passage from source to junction with the S. Tyne, a distance of about 10 km, it receives zinc-rich water from a number of old mine levels together with acidic mine-drainage water and organic enrichment from domestic and agricultural sources. Sites with zinc concentrations > 2.00 mg/l supported fewer species than did sites with concentrations of zinc < 0.36 mg/l. Sites low down on the system with high total alkalinities supported low numbers of chironomids. Cluster analyses showed that Chironomidae alone could be used to differentiate between sites with varying degress of pollution in the same way as analyses using total benthos but in which Chironomids were identified only to sub-family level. The family Chironomidae contains much useful information which is masked unless identifications are made to species level. (Collier-IVI)
W85-05868

EFFECTS OF CADMIUM IONS ON THE ULTRASTRUCTURE OF THE GILL CELLS OF THE BROWN SHRIMP CRANGON CRANGON (L.) (DECAPODA, CARIDEA),
Institute of Oceanographic and Fisheries Research, Athens (Greece).
E. Papathanassiou.
Crustaceana, Vol. 48, No. 1, p 6-17, January, 1985. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Cadmium, *Toxicity, *Water pollution effects, *Shrimp, Crustaceans, Water pollution effects.

The toxic effects of cadmium on the ultrastructure of the gill cells of the brown shrimp were studied and related to functional differences in the organelles. The gill lamellae in C. crangon consists of an outer cuticle beneath which are the epithelial cells and a central hemocoele. After exposure to 50 ppm cadmium for 20 hr there were fewer organelles

present in the cells than in cells from untreated specimens, with more pronounced effect on the mitochondria. The nucleus, although still large in relation to the cell, had its outer membrane disrupted in places. The mitochondria were swollen and contained fewer cristae than in controls. There were fewer ribosomes and the invaginations of the apical plasma membrane were smaller. Microtubules were present as long bundles, randomly orientated and there were larger numbers of vesicles. The number of organelles present in the epithelial cells of the gill lamellae was reduced when specimens of C. crangon were exposed to 25 ppm of cadmium ions. After 20 hr exposure to 5 ppm cadmium there were fewer organelles present in the epithelial cells. The mitochondria were sausage shaped or spherical and fewer than in untreated controls. They possessed fewer disorientated cristae, which were partially degenerated. There was swollen endoplasmic reticulum present near the nucleus, often in contact with the outer membrane of the nuclear envelope. There were fewer free ribosomes, fewer invaginations of the apical plasma membrane, but more vesicles than in untreated specimens. (Baker-IVI)
W85-05875

CADMIUM ACCUMULATION BY THE BLUE CRAB, CALLINECTES SAPIDUS: INVOLVEMENT OF HEMOCYANIN AND CHARACTERIZATION OF CADMIUM-BINDING PROTEINS,
Duke Univ., Beaufort, NC. Marine Lab.
M. Brouwer, and T. Brouwer-Hoexum.
Marine Environmental Research, Vol. 14, No. 1-4, p 71-88, 1984. 12 Fig, 1 Tab, 26 Ref. NOAA grant NA80-RA-D-00063.

Descriptors: *Cadmium, *Crabs, *Hemocyanin, *Proteins, *Toxicity, Animal physiology, Gills, Heavy metals, Water pollution effects, Trace metals.

The accumulation of cadmium from seawater by the blue crab, Callinectes sapidus, was studied as a function of metal concentration and exposure time, with special emphasis on cadmium-binding proteins. Cadmium was found, in decreasing order of magnitude, in gills, digestive gland and hemolymph. When exposed to 0.5 ppm cadmium for 2-24 h, virtually all of the cadmium in the cytosolic fraction of the gill was associated with a low molecular weight (LMW) cadmium-binding protein (MW 8000). However, after 48 h of exposure only 50% of the cadmium in the cytosol was bound to this protein. The rest was found to be associated with proteins of a molecular weight of 300,000 and 60,000. This pattern of cadmium distribution did not change over a 12-day depuration period. Similar results were obtained upon exposure to 0.1 ppm cadmium. The pattern of cadmium accumulation in the cytosolic fraction of the digestive gland was in marked contrast to that observed for the gill. Initially, the cadmium was distributed over three low molecular weight fractions. During depuration the distribution of cadmium changed and all of the metal became bound to a low molecular weight protein (MW 9000). The cadmium concentrations in the gill and digestive gland remained essentially constant during depuration (12 days). The LMW cadmium-binding proteins were purified by a combination of gelpermeation and ion-exchange chromatography. Their molecular weight, spectral properties and amino acid composition are characteristic of the vertebrate metallothioneins. During exposure to cadmium the metal rapidly appeared in the hemolymph, mainly associated with hemocyanin. During depuration cadmium was transferred from the hemolymph to the digestive gland, demonstrating that hemocyanin acts as a carrier in trace metal transport. (Author's abstract)
W85-05881

ZINC AND CADMIUM METABOLISM IN EUGLENA GRACILIS: METAL DISTRIBUTION IN NORMAL AND ZINC-DEFICIENT CELLS,
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
D. J. Gingrich, D. H. Petering, and C. F. Shaw, III.
Marine Environmental Research, Vol. 14, No. 1-4, p 89-102, 1984. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Euglena, *Algae, *Cadmium, *Zinc, *Cadmium, *Metals, Plant physiology, Toxicity, Water pollution effects, Proteins, Physiology.

The effect of cadmium (5 micro g/ml) on the growth of Euglena gracilis is moderated by the addition of supplemental zinc levels above the normal 1 micro g/ml level found in the growth medium. Gel chromatography reveals that the majority (ca. 85%) of cytosolic cadmium is localized in a cadmium-binding protein (CdBP). The CdBP appears to elute in a position slightly lower in molecular weight than mammalian metallothionein, contains, thiol, and upon ion-exchange chromatography elutes in multiple peaks at ionic strengths greater than mammalian metallotioneins. The remaining cadmium is associated with high molecular weight components. Cytosolic zinc is found primarily (> 80%) in a low molecular weight peak distinct from cadmium, with the remainder as high molecular weight species. As the cells become zinc-deficient and cease proliferation, zinc is lost from the low molecular weight peak while, based on cytosolic protein, the zinc content of the high molecular weight peak remains essentially constant. (Author's abstract)
W85-05882

CELLULAR RESPONSES OF MOLLUSCAN TISSUES TO ENVIRONMENTAL METALS,
Reading Univ. (England). Dept. of Zoology.
K. Simkiss, and A. Z. Mason.
Marine Environmental Research, Vol. 14, No. 1-4, p 103-118, 1984. 6 Fig, 2 Tab, 16 Ref. Natural Environmental Research Council grant GR3/3063A.

Descriptors: *Heavy metals, *Animal physiology, *Mollusks, *Water pollution effects Toxicity, Bioindicators.

The use of marine organisms as monitors of pollution assumes that the processes involved in sequestration provide a response which is proportional to the concentration of the pollutant in the environment. This assumption is considered in relation to the known cellular properties of the systems involved. Studies on the kinetics of uptake of certain metals in estuarine conditions have included the possibility that they can occur in non-polar, lipid-soluble forms which may penetrate cell membranes very rapidly. Uptake of these metals is governed by first-order kinetics and that many of the assumptions undertaken during biological monitoring programs are, in fact, valid as a first approximation. Many heavy metals of interest to environmentalists are retained within the tissues by reactive ligands. These may be inducible, metabolized and excreted, and it is the 'turnover' and availability of these ligands which may ultimately determine the final concentration of the metal in the animal. Models and experimental studies of these activities indicate that the ligands are either non-specific in nature and capable of binding a wide variety of metals or are very specific for particular metals. The former ligands may contribute to a general system of detoxification while the latter appear to be integrated into precise metabolic pathways. (Author's abstract)
W85-05883

CADMIUM-BINDING PROTEINS IN THE BLUE CRAB, CALLINECTES SAPIDUS: LABORATORY - FIELD COMPARISON,
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
D. W. Engel, and M. Brouwer.
Marine Environmental Research, Vol. 14, No. 1-4, p 139-151, 1984. 6 Fig, 1 Tab, 12 Ref.

Descriptors: *Cadmium, *Crabs, *Proteins, *Heavy metals, *Water pollution effects, Animal physiology, Copper, Zinc, Nickel, Metals, Crustaceans, Toxicity.

The blue crab, Callinectes sapidus, is distributed along the east coast of the United States from Cape Cod, Mass., through the Gulf of Mexico, including both relatively unpolluted coastal areas and estuaries contaminated with trace metals. Cadmium is of particular concern because it is concentrated in the digestive glands of blue crabs and can be passed on to consumer organisms. Tissue concentrations and partitioning of trace metals from crabs exposed in the laboratory to 100 ppb dissolved cadmium for 40 days were compared with blue crabs collected from two locatons on the Hudson River, NY, Foundry Cove and Haverstraw Bay, both of which have elevated trace metal levels relative to estuarine areas near Beaufort, NC. Crab digestive glands, gills and muscle were removed and analyzed for total cadmium, copper, zinc, and nickel concentrations using acid digestion and atomic absorption spectrophotometry, and metal-binding (metallothionein-like) proteins were determined by gel-filtration chromatography. In crabs exposed to cadmium in the laboratory, the cytosolic partitioning was similar to previous investigations at our laboratory where higher levels of cadmium (100 ppb) and shorter exposure times (14 days) were used. The similarity in cadmium partitioning from these two separate experiments indicates dose independence. In crabs from polluted environments the digestive glands contained the highest concentrations of trace metals. Chromatograms of the cytosol from the digestive glands and gills from both field and laboratory-exposed crabs showed similar distributions of cadmium, copper and zinc. The gills of both field and laboratory-exposed crabs had metal-binding proteins that contained mostly cadmium, and the digestive glands had metallothionein-like proteins that contained cadmium, copper and zinc. Estimated molecular weights for these proteins were similar to the metallothioneins found in other crustaceans and mammals. (Author's abstract)
W85-05884

METALLOTHIONEIN AND MERCURY TOLERANCE IN THE KILLIFISH, FUNDULUS HETEROCLITUS,
New Jersey Medical School, Newark. Dept. of Anatomy.
P. Weis.
Marine Environmental Research, Vol. 14, No. 1-4, p 153-166, 1984. 5 Fig, 2 Tab, 29 Ref.

Descriptors: *Metallothionein, *Mercury, *Killifish, *Fish, *Toxicity, Methylmercuric chloride, Mercuric chloride, Animal physiology, Fish physiology, Water pollution effects.

Synthesis of metallothionein (MT) as a possible mechanism by which Fundulus heteroclitus adapts to heavy metal pollution has been investigated in relation to responses to methylmercuric chloride (meHg) and HgCl2(Hg(2+)) at different life stages. Clutches of embryos from unpolluted sites exhibit teratogenic responses to a standard dose of meHg or of Hg(2+) which range from little or no effect (tolerant) to severely affected or almost complete inhibition of development (susceptible). At the time of hatching, untreated embryos from tolerant clutches had twice as much of a protein which co-migrates in SDS-PAGE gels with Fundulus MT as do those of susceptible clutches. This difference could be a mechanism for conveying tolerance to Hg(2+) and also to meHg if demethylation occurs. However, eggs at the time of deposition had virtually no MT, suggesting that the protein is synthesized too late to provide tolerance in the early stages of development which are critical in the etiology of malformations. Treatment of embryos with non-teratogenic doses of either meHg or Hg(2+) did not increase the amount of MT-like protein. This may indicate that the thionein gene is already fully active, and would also explain observations that Hg(2+) pretreatment of embryos does not enhance tolerance to Hg(2+) in the larval stage. MT, isolated from livers of Hg(2+)- or Cu(2+)-dosed or control adults, is associated with Cu and Zn but not with Hg, although it can bind Hg(2+) in vitro. Fundulus, like other fish, methylates much (ca. 75%) of its Hg burden, and meHg is considered by some not to react with MT. Fundulus liver has its Hg burden distributed between homogenate sediment (25%), the cytosol (60%) and the remainder in lipid. The liver responds to Hg(2+) treatment by increasing

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pid content. This may allow sequestration of ome lipid-soluble meHg. Of the cytosolic Hg, ost is associated with larger proteins and some a. 25%) is dialyzable. These data suggest that etallothionein is not a significant factor in Hg olerance in Fundulus adults, and has a question- ble role in embryonic and larval tolerance to lg(2+) and none to the more toxic meHg. (Au- hor's abstract)
V85-05885

RESPONSES OF THE MUSSEL MYTILUS EDULIS TO COPPER AND PHENANTHRENE: NTERACTIVE EFFECTS,
nstitute for Marine Environmental Research, Plymouth (England).
M. N. Moore, J. Widdows, J. J. Cleary, R. K. Pipe, and P. N. Salkeld.
Marine Environmental Research, Vol. 14, No. 1-4, p 167-183, 1984. 9 Tab, 34 Ref.

Descriptors: *Mussels, *Copper, *Phenanthrene, *Organic compounds, *Toxicity, *Synergistic effects, Water pollution effects, Metals, Polycyclic hydrocarbons.

Most investigations of the responses of marine organisms to xenobiotics have connected on single contaminants and little is known of possible interactive effects of different classes of xenobiotics. As these latter seldom occur in environmental isolation, it is important to understand any interactions synergistic or antagonistic) which may occur. This problem has been approached in the mussel Mytilus edulis by exposing estuarine mussels to copper (20 micro g/liter) and phenanthrene (100 micro g/liter) both individually and in combination, and measuring cytochemical subcellular and physiological responses after 3 days exposure and 3 days and 12 days recovery period. Results showed that mussels accumulated both xenobiotics during 3 days exposure. Depuration of copper was complete in 3 days recovery period, while loss of phenanthrene ranged from 30% to 70% of the concentration reached after 3 days exposure. There were no interactive effects on depuration. Both copper and phenanthrene reduced lysosomal hydrolase latency in digestive cells, and copper appeared to have a synergistic effect in preventing recovery of latency of lysosomal N-acetyl-beta-hexosaminidase during the recovery period. There was evidence, in the digestive cells, of an antagonistic effect of copper on stimulation of activity of the microsomal respiratory chain (measured as NADPH-neotetrazolium reductase) by phenanthrene. Stimulation of this system by phenanthrene persisted after 12 days recovery period. There was a synergistic interaction of copper and phenanthrene on elevation of oxygen consumption and ammonium excretion. Clearance rates and scope for growth (physiological condition) were depressed by copper but not by phenanthrene after 3 days exposure. These findings are discussed in terms of known efect of copper and phenanthrene and the interactions are considered in terms of environmental effects measurements. (Author's abstract)
W85-05886

INHIBITION OF ESSENTIAL AMINO ACID ABSORPTION IN MARINE FISHES BY MERCURY,
Rutgers - The State Univ., Piscataway, NJ. Nelson Biological Lab.
A. Farmanfarmaian, and R. Socci.
Marine Environmental Research, Vol. 14, No. 1-4, p 185-199, 1984. 1 Fig, 7 Tab, 57 Ref.

Descriptors: *Amino acids, *Mercury, *Heavy metals, *Fish physiology, *Water pollution effects, Toxicity, Intestines.

In polluted coastal waters marine fish can concentrate heavy metals in the intestine two or more orders of magnitude above those found in the water column and several-fold higher than the sediment level. These accumulations are primarily due to ingestion of contaminated food and drink. Relatively long residence time of gut content, low permeability coefficient of divalent cations through the lipid bilayers of membranes and profuse binding to the negative charge sites on the mucosal side of the gut, all combine to increase the concentration of heavy metals in the lumen. The effect of HgCl2 and CH3HgCl on the absorption of the essential amino acids, L-leucine, L-isoleucine, L-lysine and L-methioine, by the intestine of Fundulus and toadfish was measured in vitro and in vivo. At concentrations expected in the gut, HgCl2 can inhibit 20-80% of the leucine absorption. CH3HgCl is less potent in this respect. While the action of Hg(2+) appears to be limited to the luminal side, the more lipophilic CH3Hg(+) rapidly penetrates the epithelial cell layer and can inhibit the intracellular energy production needed for transport. The implications of these findings for growth and survival for marine fishes are discussed. (Author's abstract)
W85-05887

SERUM BIOCHEMICAL AND CELLULAR RESPONSES TO EXPERIMENTAL CUPRIC ION CHALLENGE IN MUSSELS,
Naval Ocean Systems Center, San Diego, CA.
G. V. Pickwell, and S. A. Steinert.
Marine Environmental Research, Vol. 14, No. 1-4, p 245-265, 1984. 6 Fig, 2 Tab, 20 Ref.

Descriptors: *Mussels, *Animal physiology, *Mollusks, *Copper, *Toxicity, Bioassays, Metals, Water pollution effects, Proteins.

Rapid and sensitive bioassay procedures were developed foi laboratory and field applications based on hemolymph factors in animals such as the bay mussel, Mytilus edulis. Mussel hemolymph could be easily and repeatedly sampled from individual animals in sufficient amounts to allow analyses for lysozyme, proteolytic activity, total protein and hemocyte counts. In static tests there seemed to be graded responses indicating release of increasing amounts of the above factors into the hemolymph in roughly direct proportion to Cu(2+) concentration at lethal and sublethal levels which indicates increased lysosomal and cellular disruption as cupric ion exposure was increased or prolonged. At the same time, Cu(2+) concentrations in the mussel hemolymph increased up to an order of magnitude above ambient in the range of 26 to 267 ppb; this was evidence for the release of Cu-binding proteins into the mussel hemolymph. Simultaneously with the above events the serum granulocytes increased in numbers above control values by factors of 3 or 4 in response to copper challenge while macrophage counts, including controls, declined precipitously. (Author's abstract)
W85-05888

FIELD ASSESSMENT OF BIOCHEMICAL STRESS INDICES FOR THE SANDWORM NEANTHES VIRENS (SARS),
Battelle New England Marine Research Lab., Duxbury, MA.
R. S. Carr, and J. M. Neff.
Marine Environmental Research, Vol. 14, No. 1-4, p 267-279, 1984. 6 Tab, 33 Ref.

Descriptors: *Stress, *Sandworms, *Portland Harbor, *Maine, *Water pollution effects, Benthos, Sediment, Oil pollution, Animal physiology.

Certain biochemical stress responses have been observed in the laboratory for Neanthes virens subjected to various environmental and pollutant stressors. The purpose of the present study was to determine whether similar alterations in these biochemical parameters could be detected in a natural population of N. virens from a contaminated site as compared with animals from a nearby reference site. A site in Portland Harbor, Maine, adjacent to an oil storage facility with oil-contaminated sediments was selected as the experimental study area and the reference site was at Pine Point, approximately 15 miles south of Portland. Animals were collected from the two sites on consecutive days on a bimonthly basis at low tide within a day of the full moon for September 1981 through March 1982. Coelomic fluid samples were taken within 2 h after collection and the animals were then frozen in liquid nitrogen for transport back to the laboratory. Coelomic fluid samples were analyzed for glucose and the frozen tissues were analyzed for glycogen, lipid and free amino acid concentrations. Significant differences in these parameters were often observed between the two populations. The glycogen content of animals from the contaminated site was always less than that of animals from the reference site, whereas the lipid levels were always higher. Significant differences between the free amino acid composition of the animals from the two sites were also observed. Although distinct biochemical differences can be detected between these two populations, the considerable biological variation in these parameters may limit their usefulness for field monitoring investigations for this species. (Author's abstract)
W85-05889

USE OF THE AURELIA METAMORPHOSIS TEST SYSTEM TO DETECT SUBTLE EFFECTS OF SELECTED HYDROCARBONS AND PETROLEUM OIL,
Eastern Virginia Medical School, Norfolk, VA. Dept. of Pathology.
D. B. Spangenberg.
Marine Environmental Research, Vol. 14, No. 1-4, p 281-303, 1984. 5 Fig, 3 Tab, 38 Ref.

Descriptors: *Jelly fish, *Aurelia, *Hydrocarbons, *Bioassays, *Toxicity, Growth stages, Water pollution effects, Aniline, Anthracene, Benz-anthracene, Benzene, Benzo(a)pyrene, Biphenyl, Cresol, Napthalene, Perylene, Phenol, Pyrene.

The Aurelia Metamorphosis Test System was devised to use simple Aurelia polyps as indicator organisms for the detection of subtle effects of petroleum-related hydrocarbons and of Alaskan crude petroleum oil (ACPO) on developmental processes involved in strobilation initiation, differentiation of ephyrae, and genetic modification expressed through cloning. Compounds tested were ACPO, aniline, anthracene, benzanthracene, benzene, benzo(a)pyrene, biphenyl, cresol, naphthalene, perylene, phenol and pyrene. Gross morphology of the ephyrae (patterning, numbes and appearance of structures) statolith and nematocyst numbers, and pulsing behavior were recorded using the light microscope. Selected ephyrae with teratological malformations were studied with the scanning electron microscope and swimming behavior was observed visually. The variety of subtle developmental, behavioral and genetic effects due to marine hydrocarbons detected using the Aurelia Metamorphosis Test System demonstrated that this test system could be used as an early warning system to detect subtle effects of other marine pollutants. (Author's abstract)
W85-05890

EFFECTS OF TOXIC CHEMICALS ON MACROPHAGE PHAGOCYTOSIS IN TWO ESTUARINE FISHES,
Virginia Inst. of Marine Science, Gloucester Point.
B. A. Weeks, and J. E. Warinner.
Marine Environmental Research, Vol. 14, No. 1-4, p 327-335, 1984. 4 Fig, 12 Ref.

Descriptors: *Polyaromatic hydrocarbons, *Macrophages, *Phagocytosis, *Fish physiology, *Bioassays, *Elizabeth River, *Ware River, *Virginia, Water pollution effects, Toxicity, Hydrocarbons, Spot, Hogchoker.

The phagocytic efficiency of macrophages isolated from the kidney of spot, Leiostomus xanthurus, and hogchoker, Trinectes maculatus, was determined in fish captured from the Elizabeth River (Virginia). Fish were captured by trawl net from the reach of the Elizabeth River most contaminated with PAHs and from the Ware River. Macrophage phagocytosis was found to be markedly reduced in the Elizabeth River fish as compared to Ware River controls. The macrophages phagocytic activity of Elizabeth River fish returned to normal after the fish were held in clean water for several weeks. This indicates that the decreased phagocytic activity was related to exposure to Elizabeth River pollutants but may be reversible. If the results apply to a wide variety of species, this technique may make it possible to monitor fish

health on a broader scale and thereby assess the degree of environmental pollution. (Collier-IVI)
W85-05891

EFFECTS OF CONTAMINATED SEDIMENTS AND SEDIMENT-EXPOSED EFFLUENT WATER ON AN ESTUARINE FISH: ACUTE TOXICITY,
Virginia Inst. of Marine Science, Gloucester Point.
W. J. Hargis, Jr., M. H. Roberts, Jr., and D. E. Zwerner.
Marine Environmental Research, Vol. 14, No. 1-4, p 337-354, 1984. 7 Fig, 3 Tab, 21 Ref.

Descriptors: *Sediments, *Water pollution effects, *Elizabeth River, *Virginia, *Ware River, *Fish, Toxicity, Spot, Hydrocarbons, Polyaromatic hydrocarbons.

The Elizabeth River is Virginia's most heavily populated, industrialized and contaminated subestuary. Its sediments contain the residues of wastes discharged for several hundred years. Spot (Leiostomus xanthurus) were used in an examination of some of the effects of sediment from a particularly noxious location. The spot is a bottom-feeding sciaenid and naturally occurring spring-summer migrant of the river whose juveniles adapt readily to laboratory conditions. Spot from the Ware River, a nearby uncontaminated reference subestuary, were placed in two 38 liter (100 US gal), flow-through tanks (70 each). One tank contained Elizabeth River sediments contaminated with PAHs. The second tank contained uncontaminated sediment from the York River as a control. 13 spot each were placed in two aquaria that received the overflow from the sediment-containing tanks. Animals from the reference estuary were examined and processed to provide baseline information. Results obtained to date show the following: (1) spot experimentally exposed to contaminated sediment developed penetrating integumental lesions within 8 days after exposure began and later severe fin and gill erosion; (2) their hematocrits were significantly reduced and no weight gain occurred; (3) pancreatic and liver alterations were observed in some of the chemically stressed fish; (4) control fish exhibited no fin erosion or integumental lesions; (5) control fish showed no hematocrit or growth reduction; and (6) dead fish were first observed in the contaminated-sediment tank after 8 days while no control fish died. Clearly, one or more factors associated with Elizabeth River sediments and/or water closely associated with those sediments (probably the heavy concentrations of PAHs) are capable of causing serious injury, disease and death in experimental spot populations. (Author's abstract)
W85-05892

GILL FOULING AND PARASITISM IN THE ROCK CRAB, CANCER IRRORATUS SAY,
National Marine Fisheries Service, Oxford, MD. Northeast Fisheries Center.
T. K. Sawyer, E. J. Lewis, M. E. Galasso, and J. J. Ziskowski.
Marine Environmental Research, Vol. 14, No. 1-4, p 355-369, 1984. 1 Fig, 3 Tab, 32 Ref.

Descriptors: *Crabs, *Water pollution effects, *New York Bight, *Boothbay Harbor, *Maine, *Ocean dumping, *Gills, *Parasites, Sludge disposal, Waste disposal, Pathology.

Rock crabs, Cancer irroratus, were examined grossly and microscopically to estimate the influence of molting activity, geographical source and seabottom sediments on gill color, carapace color and tissue pathology. Collections were made from deepwater stations (20-55 m) in the Hudson Shelf Valley near dredge- and sewage-sludge disposal sites in the New York Bight apex, and from nearshore waters near Boothbay Harbor, Maine. Extensive gill blackening was noted in up to 30% of the crabs from the New York stations when all specimens were in the intermolt condition. Blackening was not noted in intermolt crabs collected in Maine. Carapace blackening was present in up to 79% of the New York crabs but absent in those from Maine. Severe blackening was attributed to direct contact of C. irroratus with blackened, highly organic sediments in the Hudson Shelf Valley. Fouling microorganisms on gill epicuticle included bacteria, diatoms, stalked ciliates, amoebae, flagellates and copepods. Bacteria, diatoms, amoebae and flagellates were common on crab gills from both locations. Ciliates and copepods counted in histological sections were considerably fewer in crabs from the New York stations than in those from Maine. Melanized nodules (hemocyte clumps) were present in gill tissue in up to 58% of the New York crabs and in up to 68% of Maine crabs. Unidentified microsporidans were found in up to 55% of the New York specimens and in less than 2% of those from Maine. Histological data accumulated since 1975 are summarized to provide a list of endoparasites, polychaete worms and barnacles observed in C. irroratus from the northeastern United States. Gill blackening, but not parasitism or microbial fouling, proved to be the best indicator for monitoring the effects of ocean dumping on the health of a benthic crustacean species. (Author's abstract)
W85-05893

HISTOPATHOLOGICAL CHANGES IN GRASS SHRIMP EXPOSED TO CHROMIUM, PENTACHLOROPHENOL AND DITHIOCARBAMATES,
University of West Florida, Pensacola. Dept. of Biology.
K. R. Rao, and D. G. Doughtie.
Marine Environmental Research, Vol. 14, No. 1-4, p 371-395, 1984. 42 Fig, 2 Tab, 37 Ref.

Descriptors: *Animal pathology, *Shrimp, *Chromium, *Pentachlorophenol, *Dithiocarbamate, *Gills, *Water pollution effects, Bioassays, Chlorinated hydrocarbons, Heavy metals, Metals, Toxicity, Animal physiology.

Histopathological/ultrastructural changes were monitored in various tissues of grass shrimp (Palaemonetes pugio) exposed to hexavalent chromium, pentachlorophenol (PCP) and two dithiocarbamate formulations: Aquatreat DNM-30 (15% sodium dimethyl dithiocarbamate plus 15% disodium ethylene bis-dithiocarbamate) and Busan-85 (50% potassium dimethyl dithiocarbamate). The pathological alterations induced by dithiocarbamates and PCP were most severe and first evident in the gills. Of the biocides tested, the dithiocarbamates caused the most extensive branchial damage - the so-called black gill syndrome, involving early melanization and eventual lamellar truncation. Hexavalent chromium, on the other hand, did not induce marked changes in the gills, but it caused invasive melanized cuticular lesions (particularly at the articulations of the periopods, pleopods and abdominal segments). Additionally, chromium caused apparent labyrinth hypoactivity in the antennal glands, whereas the dithiocarbamates seemed to induce labyrinth hyperactivity. Hepatopancreatic histopathology was more severe in shrimp exposed to chromium and PCP than in dithiocarbamate-exposed shrimp. The apparent mitotic activity in the hepatopancreas was increased in Aquatreat-exposed shrimp and suppressed in chromium-exposed shrimp; many mitotic figures in the latter case were abnormal. All four compounds caused varying degrees of midgut epithelial hypertrophy, cytoplasmic vacuolization and diminution of basal tubular endoplasmic reticulum, but only PCP caused widespread rupture, of midgut epithelial cell apices. Additional notable ultrastructural anomalies included: mitochondrial compartmentalization in PCP-exposed shrimp; mitochondrial fusion in dithiocarbamate-exposed shrimp; and unusual intranuclear inclusions in different tissues of chromium-exposed shrimp. These pathological changes point to differences in the mechanisms of pollutant toxicity and indicate their potential use in the biological monitoring of aquatic pollutants. (Author's abstract)
W85-05894

INTERSPECIES DIFFERENCES IN HEAVY METAL DETOXICATION IN OYSTERS,
Institute of Marine Biochemistry, Aberdeen (Scotland).
S. G. George, B. J. Pirie, J. M. Frazier, and J. D. Thomson.
Marine Environmental Research, Vol. 14, No. 1-4, p 462-464, 1984. 8 Ref.

Descriptors: *Heavy metals, *Detoxication, *Oysters, Water pollution effects, Cadmium, Zinc, Copper, Toxicity.

In an analytical electron microscopic study of the response of Ostrea edulis from a highly metalliferous environment to Cd exposure for 100 days, it was found that while the tissue Cu and Zn concentrations remained constant, there was a decrease in the numbers of metal-containing amoebocytes and that this is largely due to a reduction in numbers of the mixed Cu/Zn-containing cells rather than in the specific Cu- or Zn-containing cells. No specific Cd-containing blood cell or Cd-binding protein was found in the blood cells. Since only O. edulis contains the specific metal-containing cells, it is suggested that their function is one of metal detoxication and thus this may be an adaptive response to selection pressure of sustained Cu and Zn pollution for over 100 years. Comparisons with the results of other studies underscored the importance of simultaneous measurement of all interacting metals and of knowledge of the cellular localization of metals in order to secure a meaningful interpretation of data. (Baker-IVI)
W85-05896

INTRACELLULAR CONTROL OF CD CONCENTRATIONS IN MARINE MUSSELS,
Institute of Marine Biochemistry, Aberdeen (Scotland).
S. G. George.
Marine Environmental Research, Vol. 14, No. 1-4, p 465-468, 1984. 17 Ref.

Descriptors: *Mussels, *Cadmium, Heavy metals, Water pollution effects, Absorption, Isotope studies, Cadmium radioisotopes, Ligands.

Artificial liposomes containing Cd-109 were synthesized and Cd exchange measured in the presence of various intracellular complexing ligands. While there was measurable exchange of Cd in the absence of ligand, this was 4-fold faster than for Na and exchange was faster in the presence of glutathione or thionein. The data found were consistent with control of intracellular Cd concentrations being mediated by synthesis of an as yet unknown intracellular complexing ligand, or ligands, which also mediate uptake and initial detoxication, the synthesis of metallothionein and its turnover in the cell, the sequestration of metal by the tertiary lysosomes and excretion of these lysosomes. Since all these systesms are able to bind Cd, Cu and Zn, their metabolism is clearly interrelated and metabolic studies must involve simultaneous determination of all these metals. (Baker-IVI)
W85-05897

ALTERATIONS IN TISSUE WATER BALANCE AND ADENYLATES OF BLUEGILL (LEPOMIS MACROCHIRUS) EXPOSED TO COPPER,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
A. G. Heath.
Marine Environmental Research, Vol. 14, No. 1-4, p 483-485, 1984. 6 Fig.

Descriptors: *Water pollution effects, *Tissue water balance, *Adenylates, *Bluegill, *Copper, Adenosine triphosphate, Mitochondria, Fish, Heavy metals, Enzymes, Toxicity.

Use of tissue adenylate concentrations as indicators of environmental copper stress in freshwater fish was investigated. Bluegill were exposed in a flow through system to copper (2.0 mg/liter unfiltered; 1.21 mg/liter filtered through 40 U filter) for 24, 48, 72 and 96 hr at 24 C. Tissue water content of liver increased 4.8% by 24 hr and in muscle 4.6% by 48 hr. The increased water content may be due largely to inhibition of Na- or K-activated ATPase in the gill tissue leading to osmoregulatory dysfunction. Copper exposed fish exhibited significant decreases in white muscle ATP, ADP, total adenylates and energy charge by 48 hr. The changes in ATP are due to some combination of increased

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issue water content, damage to mitochondria, and opper inhibition of cellular enzymes. At the concentration of copper used here, tissue hypoxia did ot occur. (Baker-IVI)
V85-05898

HISTOPATHOLOGY OF MERCENARIA MERCENARIA AS AN INDICATOR OF POLLUTANT STRESS,
Delaware Univ., Newark. School of Life and Health Sciences.
M. R. Tripp, C. R. Fries, M. A. Craven, C. E. Grier, and C. E. Gates.
Marine Environmental Research, Vol. 14, No. 1-4, p 521-524, 1984. 2 Fig. NSF Grant OCE-77-24037.

Descriptors: *Water pollution effects, *Indicator organisms, *Clams, Organic compounds, Benzo(a)pyrene, Hexachlorobenzene, Pentachlorophenol, Enzymes, Toxicity, Hydrocarbons, Chlorinated hydrocarbons.

Morphological and biochemical parameters of Mercenaria mercenaria were evaluated for cyclic variations and to determine whether they were affected by chemical stressors. Test chemicals included benzo(a)pyrene (BAP), hexachlorobenzene (HCB) and pentachlorophenol (PCP). Tubule dimensions and digestive cell size changed slightly in HCB- and PCP-injected clams, but there was no change in BAP-injected clams. Lysosomal enzyme content varied irregularly. beta-Glucuronidase values were decreased in BAP-injected animals just after injection but returned to normal within a few days; all chemical-injected animals had higher than normal values by day 18. Acid phosphatase values were depressed at day 2, rebounded sharply to above control values by day 4 and gradually decreased towards normal thereafter. Clams held for 6 months in seawater plus test chemicals did not show significant changes in tubule width or length, lumen width or cell height. HCB and BAP both decreased cell width while PCP decreased both lumen length and cell width. Clams injected with BAP, HCB, or PCP had some significant changes in tubule or cell dimensions. They also showed altered concentrations of lysosomal enzymes but not massive lysis of digestive tubule cells. These data suggest that BAP had no significant effect on M. mercenaria while HCB and PCP may have mildly toxic effects on the digestive gland. (Baker-IVI)
W85-05899

ENVIRONMENTAL IMPLICATIONS OF NEOPLASIA IN GREAT LAKES FISH,
Roswell Park Memorial Inst., Buffalo, NY. Dept. of Experimental Biology.
J. J. Black.
Marine Environmental Research, Vol. 14, No. 1-4, p 529-534, 1984. 1 Tab, 17 Ref.

Descriptors: *Great Lakes, *Fish, *Water pollution effects, *Neoplasia, Carcinogens, Organic compounds, Aromatic hydrocarbons, Liver, Skin, Bullheads, Polycyclic aromatic hydrocarbons.

The Great Lakes constitute the preeminent freshwater resource of North American and despite numerous point source and non-point source related pollution problems, they are major sources of sport and commercial fisheries of a diverse range of species. Brown bullheads, when exposed by skin painting to an organic solvent extract derived from a heavily polluted river sediment contaminated with a complex mixture of polycyclic aromatic hydrocarbons underwent a series of localized skin changes which progressed to neoplasia. Sensitivity to liver carcinogens present in the sediments was also indicated. Further studies will be required to determine the precise etiology of neoplasms found in Great Lakes fish populations. (Baker-IVI)
W85-05900

ENVIRONMENTAL HEALTH INVESTIGATION OF COPPER INTOXICATION FROM A PUBLIC WATER SUPPLY,
Vermont State Dept. of Health, Burlington. Div. of Environmental Health.
For primary bibliographic entry see Field 5F.
W85-05913

OFF-SITE COSTS OF SOIL EROSION,
Conservation Foundation, Washington, DC.
E. H. Clark, II.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 19-22, January-February, 1985. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Soil erosion, *Economic aspects, *Off-site costs, Soil loss, Sediments, Nutrients, Croplands, Salinity, Lakes, Streams.

Instream damages include biological impacts, recreational impacts, water storage damages, and navigation. Off-stream effects include flood damages, water treatment impacts, and water quality effects. Erosion-related pollutants are estimated to have had a net damage cost of $3.2 billion to $13.0 billion in 1980 with the single-value estimate being $6.0 billion per year. Cropland's share is $2.2 billion per year. Many of these costs, for instance, salinity damage to household and industrial water using equipment, are not directly related to erosion. They could continue even if erosion were stopped. The estimated damage directly related to sediment is $3.0 billion to $3.5 billion for all sources, and $1.0 billion to $1.2 billion for cropland erosion. (Baker-IVI)
W85-05941

RELATION BETWEEN TOXICITY AND FREE FORMS OF SOME TRACE METALS (RELATION ENTRE TOXICITE ET FORMS LIBRES DE QUELQUES METAUX TRACES),
Lille-2 Univ. (France). Unit of Pharmacy.
J. Pommery, M. Imbenotte, and F. Erb.
Environmental Pollution (Series B), Vol. 9, No. 2, p 127-136, 1985. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Toxicity, *Trace metals, Cadmium, Copper, Zinc, Humic acids, Daphnia, Heavy metals, Complexation.

The toxicity of trace metals, as free species or in complexed form with humic acids, has been studied by means of a medium-term daphnia test. Four parameters relative to sublethal effects and two lethal criteria were determined over a 30-day period. The toxicity due to metal concentrations (cadmium, 5 micro-g/liter; copper, 15 micro-g/liter and zinc, 50 micro-g/liter) was significantly established. Free metal concentrations were determined by differential pulse anodic stripping voltammetry and correlated with toxic effects. Comparison of the equations of the regression lines revealed that the effect of humic acids is not restricted to a pure detoxification by complexation. Their presence modifies the toxic behavior of free metals, as confirmed by the evaluation of the 30-day LC50. (Author's abstract)
W85-05976

CELLULAR METAL DISTRIBUTION IN THE PACIFIC OYSTER, CRASSOSTREA GIGAS (THUN.) DETERMINED BY QUANTITATIVE X-RAY MICROPROBE ANALYSIS,
Tasmanian Fisheries Development Authority, Taroona (Australia).
J. D. Thomson, B. J. S. Pirie, and S. G. George.
Journal of Experimental Marine Biology and Ecology, Vol. 85, No. 1, p 37-45, January, 1985. 2 Fig, 1 Tab, 22 Ref.

Descriptors: *Oysters, *Metals, *Derwent Estuary, *Tasmania, Water pollution effects, Copper, Zinc, Calcium, Iron, Heavy metals, Estuarine environment.

Both urban and industrial activities on the Derwent Estuary, Tasmania have resulted in elevated levels of metals in oysters. Mature oysters (Crassostrea gigas) were removed from a commercial oyster farm and retained in a pond at Crayfish Point on the Derwent Estuary for 4 months. Tissues of the oysters were examined using electron microscopy and the cellular metal concentrations measured by X-ray microanalysis. All tissues contained elevated copper and zinc concentrations. Calcium, iron, copper and zinc were present in the tertiary lysosomes, except in reproductive tissues. Only occasional membrane-limited vesicles were present in the gonad, and these contained very low concentrations of metals. In comparison with other animals, oysters have highly elevated tissue concentrations of Cu and Zn. Copper and zinc were selectively accumulated in membrane-limited vesicles of blood amoebocytes to cellular concentrations of approximately 70 mM Cu and 390 mM Zn and these amoebocytes contain > 90% of the body copper and zinc. Even in the reproductive tissues of these oysters, where the membrane-limited vesicles were not apparent, concentrations of 7-10 mM Ca, 0.2-0.8 mM Fe, 10-18 mM Cu and 26-30 mM Zn were found, and these must therefore be due to an elevated cytoplasmic concentration. (Moore-IVI)
W85-05995

SEPARATED DISTRIBUTION OF THE TWO VARIETIES OF ACHNANTHES MINUTISSIMA KUETZ. ACCORDING TO THE DEGREE OF RIVER WATER POLLUTION,
Tokyo Gakugei Univ. (Japan). Dept. of Biology.
S. Mayama, and H. Kobayasi.
Japanese Journal of Limnology, Vol. 45, No. 4, p 304-312, October, 1984. 5 Fig, 1 Tab, 28 Ref.

Descriptors: *Diatoms, *Distribution, *Water pollution effects, *Japan, *Tokyo, Urban areas, Rivers, Benthos.

Achnanthes minutissima var. minutissima is generally regarded as pollution-sensitive, while A. minutissima var. saprophila is considered to be one of the most pollution-tolerant diatoms. The distributions of these varieties were investigated in detail in the river waters of Tokyo (Japan) and vicinity. A total of 141 samples of benthic diatoms was collected from 52 station on 25 rivers which were estimated a alpha-mesosaprobic, alpha-meso/polysaprobic and polysaprobic. During the same period, 29 samples of benthic diatoms were taken from 15 stations estimated to be oligosaprobic, oligo/beta-mesosaprobic and beta-mesosaprobic on the Tama-gawa and Minamiasa-kawa. A. minutissima var. saprophila was found in 115 samples taken from 19 rivers including 46 sampling stations out of 52 in Tokyo. A. minutissima saprophila was found only in heavily to excessively polluted waters and even occurred as dominant or subdominant taxon in some samples. It did not universally occur in heavily to excessively polluted waters in high proportion, and was not observed in 6 of the 25 rivers. Vigorous growth was observed in the strongly polluted stretch of the Minamiasa-kawa. (Moore-IVI)
W85-06001

PRELIMINARY STUDY OF AQUATIC INSECT COMMUNITIES AND LEAF DECOMPOSITION IN ACID STREAMS NEAR DOREST, ONTARIO,
Toronto Univ. (Ontario). Dept. of Zoology.
R. J. Mackay, and K. E. Kersey.
Hydrobiologia, Vol. 122, No. 1, p 3-11, March, 1985. 3 Fig, 4 Tab, 32 Ref.

Descriptors: *Aquatic insects, *Leaves, *Decomposition, *Acid streams, *Ontario, Acid precipitation, Water pollution effects, Caddisflies, Stoneflies, Midges, Mayflies, Hydrogen ion concentration, Snowmelt.

Some streams near Dorset in south-central Ontario suffer from acid precipitation via run-off and seepage from thin soils with little buffering capacity. A spring-summer survey of eight headwater streams revealed some characteristics of their insect communities which could be correlated with pH. The streams could be divided into three groups according to pH and community structure. In the most acid group (annual pH range 4.3-4.8), Ephemeroptera were absent from two streams although mature Leptophlebia were collected just after spring thaw from the most acid one (pH 4.3-4.5). One of these three streams also lacked Plecoptera but the others had two or three genera, all shredders. The second group of three streams (pH 5.0-6.3), with one exception, did support Ephemerop-

tera (3-4 genera) and Plecoptera (1-4 genera), most of the latter being shredders. In all six of these acid streams, Trichoptera were more diverse and more dense than Ephemeroptera and Plecoptera; again, shredders were clearly dominant, especially the limnephilid caddisfly, Frenesia difficilis (Walker). These six streams also had similar chironomid communities (densities were an order of magnitude higher than other insects). Dominance by Chironomini and abundant Tanypodinae typified the most acid streams. In contrast, the two streams in the third group (pH 5.3-6.7) had richer and more balanced communities in general with relatively fewer shredders (no Frenesia), more collectors, and fewer Chironomini and Tanypodinae. As a field experiment showed that autumn-shed leaves decomposed more slowly in acid than in non-acid streams, summer-growing shredders may benefit from the pulse of acidity at snowmelt. (Author's abstract)
W85-06003

PHYSIOGRAPHY AND LIMNOLOGY OF THREE LAKES IN THE ENVIRONS OF THE UNION TERRITORY OF DELHI, INDIA,
Delhi Univ. (India). Ecology and Experimental Taxonomy Lab.
For primary bibliographic entry see Field 2H.
W85-06012

MERCURIC CHLORIDE INTOXICATION IN FRESHWATER PRAWN, II; EFFECT ON PHOSPHATASES ACTIVITY,
Gorakhpur Univ. (India). Dept. of Zoology.
R. Murti, Omkar, and G. S. Shukla.
Ecotoxicology and Environmental Safety, Vol. 8, No. 6, p 581-586, December, 1984. 1 Tab, 31 Ref.

Descriptors: *Mercuric chloride, *Prawns, *Enzyme activity, *Toxicity, Acid phosphatase, Alkaline phosphatase, Glucose-6-phosphatase, Water pollution effects, Mercury compounds.

The effects of mercuric chloride intoxication on the activities of acid and alkaline phosphatases and glucose-6-phosphatase in the hepatopancreas of a freshwater prawn Macrobrachium lamarrei (H. Milne Edwards) were determined after 24, 48, 72, and 96 hr. Mercuric chloride intoxication resulted in elevation of acid phosphatase and inhibition of alkaline phosphatase activities, but glucose-6-phosphatase activity was elevated up to 72 hr after which (i.e after 96 hr of exposure) inhibition in the enzyme activity was noted at two higher concentrations. Alterations in the activities of these enzymes after mercuric chloride intoxication have been shown to adversely affect the general metabolism of the freshwater prawn. (Author's abstract)
W85-06016

GUIDE FOR ASSESSING WATER-QUALITY IMPACTS OF HIGHWAY OPERATION AND MAINTENANCE,
R. R. Horner, and B. W. Mar.
Transportation Research Record, Vol. 948, p 31-40, 1984. 5 Fig, 2 Tab, 43 Ref.

Descriptors: *Water quality, *Highways, *Environmental effects, *Runoff, Washington, Water pollution sources, Evaluation, Toxicity, Organic compounds, Metals, Rainfall.

A procedure for assessing highway runoff water quality has been formulated on the basis of a large data base that represents conditions prevalent in the state of Washington. The procedure consists of a component for predicting total pollutant loadings over an extended time period and a series of charts with which the impacts of individual events can be assessed probabilistically. A significant finding was that highway runoff in Washington State contains lower levels of contamination than general urban drainage and, in normal runoff events, does not have a substantial impact on the quality of receiving water. Limited problem areas were identified and thus a basis was provide for reducing mitigation costs overall and applying resources to those cases most in need of attention. (Baker-IVI)
W85-06068

HYDROGEOCHEMICAL ASPECTS OF SURFACE MINE RECLAMATION IN THE NORTHERN GREAT PLAINS,
North Dakota Mining and Mineral Resources Research Inst., Grand Forks.
For primary bibliographic entry see Field 4C.
W85-06076

EFFECTS OF FOUR AROMATIC ORGANIC POLLUTANTS ON MICROBIAL GLUCOSE METABOLISM AND THYMIDINE INCORPORATION IN MARINE SEDIMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. E. Bauer, and D. G. Capone.
Applied and Environmental Microbiology, Vol. 49, No. 4, p 828-835, April, 1985. 4 Fig, 3 Tab, 23 Ref.

Descriptors: *Aromatic compounds, *Bacterial metabolism, *Glucose, *Thymidine, *Sediments, Isotope studies, Microorganisms, Anthracene, Napthalene, Dichlorodiphenyltrichloroethane, Pentachlorophenol, Toxicity, Water pollution effects, Aerobic conditions, Anaerobic conditions, Bioindicators.

The metabolism of D-(U-C-14)glucose and the incorporation of (methyl-H-3)thymidine by aerobic and anaerobic marine sediment microbes exposed to 1 to 1,000 ppm anthracene, naphthalene, p,p'-dichlorodiphenyltrichloroethane, and pentachlorophenol were examined. Cell-specific rates of (C-14)glucose metabolism averaged 1.7 x 10 to the 21st power mol/min per cell for aerobic and anaerobic sediment slurries, respectively; (H-3)thymidine incorporation rates averaged 43 x 10 to the minus 24th power and 9 x 10 to the minus 24th power mol/min per cell for aerobic and anaerobic slurries, respectively. Aerobic sediments exposed to three of the organic pollutants for 2 to 7 days showed recovery of both activities. Anaerobic sediments showed little recovery after 2 days of pre-exposure to the pollutants. It is concluded that (i) anaerobic sediments are more sensitive than aerobic sediments to pollutant additions; (ii) (H-3)thymidine incorporation is more sensitive to pollutant additions than is (C-14)glucose metabolism; and (iii) the toxicity of the pollutants increased in the following order: anthracene, p,p'-dichlorodiphenyltrichloroethane, naphthalene, and pentachlorophenol. (Author's abstract)
W85-06143

CATASTROPHIC ANOXIA IN THE CHESAPEAKE BAY IN 1984,
Johns Hopkins Univ., Baltimore, MD. McCollum-Pratt Inst.
For primary bibliographic entry see Field 2L.
W85-06159

ERYTHROCYTIC AND LEUKOCYTIC RESPONSES TO CADMIUM POISONING IN A FRESHWATER FISH, PUNTIUS CONCHONIUS HAM,
D.S.B. Constituent Coll., Naini Tal (India). Dept. of Zoology.
T. S. Gill, and J. C. Pant.
Environmental Research, Vol. 36, No. 2, p 327-337, April, 1985. 12 Fig, 2 Tab, 35 Ref.

Descriptors: *Cadmium, *Fish, *Toxicity, Blood, Water pollution effects, Heavy metals, Chronic toxicity.

Chronically sublethal concentrations of cadmium caused conspicuous hematological anomalies in the cyprinid fish, Puntius conchonius. Exposure to 0.63 and 0.84 mg/liter cadmium chloride (1/20 and 1/15 of 96-hr LC50) induced morphological aberrations in mature erythrocytes including cytoplasmic vacuolation, hypochromia, deterioration of cellular membrane, basophilic stippling of cytoplasm, clumping of chromatin material and extrusion of nuclei, and schistocytosis. Anomalous basophils and monocytes were also encountered though less frequently. Decreased erythrocyte counts, hemoglobin and hematocrit values were also associated with chronic cadmium poisoning. The mean corpuscular hemoglobin and mean corpuscular volume increased (30 days) but mean corpuscular hemoglobin concentration showed no obvious change. A significant thrombocytopenia (90 days), elevated small lymphocyte and basophil populations, and a mild neutropenia were manifested in the cadmium-exposed fish. Large lymphocytes were not significantly affected. (Author's abstract)
W85-06167

EVALUATION OF CARBAMATE TOXICITY: ACUTE TOXICITY IN A CULTURE OF PARAMECIUM MULTIMICRONUCLEATUM UPON EXPOSURE TO ALDICARB, CARBARYL, AND MEXACARBATE AS MEASURED BY WARBURG RESPIROMETRY AND ACUTE PLATE ASSAY,
Wisconsin Univ.-Parkside, Kenosha.
C. E. Edmiston, Jr., M. Goheen, G. W. Malaney, and W. L. Mills.
Environmental Research, Vol. 36, No. 2, p 338-350, April, 1985. 9 Fig, 2 Tab, 27 Ref.

Descriptors: *Carbamates, *Toxicity, *Paramecium, Protozoa, Aldicarb, Carbaryl, Mexacarbate, Pesticide toxicity, Metabolism, Oxygen uptake, Respirometry.

The present study was undertaken to explore the acute toxicity of the three carbamate pesticides, aldicarb, carbaryl, and mexacarbate, on a population of Paramecium multimicronucleatum. The toxicity was evaluated by the Warburg respirometer and the static acute plate assay. Aldicarb, carbaryl, and mexacarbate were shown to significantly inhibit cumulative oxygen uptake at 24 hr in the paramecium culture at 160, 120, and 100 ppm, respectively. Aldicarb, carbaryl, and mexacarbate concentrations of 60, 20, and 10 ppm demonstrated no inhibition of cumulative oxygen uptake when compared to a paramecium control at 24 hr. Pesticide concentrations intermediate to the high and low concentrations demonstrated varying degrees of inhibition. Static plate assay data for aldicarb demonstrated LC50 values of 93, 104, 122, and 145 ppm at 24, 17, 13, and 9 hr, while carbaryl demonstrated LC50 values of 28, 34, 46, 65, and 105 ppm at 24, 17, 13, 9, and 7 hr, respectively. Mexacarbate LC50 values were 19, 25, 35, 57, and 83 ppm at 24, 17, 13, 9, and 7 hr. Oxygen uptake values compared favorably with the static assay data. Scanning electron micrographs demonstrated several morphologic changes in paramecium with increased pesticide concentration and exposure time including ciliary abnormalities and disruption of surface structure. (Author's abstract)
W85-06168

MERCURY, SELENIUM, ARSENIC AND ZINC IN WADERS FROM THE DUTCH WADDEN SEA,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
A. A. Goede.
Environmental Pollution (Series A), Vol. 37, No. 4, p 287-309, 1984. 6 Fig, 4 Tab, 60 Ref.

Descriptors: *Metals, *Birds, *Wadden Sea, *Netherlands, Mercury, Selenium, Arsenic, Zinc, Toxicity, Heavy metals, Water pollution effects.

The river Rhine carries pollutants, including heavy metals, to a large estuarine area, the Wadden Sea, off the Netherlands. The metal contamination of waders (knots, redshanks, and godwits) in the Wadden Sea was investigated using the primaries (feathers) formed in this area as a monitoring tissue. Elevated levels of mercury in feathers were found in adult waders. A cautious estimate for knots and redshanks from Schiermonnikoog gives at least a 5-fold elevation in concentration. Even though feather concentrations were high, liver and kidney concentrations were relatively low just after molt. A negative correlation was found between mercury and selenium in concentrations in the liver. Selenium may have been excreted via the feather oils which contaminated the feathers. All but one juvenile had no detectable amounts of arsenic in the shaft. Compared with these, the adults from the Wadden Sea had elevated levels. Significant differences in concentrations were

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noted in the different sampling years in redshanks and male godwits from Schiermonnikoog. In all juveniles from past and present samples, the range of vane zinc concentrations amounted to 100-400 mg/kg. In most cases significant positive correlations were found between arsenic concentrations in the kidney and in the liver. Similarly selenium concentrations in kidney were related to those in the liver and a negative correlation was found between selenium in the liver and mercury in the liver. (Baker-IVI)
W85-06169

LEAD AND CADMIUM IN WADERS FROM THE DUTCH WADDEN SEA,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
A. A. Goede, and P. de Voogt.
Environmental Pollution (Series A), Vol. 37, No. 4, p 311-322, 1984. 1 Fig, 3 Tab, 18 Ref.

Descriptors: *Waders, *Birds, *Lead, *Cadmium, *Wadden Sea, Heavy metals, Feathers, Pollutant identification, Water pollution effects, Zinc protoporphyrin.

The Wadden Sea is a large marine area in the northern part of the Netherlands and Federal Republic of Germany, and the western part of Denmark. The contamination of this area present a potential hazard for the many wader species present for the post-nuptual molt. In the Dutch Wadden Sea, three wader species (knot, Icelandic redshank, and bartailed godwit) were investigated for lead and cadmium concentrations, using mainly feathers as the monitoring tissue. The exposure to Pb was studied by means of a relatively new method, the zinc protoporphyrin concentration in the blood of the waders. The rapid accumulation of Pb in the vanes of juveniles after arrival in the Wadden Sea and the elevated levels the the adult vanes grown in this area indicate that waders are exposed to Pb. The situation with regard to cadmium did not seem to be serious. (Moore-IVI)
W85-06170

WATER QUALITY VARIATIONS AND CONTROL TECHNOLOGY OF YAMUNA RIVER,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava.
Environmental Pollution (Series A), Vol. 37, No. 4, p 355-376, 1985. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Water quality, *Yamuna River, *India, *Water quality control, Seasonal variation, Rivers, Water pollution sources, Water pollution effects, Water pollution control, Wastewater pollution, Pollution load.

The Yamuna River (India) is one of the important rivers of the Indogangetic plain. A water quality survey of the Yamuna River was undertaken to determine the variations in the quality of this river along its course during both summer and winter. There is considerable human activity along the course of the river, including domestic, commercial, agricultural and industrial activities, and, as a result, different types of waste material enter the river, continuously altering its water quality. A water quality index representing the integrated effect of the concentrations and relative importance of the parameters is used to denote degradation of the river quality. Stretches of the river are identified which require quality upgrading. A comprehensive strategy is presented for improving the water quality of the river. The defensive approaches would aim at reducing the pollution load on the river through proper planning, treatment and disposal of wastewater. The offensive approaches should aim at the fullest exploitation and improvement in the waste assimilative capacity of the river, so that the river quality can be enhanced. (Moore-IVI)
W85-06171

5D. Waste Treatment Processes

EFFECT OF PH ON THE UPTAKE OF ZINC, COPPER AND NICKEL FROM CHLORIDE SOLUTIONS BY AN UNCONTAMINATED SEWAGE SLUDGE,
Rothamsted Experiment Station, Harpenden (England). Dept. of Soils and Plant Nutrition.
T. McM. Adams.
Environmental Pollution (Series B), Vol. 9, No. 2, p 151-161, 1985. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Sludge, *Zinc, *Copper, *Nickel, *Hydrogen ion concentration, Cation exchange, Adsorption, Heavy metals, Wastewater treatment, Complexation.

The uptake of zinc, copper and nickel by an uncontaminated sewage sludge was studied as a function of added metal concentration and of pH. The quantity of metal taken up at constant pH increased with added metal concentration up to an apparent saturation value in some cases, but the data did not fit Langmuir or Freundlich adsorption isotherms closely. The proportion of total metal in the solution phase at a given pH in these uptake experiments was generally larger than that in the solution phase in comparable experiments involving the release of the metals into solution from metal-contaminated sludges, to which the metals had been added during sewage treatment. Differences between the cation exchange capacity of uncontaminated and of metal-loaded sludges were used to calculate the amount of metal held on cation exchange sites by complexation in the metal-loaded sludges. The amount of exchangeable metal was determined by displacement with barium. The proportion of total metal held on the sites in exchangeable and complexed forms in metal-loaded sludges is 52% of zinc, 71% of copper and 92% of nickel. (Author's abstract)
W85-05977

PROGRESS IN MUNICIPAL PHOSPHORUS CONTROL,
Windsor Univ. (Ontario). Great Lakes Inst.
For primary bibliographic entry see Field 5G.
W85-05981

PRELIMINARY TREATMENT OF CHEMICAL WASTEWATER BY MEANS OF SEDIMENTATION AND PRESSURE-RELEASE FLOTATION (VORKLARUNG VON CHEMIEABWASSER DURCH SEDIMENTATION UND ENTSPANNUNGSFLOTATION),
Hoechst A.G., Frankfurt-am-Main (Germany, F.R.). Verfahrenstechnik.
H. Bennoit.
Chemie Ingenieur Technick, Vol 57, No. 2, p 158-159, February, 1985. 2 Fig, 4 Ref.

Descriptors: *Industrial wastewater, *Sedimentation, *Pressure-release flotation, Wastewater treatment, Flotation, Wastewater inflow, Hydraulic surface load, Solids reduction.

Pressure-release flotation (PRF) was compared with sedimentation for preliminary treatment of insoluble components of chemical wastewater with highly variable levels of pollution. A continuous wastewater-treatment facility (maximal capacity 12 cu m/hr) was used, consisting of a first chemical/physical-treatment stage (precipitation and two-stage neutralization to pH 8-9) and a second stage in which wastewater is divided, passing through a 4.5-cu-m vertical-flow thickening tank and a 1.5-cu-m rectangular flotation facility. A relatively constant separation level of 90-98% was seen with PRF at 20% pressurized-water input and 4-bar saturation pressure with a wastewater inflow of 4 cu m/sq m h; at 3 cu m/sq m h, values were close to 98%, denoting a 2-10 mg/l concentration of undissolved solids in treated wastewater. The flotation facility reached a limit in efficiency at wastewater inflow/hydraulic surface load of 5-6 cu m/sq m h with resulting flow-through time of 15 min. Variation of the two control parameters in pressurized-water application did not result in improved separation levels; eg, 30% pressurized-water input resulted in solids reduction in outflow of only 68-80% (due to an excessively high surface load of 6.5 cu m/sq m h). (Gish-IVI)
W85-05983

REMOVAL OF METALS FROM SLUDGE USING CHITOSAN COLUMNS,
Cornell Univ., Ithaca, NY. Dept. of Food Science.
T. Yang, and R. R. Zall.
Industrial Water Engineering, Vol. 21, No. 4, p 16-20, July/August, 1984. 10 Fig, 2 Tab, 13 Ref.

Descriptors: *Sludge treatment, *Metals, *Chitosan, Wastewater treatment, Water pollution control, Sludge, Copper, Zinc, Cadmium, Chromium, Lead.

The feasibility of using chitosan columns to remove selected metals from sludge was investigated. Column performance was evaluated on the basis of breakthrough curves. In addition, different operational factors such as particle size, bed depth, flow rate, influent concentration and pH were studied. The work was limited to the removal of selected metals using chitosan in bench-top studies with a laboratory size column. The project provides information which may contribute to the development of column systems with chitosan for use as a tertiary treatment process. Four liters of a solution with 100 ppm concentration of each of the test metals, Cu, Zn, Cr, Cd, and Pb, were introduced to the bottom of the column. The study indicated that a column system charged with chitosan is able to be used to remove metals from sludge. (Baker-IVI)
W85-05994

LAND TREATMENT OF WASTES: CONCEPTS AND GENERAL DESIGN,
Texas Univ. at Austin.
R. C. Loehr, and M. R. Overcash.
Journal of Environmental Engineering, Vol. 111, No. 2, p 141-160, April, 1985. 3 Fig, 8 Tab, 7 Ref.

Descriptors: *Land disposal, *Wastewater treatment, *Waste treatment, Municipal wastes, Industrial wastes, Decision making, Costs, Evaluation, Data acquisition, Site selection.

Land treatment is a managed treatment and ultimate disposal process that involves the controlled application of a municipal or industrial waste to a soil or soil-vegetation system. The objective of land treatment is the biological degradation of organic waste constituents and the immobilization of inorganic waste constituents. The design methodology for land treatment includes several stages of data acquisition, waste and site evaluation, and consideration of approaches to minimize total system costs. The limiting constituent concept is identified as the basis of successful design and operation of land treatment systems. The concept provides a standard methodology for considering important site-specific soil data, climatic conditions, waste characteristics, and environmental concerns. It is based upon the nondegradation concept and embodies information from many disciplines to avoid adverse environmental impacts. Land treatment can be used with wastes that have different characteristics and land limiting constituents. This approach can be used with any waste to determine the technical and economic feasibility of this technology. (Moore-IVI)
W85-06018

PRACTICAL STEPS LEADING TOWARD THE EFFLUENT-FREE MILL,
Sappi Ltd., Johannesburg (South Africa).
B. Coetzee, C. J. Davies, F. E. Mera, and L. K. Swift.
Tappi Journal, Vol. 68, No. 4, p 92-97, April, 1985. 6 Fig, 4 Tab, 3 Ref.

Descriptors: *Pulp and paper industry, *Water pollution control, *Design criteria, Industrial wastes, Water quality control, Water management, Water reclamation.

A new, 1500 ton/day, totally integrated, multigrade bleached kraft pulp mill is designed to operate with what may be the lowest effluent discharge of any similar mill in the industry. The Ngodwana mill in South Africa operates under a unique set of environmental constraints, with some of the most modern technologies and innovative measures

having been applied to minimize water usage. Two major drawbacks at the mill include the limited nature of the water supply and the fact that no receiving stream or body of water could be used for disposing of effluent emanating from the mill. At the facility unbleached chemical pulp is produced on both the existing 300-ton/day fiber line and a new continuous fiber line rated at 750 tons/day. The fiber line is followed by an OD/CED bleach plant that can produce fully bleached or semibleached pulp. Additional pulp furnished is provided by a 330-ton/day groundwood mill utilizing both atmospheric and stone grinders and a secondary fiber plant rated at 100 tons/day. Design features employed at the mill to minimize water requirements include spill collection systems, closed seal water systems, evaporator condensates, cooling towers, closed vacuum pump cooling systems, paper machines, OD/CED bleaching, and a number of built in options. (Baker-IVI)
W85-06058

TEN YEARS OF EXPERIENCE WITH SUBSURFACE INJECTION,
Black and Veatch, Aurora, CO.
S. B. Smith, C. P. Houck, and J. L. Smith.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1771-1779, November-December, 1984. 1 Fig, 10 Tab, 12 Ref.

Descriptors: *Subsurface injection, *Wastewater disposal, Heavy metals, Environmental impact, Sludge disposal, Groundwater contamination, Crop production.

The subsurface injection of sludge has proven to be a viable operation that conserves natural resources. Fifteen different sites have been developed, and the operational components of each site are discussed, including management techniques and equipment selection for inclement weather conditions. Several sites have been further evaluated for environmental effects including ground water, soil, crop, and percolate quality. Analyses results indicate that heavy metals applied in the sludge have been retained in the soil and have not been available for plant uptake on near-neutral pH soils and that there has been no detectable degradation of the environment caused by the application of sludge. (Author's abstract)
W85-06086

MULTISPECIES MODEL OF BIOLOGICAL TREATMENT WITH SEQUENTIAL POLLUTANT OXIDATION,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. B. Vasiliev, and V. A. Vavilin.
Biotechnology and Bioengineering, Vol. 27, No. 4, p 490-497, April, 1985. 6 Fig, 2 Tab, 7 Ref.

Descriptors: *Biological wastewater treatment, *Model studies, *Oxidation, Activated sludge process, Microorganisms, Wastewater treatment, Pollutant load.

A multicomponent multispecies biological treatment model of biological wastewater treatment was used to study sequential pollutant oxidation. Under a sequential oxidation mechanism there will be adjustments of species distribution in sludge to the particular operational regime of a treatment plant. The effects of such adaptation under sequential and under simultaneous oxidation mechanisms would be generally similar. The steady-state distribution of species in activated sludge is dependent on the level of organic loading. Under large loadings, fast-growing species will predominate in the sludge microflora, while at low loadings, the slow-growing one will predominate. Under periodic loading variations, an adjustment of the species distribution to the average loading level will take place. (Moore-IVI)
W85-06166

5E. Ultimate Disposal Of Wastes

TEN YEARS OF EXPERIENCE WITH SUBSURFACE INJECTION,
Black and Veatch, Aurora, CO.
For primary bibliographic entry see Field 5D.
W85-06086

5F. Water Treatment and Quality Alteration

ENVIRONMENTAL HEALTH INVESTIGATION OF COPPER INTOXICATION FROM A PUBLIC WATER SUPPLY,
Vermont State Dept. of Health, Burlington. Div. of Environmental Health.
H. E. Sargent, and H. Jean.
Journal of the New England Water Works Association, Vol. 98, No. 4, p 347-362, December, 1984. 1 Fig, 3 Tab, 6 Ref.

Descriptors: *Public health, *Copper, *Drinking water, *Jeffersonville, *Vermont, Water pollution effects, Toxicity, Pipes, Water distribution, Corrosion.

An environmental investigation is presented of drinking water induced copper toxicosis in a family served by the Jeffersonville, Vermont water system. A 500 ft long type K copper main serves five homes on a deadend street. Family A, at the end, is the family which reported alleged problems on ingesting the village water. The average copper content of all 423 public supplies in Vermont at their sources is 0.046 mg/L. The average of all yearly distribution samples is 0.983 mg/L, suggesting that copper is commonly used as a pipe material in Vermont and that the water is to some degree aggressive. Samples of water taken from the home of Family A showed a range of 2.8 to 7.8 mg Cu/l which caused the village trustees to decide to replace the 500 feet of copper main. The father and two daughters often became ill 5 to 20 minutes after drinking water. While blood levels of copper were normal for family A, hair samples showed elevated copper levels and a nail clipping also showed elevated copper levels. The village also reviewed the aggressive nature of their water in efforts to reduce this through chemical treatment. Until such steps are taken all residents have been advised to run their water for a minute on first use each morning to clear the line of any accumulated copper and lead. (Baker-IVI)
W85-05913

ALUMINUM IN DRINKING WATERS,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
W. Sung, W. J. Gallot, R. Gottlieb, and D. A. Viscardi.
Journal of the New England Water Works Association, Vol. 98, No. 4, p 363-389, December, 1984. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Aluminum, *Drinking water, *Alum, *Water treatment, Coagulation, Turbidity, Color, Hydrogen ion concentration, Temperature effects, Public health.

Aluminum, in the form of alum, an aluminum sulfate, is often used in water treatment plants in the coagulation process for removing color and turbidity. Recent advances on the conceptual developments on color and turbidity removal mechanisms with alum are reviewed. An optimum control strategy has been developed for color and turbidity removal. Equilibrium calculations are used in the interpretation of observed aluminum behavior. The total amount of residual aluminum leaving a water treatment plant includes dissolved and particulate aluminum. Dissolved aluminum is determined by pH, the presence of ligands and temperature while the amount of particulate aluminum is dependent on the actual performance of sedimentation and filtration. In jar tests in this study the residual aluminum ranged from about 20 to 80 micro-g/l and consisted of both dissolved and particulate aluminum. (Baker-IVI)
W85-05914

TARGETED CHLORINATION IS VIABLE AND ENVIRONMENTALLY ACCEPTABLE,
Tennessee Valley Authority, Chattanooga.
R. D. Moss, S. P. Gautney, and P. A. March.
Power, Vol. 129, No. 2, p 79-81, February, 1985. 5 Fig, 13 Ref.

Descriptors: *Chlorination, *Water treatment, *Cooling water, Biofouling, Powerplants, Economic aspects, Effluents, Targeted chlorination, Condenser tubes.

Potential plugging of condenser tubes makes biological fouling a leading problem in cooling-water systems. Chlorine is an effective biocide, but concern for adverse environmental effects of escaping residual chlorine has fostered efforts to optimize application efficiencies while limiting chlorine in effluents to tolerable levels. The concept of targeted chlorination (TC) is to sequentially chlorinate a few condenser tubes at a time, using high enough chlorine concentrations to destroy micro-organisms present in those tubes. By mixing the small amount of discharged chlorinated water with the rest of the cooling water at the condenser outlet, the concentration at the plant discharge can be held within EPA limits. A 1:6-scale model of the Kingston condenser was built to provide velocity data, flow-distribution data, and concentration data regarding three types of TC systems: manifold against tubesheet, nozzles in inlet pipes, and nozzles in the inlet waterbox. A full-scale mockup test was conducted to ensure that all the mechanical parts functioned as designed. An economic evaluation was conducted to assess the costs of various alternatives for treatment to meet EPA effluent limits. (Baker-IVI)
W85-05916

APPLICATION OF A NEW ENVIRONMENTALLY ACCEPTABLE COOLING WATER TREATMENT,
T. W. Isaac, A. J. Korvin, and R. S. Klonowski.
Industrial Water Engineering, Vol. 21, No. 3, p 18-23, May-June, 1984. 9 Fig, 5 Tab, 10 Ref.

Descriptors: *Industrial water, *Water treatment, *Cooling water, Corrosion control, Organophosphonates, Triazoles, Polymers.

Cooling water corrosion inhibitors which provide effective control and have negligible effect on the environment are in great demand due to the increasingly stringent limitations being placed on industrial effluents by various agencies. A specific blend of chlorine resistant organophosphonate in combination with a triazole and a low molecular weight polymeric diol is evaluated. The key ingredient is the polymeric compound which enhances the synergistic corrosion inhibition of organophosphonate with triazole in both alloy metal and steel systems. A large number of different polymeric diols in combination with phosphonate and triazole were initially screened for corrosion inhibition potential. (Baker-IVI)
W85-05991

WHY OZONE IS A VIABLE ALTERNATIVE TO CHEMICALS FOR THE TREATMENT OF COOLING TOWER AND HEAT EXCHANGER WATER,
United States Ozonair Corp., South San Francisco, CA.
K. Stopka.
Industrial Water Engineering, Vol. 21, No. 3, p 24-29, 1984. 3 Tab.

Descriptors: *Cooling water, *Industrial water, *Water treatment, *Ozone, Heat exchangers, Water pollution control, Disinfection, Blowdown, Turbidity.

The occurrence in cooling towers of various pathogens such as the one responsible for Legionnaires' Disease and the ineffectiveness of chemical treatment against these pathogens, has prompted the investigation of ozone as a viable alternative to chemical treatment. The advantages of ozone over chemical treatment are: elimination of blow down, prevention of algae growth and scale, complete control of microbial life, simplicity of operation and very little maintenance, no pH control, no storage of chemicals or hazards; and, depending on

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he size of the cooling tower, economic payback in a reasonable period of time. Experience with ozone n the treatment of cooling tower water is briefly eviewed. Besides highly efficient sterilization, mi-roflocculation which takes place after ozonation nd the removal of organic slime are the main easons why, a year later, without a single blow down, the turbidity of the ozonated water is supe-ior to chemically treated city water. (Baker-IVI)
W85-05992

REVERSE OSMOSIS MEMBRANE FOULING AND PRETREATMENT CONSIDERATIONS,
For primary bibliographic entry see Field 3A.
W85-05993

OPTIMAL EXPANSION OF WATER DISTRIBUTION SYSTEMS,
Visvesvaraya Regional Coll. of Engineering, Nagpur (India). Dept. of Civil Engineering.
P. R. Bhave.
Journal of Environmental Engineering, Vol. 111, No. 2, p 177-197, April, 1985. 4 Fig, 5 Tab, 27 Ref, 1 Append.

Descriptors: *Water conveyance, *Optimization, *System expansion, Systems engineering, Pipes, Tunnels, Looped systems, Design.

Water distribution systems can be of the branching type generally used for small communities, or of the looped type used mostly for urban areas. The discharge in the links of looped distribution systems cannot be fixed uniquely; therefore, their optimal design is rather difficult. A method for the optimal expansion of water distibution systems subjected to a single loading pattern is developed. The method optimally decides the pumping heads at new source nodes, if any, and also optimally selects the links which need strengthening to improve the delivery capability of the existing system. The method is iterative and converges rapidly to a local but fairly good optimal solution. Optimization of an entirely new distribution system is a particular characteristic of this general approach. The method is also suitable for hand calculation for small systems. The method is illustrated through an example and application to the New York City water supply tunnel system. The procedure can possibly be extended to time-varying conditions, such as are found in actual practice. (Moore-IVI)
W85-06020

SOURCE OF DEIONIZED WATER FOR HIGH-PRESSURE STEAM,
Sybron Chemical Div., Birmingham, NJ.
F. X. McGarvey, M. Moldofsky, and S. Beran.
Tappi Journal, Vol. 67, No. 8, p 58-61, August, 1984. 7 Fig, 3 Tab, 10 Ref.

Descriptors: *Pulp and paper industry, *Water management, *Deionized water, Engineering, Design criteria, Industrial water, Water quality, Ion exchange processes, Purification, Water treatment.

Paper mills use a lot of water, frequently demanding more than 20,000 gal/ton of finished paper products. Water usage has become more efficient in recent years but the trend to high pressure steam generation has placed special demands on the water quality to be used for boiler feed. Mill locations are such that sources of good quality water are quite limited. Field experiences in treating these waters relate particularly to organic fouling of strong base resins, the removal of colloidal silica by macroporous strong base resins, and economic evaluation of the ion-exchange process. An accurate analysis of inorganic salts is an important requirement for the design of a plant to produce a high quality deionized water. Treatment for organic substances and silica is also reviewed and a typical paper mill feedwater system is diagrammed. (Baker-IVI)
W85-06061

SURVEY OF THE USE OF ACTIVATED CARBON WATER FILTERS IN CANADIAN HOMES,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
R. S. Tobin, E. A. Junkins, and F. E. Eaton.
Canadian Journal of Public Health, Vol. 75, No. 5, p 384-387, September-October, 1984. 3 Tab, 18 Ref.

Descriptors: *Activated carbon, *Domestic water, *Canada, *Filters, Surveys, Water treatment, Public health.

Activated carbon filters are used in many Canadian homes to improve the asthetic qualities of water and to remove some chemical constituents. The filtering mechanism of activated carbon provides a rich nutrient base derived from the water for any entrapped bacteria that can subsequently multiply and be released into the effluent water. As part of the evaluation of the possible health risk from the use of activated carbon in home water treatment devices, a survey was conducted to estimate how many Canadians use activated carbon filters and to determine how they are used. Filters containing activated carbon are used in 1.4% of all households in the 16 cities surveyed. In these centers, about 160,000 people are exposed to water that has passed through activated carbon filters, by direct ingestion of water or in drinks, contamination of food, inhalation of aerosols, contact with wounds or skin, immersion of the body while bathing or in the shower, and by contamination of humidifiers and vaporizers. (Author's abstract)
W85-06102

REDUCING THE COST OF HIGH TECHNOLOGY WATER TREATMENTS,
J. Cross.
Water and Waste Treatment, Vol. 28, No. 3, p 33-34. March, 1985. 3 Fig.

Descriptors: *Water treatment, *Economic aspects, Pretreatment, Membrane processes, Reverse osmosis, Ultrafiltration, Pharmaceutical industry, Beverage industry, Industrial water.

Pretreatment can cut replacement of the various parts or a water treatment system. To reduce fouling of the membrane in a reverse osmosis (RO) process, which should reduce the output and quality of the permeate, the feedwater to RO plants must be pretreated. The design of the pretreatment package will be determined largely by the quality of the raw water, in particular, the total hardness, the level of dissolved iron and the degree of colloidal contamination. In ultrafiltration systems, an automatic flushing mechanism should be included which ensures that the modules are regularly backwashed. Both reverse osmosis and ultrafiltration membranes are able to retain the large contaminants found in water supplies. Both can thus be used to extend the lifespan of downstream submicron filters with substantial savings in the cost of replacements. Case histories of cost reduction measures are examined for a boiler feedwater system, the soft drinks industry, and the pharmaceutical industry. (Baker-IVI)
W85-06123

TRENDS IN DRINKING WATER TREATMENT; THE SHAPE OF THINGS TO COME - PART I, REGULATORY DIRECTION,
Metcalf and Eddy of New York, NY.
G. P. Fulton.
Public Works, Vol. 116, No. 4, p 55-57, April, 1985. 3 Tab.

Descriptors: *Water quality control, *Drinking water, *Regulations, Public participation, Water management, Organic compounds, Pesticides, Particulates, Pathogens.

In the late 1960s and early 1970s the development of new analytical equipment and procedures enabled minute quantities of potentially harmful compounds present in water supply sources to be discerned. In the area of organic contaminants, much controversy has been generated with the result that the water supply industry has delayed decision on the handling of the organic contaminant problems except for three groups of such constituents: total trihalomethanes, herbicides and pesticides. Public concern and pressures have each played a part in the growing pressures placed on water treatment authorities. Water quality and treatment directions are reviewed for the areas of esthetics, particulates, pathogens, inorganics, and organics. (Baker-IVI)
W85-06124

RELATIVE RESISTANCE TO CHLORINE OF POLIOVIRUS AND COXSACKIEVIRUS ISOLATES FROM ENVIRONMENTAL SOURCES AND DRINKING WATER,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment, M. Tremblay, and M. Trudel.
Applied and Environmental Microbiology, Vol. 49, No. 4, p 981-983, April, 1985. 1 Tab, 3 Ref.

Descriptors: *Chlorine, *Poliovirus, *Coxsackievirus, *Viruses, *Drinking water, *Disinfection, Water treatment, Enteroviruses.

Several poliovirus and coxsackievirus isolates from environmental sources were compared with laboratory strains to determine their rate of inactivation by chlorine. All viruses were tested for up to 1,000 min in the presence of an initial free residual chlorine level of ca. 0.4 mg/liter. Coxsackievirus B5 (CB-5) isolates were found to be more resistant to chlorine than coxsackievirus B4 (CB-4), followed by poliovirus 1, 2, and 3 in order of decreasing resistance to chlorine. Environmental isolates of CB-5 were more resistant than the laboratory strain tested, and for two strains 12 and 22% of the input virus was still infectious after 100 min in the presence of free residual chlorine. Although CB-4 isolates were less resistant to chlorine than CB-5 isolates, isolates from environmental sources did not appear to be more resistant to chlorine than laboratory strains. Viruses isolated at different phases during the preparation of drinking water were not more resistant to chlorine and must thus have been protected by other mechanisms. (Author's abstract)
W85-06147

5G. Water Quality Control

AQUIFER PROTECTION PLANNING: GROUNDWATER PROTECTION IN TWO MASSACHUSETTS COMMUNITIES,
Lexington, KY.
S. M. Kilner, W. J. Rizzo, and J. F. Shawcross.
Journal of the New England Water Works Association, Vol. 98, No. 4, p 325-346, December, 1984. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Groundwater protection, *Drinking water, *Burlington, *Littleton, *Massachusetts, Decision making, Water quality control, Aquifers, Water pollution control.

The Aquifer Protection Plans of two communities, Burlington and Littleton, Massachusetts, were developed for different reasons. The stimulus in Burlington was predominantly remedial as it had lost one of its wells to trichloroethylene contamination. The objective in Littleton was primarily preventive; the community was in the process of selecting a new well site and wanted to assure the long term protection of its quality. Attention is given to the planning process to be used in aquifer protection decision making problems, sampling programs to identify the contamination source in Burlington, regulations of concern, implementation and enforcement of new regulations, steps to be taken in selecting a location for a new well, and the protection plan. The most profound conclusion that was drawn from the study was that the traditional approach to well siting and groundwater protection is inadequate. A second conclusion is that of the need for regional treatment and protection of groundwater quality. It was also apparent that despite the sanctity and acceptance of the need for safe drinking water, the process of actually protecting it is fraught with controversy, and compromises are inevitable. The matter of the cost of administering the protection program is also considered. (Baker-IVI)
W85-05912

TARGETED CHLORINATION IS VIABLE AND ENVIRONMENTALLY ACCEPTABLE,
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 5F.
W85-05916

AGRICULTURAL NONPOINT POLLUTION CONTROL: AN ASSESSMENT,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden, and D. L. Uchtmann.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 23-26, January-February, 1985. 33 Ref.

Descriptors: *Water pollution control, *Agriculture, *Nonpoint pollution sources, Sediment transport, Water quality control, Soil conservation, Legislation, Regulations.

Links between agriculture and water quality are both obvious and elusive. General relationships are easy to accept, but far less is known about the underlying hydrological or biochemical processes. EPA reported that water quality conditions remained stable for most bodies of water in the US between 1970 and 1980. The traditional soil conservation agencies dominate most state programs for reducing nonpoint agricultural pollution. Important changes concerning the availability of conservation agency services have been induced mainly by the new environmental responsibilities. In some states conservation agencies have exhibited renewed interest in watershed based planning and assessment of their activities. States are ultimately responsible for upgrading water quality. To that end, 39 states have created purely voluntary programs for reducing nonpoint source pollution from agriculture. Congress is again considering revisions in the Federal Water Pollution Control Act. Voluntary programs face formidable obstacles. Regulatory programs can better pinpoint abatement efforts and motivate action where cooperation is not volunteered. A mixture of assistance and mandatory provisions, like those now used in 11 states, seems to address policy most effectively. (Baker-IVI)
W85-05942

POLICIES FOR NONPOINT-SOURCE WATER POLLUTION CONTROL,
Resources for the Future, Inc., Washington, DC. Quality of the Environment Div.
W. Harrington, A. J. Krupnick, and H. M. Peskin.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 27-32, January-February, 1985. 3 Fig, 17 Ref.

Descriptors: *Policy, *Water pollution control, *Nonpoint source pollution, Water quality control, Decision making, Political aspects.

Point source water pollution controls alone are insufficient to meet the objectives of the Clean Water Act. The failure of existing policies to reduce nonpoint pollution, together with the inability of point-source control policies alone to achieve water quality objectives has rekindled interest in workable nonpoint-source control policies. The policy options for nonpoint source pollution control include volunteerism, command and control policies, economic incentives, adjustment of other government policies, and cross-compliance with other federal programs. Governmental responsibilities for implementing pollution control policies are briefly considered along with a means for selecting a policy approach. (Baker-IVI)
W85-05943

PAYING THE NONPOINT POLLUTION CONTROL BILL,
Michigan State Univ., East Lansing. Dept. of Agricultural Economics.
L. W. Libby.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 33-36, January-February, 1985. 2 Fig, 8 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Economic aspects, Farming, Erosion, Runoff, Political aspects.

Agricultural nonpoint pollution happens because of what farmers and other users do or fail to do on the land. The first step in discussing the distribution of costs for nonpoint pollution control requires identifying key people involved. First, those whose actions inadvertently cause nonpoint pollution such as the farmers when erosion and runoff from farms is the cause. A second category of interested parties include those whose livelihood depends on farmers including the agricultural business at both the input and output ends of farm production. Third are groups and individuals currently bearing the impacts of nonpoint pollution. A fourth category are those paid to care about nonpoint pollution - officials of federal, state, and local governments. Achieving a satisfactory reduction in nonpoint pollution will cost money with the amount depending on the method taken. Alternative approaches include the benefits-received approach, the ability-to-pay approach, and mandatory soil conservation measures. In the future there must be greater coherence among the national and local governmental agencies involved. (Baker-IVI)
W85-05944

STATE INITIATIVES IN NONPOINT-SOURCE POLLUTION CONTROL,
Association of State and Interstate Water Pollution Control Administrators, Washington, DC.
R. Savage.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 53-54, January-February, 1985. 1 Fig, 1 Tab.

Descriptors: *Nonpoint pollution sources, *Water pollution control, Planning, Mining, Management, Agriculture, Water quality, Water pollution sources, Regulation.

The Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) represents the interests of state, interstate, and territorial officials who administer water quality programs. This group recently investigated water quality progress over the 10 year period from 1972 to 1982. The need was identified for more comprehensive evaluation of nonpoint-source pollution problems and more aggressive implementation of control programs. A nonpoint source pollution survey was initiated to further define needs and methods for evaluating the impacts of nonpoint source pollution. Nearly all the states responded that they use of mix of federal, state and local programs to address nonpoint source pollution problems. Most states use both voluntary and regulatory programs for mining, construction, and urban nonpoint sources, while virtually all states rely on the educational/voluntary approach for agricultural sources. (Baker-IVI)
W85-05946

NONPOINT POLLUTION CONTROL: THE WISCONSIN EXPERIENCE,
Wisconsin Dept. of Natural Resources, Madison. Nonpoint Source and Land Management Section.
J. G. Konrad, J. S. Baumann, and S. E. Bergquist.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 55-61, January-February, 1985. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Wisconsin, Planning, Decision making, Management, Water quality,.

Three premises undergird the Wisconsin program. First, because pollutants can originate from many different nonpoint sources, effective controls must be comprehensive. Second, because of the comprehensive nature of the Wisconsin nonpoint-source control program, the goals of soil conservation programs are not the same as the state's water quality goals. Third, a nonpoint-source pollution control program is, by definition, a water quality program. Six years of program experience have shown that the successful blend of many agencies and units of government results in a comprehensive program that assures the achievement of nonpoint-source pollution control objectives. Major program objectives are to identify the most effective approach for achieving specific water quality objectives and to provide adequate financial and technical assistance to landowners and operators for the installation of approved nonpoint source control practices; to provide coordination between nonpoint source pollution control efforts and other elements of the state's water quality program; and to focus limited technical and financial resources in critical geographic areas. Six criteria were used to determine which watershed projects must receive priority management concern: the severity of water quality problems, the magnitude of the pollutant load likely causing the pollution and the potential to reduce that load significantly; landowners' willingness to participate in the program; the willingness and capability of local agencies to carry out their role in the program; the willingness and capability of local agencies and units of government to control other sources of pollution; and the potential public use and benefits that will result from the proposed watershed project. (Baker-IVI)
W85-05947

CONSERVATION DISTRICT ROLE IN NONPOINT POLLUTION CONTROL,
National Association of Conservation Districts, Washington, DC.
M. M. Garner, and R. E. Williams.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 62-64, January-February, 1985. 1 Fig, 5 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Conservation districts, Water quality control, Management, Decision making.

The essential elements of successful water quality management programs are obvious - research, information and education, technical assistance, cost-sharing, and often a regulatory authority for unusual problems. Conservation districts have neither the expertise nor the resources to be self-sufficient. What they do have is broad authority to plan and carry out programs for soil and water conservation. In a growing number of states, this authority includes responsibility for certain aspects of water quality. These additional responsibilities make close cooperation and mutual effort with water quality management agencies mandatory. Districts realize that with the advent of water quality as a national concern they are dependent on other than traditional soil conservation agencies for expertise and cooperation. Conservation districts create interest, organize efforts, and achieve harmonious coordination of multiple agency involvement in the solution of nonpoint source pollution problems. If nonpoint source pollution problems are to be controlled effectively, conservation districts must reach out to all agencies and organizations that can contribute expertise, resources and time for cooperative efforts. Their ability to do this will determine, in large measure, not only their own effectiveness but the success of local people in achieving natural resource conservation. (Baker-IVI)
W85-05948

SETTING AGRICULTURAL POLLUTION CONTROL PRIORITIES,
Idaho Soil Conservation Commission, Boise.
L. L. Holstine, and S. M. Lowman.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 65-67, January-February, 1985. 1 Fig, 1 Tab.

Descriptors: *Water pollution control, *Agriculture, *Priorities, *Idaho, Soil erosion, Watersheds, Grazing, Cost-sharing, Public participation.

An important part of the program for pollution control in Idaho has revolved around the setting of priorities. Emphasis was put on concentrating efforts in those areas with severe impacts from farming and grazing activities. The commission contacted the 51 conservation districts in the state, asking each to identify soil erosion problems. This compilation of identified erosion problems and affected stream segments was then circulated for public review and input. Meetings were held to involve local people familiar with the land and water in question. After evaluating and incorporating the changes from the public input the division and commission analyzed whether the impact of

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agricultural activities was severe, moderate, or slight, based on the division's segment priority list. To date nine projects have been funded in high priority watersheds. The process used to set priorities for the state cost-sharing program involved the same agencies, but it also involved a specific rating system. Potential projects identified as a public health emergency need no further rating as this section has the highest number of points possible for priority setting. (Baker-IVI)
W85-05949

SELECTING CRITICAL AREAS FOR NONPOINT-SOURCE POLLUTION CONTROL,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. P. Maas, M. D. Smolen, and S. A. Dressing.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 68-71, January-February, 1985. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, Agriculture, Soil erosion, Water pollution sources, Fertilizers, Animal wastes, Conservation.

Guidelines for selecting critical areas for nonpoint source pollution control can be established with the help of what is currently known about pollutant transport processes. There are two distinct critical area perspectives: the land resource perspective and the water resource perspective. Although each specific pollution control project probably requires somewhat unique appropriate criteria, guidelines can be established for most situations. Attention must be given to the type of water resource impairment, erosion rate, manure sources, fertilizer rates and timing, pathogen source magnitude, distance to nearest watercourse, distance to impaired water resource, present conservation status, planning time frame, designated high priority subbasin, and on-site evaluation. (Baker-IVI)
W85-05950

URBAN SEDIMENT AND STORMWATER CONTROL: THE MARYLAND EXPERIENCE,
Maryland Water Resources Administration, Annapolis.
For primary bibliographic entry see Field 4D.
W85-05951

SUCCESSFUL WATER QUALITY PLANNING: AN AREAWIDE PERSPECTIVE,
Southern California Association of Governments, Los Angeles. Water Quality and Waste Management Program.
M. K. Gensemer, and M. Yamaguchi.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 76-78, January-February, 1985. 2 Fig.

Descriptors: *Water quality control, *Planning, *California, Nonpoint pollution sources, Water pollution control, Management, Public participation.

In 1976 the California State Water Resources Control Board designated the Southern California Association of Governments as the area wide waste treatment management planning agency for the South Coast planning area. The 208 plan investigated water quality problems and identified waste management needs throughout the 208 planning region. It resulted in 10 plan element reports and 22 plan element appendices. The various 208 continuing planning projects in the South Coast region ranged from moderately to highly successful. Two major projects are reviewed, the Upper Newport Bay Watershed - San Diego Creek Comprehensive Stormwater Sedimentation Control Plan; and the San Fernando Valley Basin plan. Some factors that can be identified as furthering the objective of implementing nonpoint-source pollution control planning projects include: emphasis on implementation in the initial project conception; local endorsement of the planning process from the time of project initiation and dedication to seeing the problem resolved; formation of oversight, technical, and/or executive committees made up of the various interested parties to assume shared planning and implementation responsibilities; a regional agency acting as mediator between local governments and between local and state authorities; and public participation that emphasizes promoting problem solutions rather than merely disseminating information. (Baker-IVI)
W85-05952

SAVING THE CHESAPEAKE: MARYLAND'S AGRICULTURAL EDUCATION PROGRAM,
Maryland Univ., College Park. Dept. of Agronomy.
W. L. Magette, R. A. Weismiller, and K. C. Gugulis.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 79-81, January-February, 1985.

Descriptors: *Agriculture, *Education, *Chesapeake Bay, *Maryland, Public relations, Water pollution control, Estuaries, Public information.

A multimillion dollar study completed in 1983 identified the major sources of pollution to the Chesapeake Bay, among them being agriculture. The Bay is the nation's largest estuary. Research has indicated that large quantities of nutrients were entering the bay, causing increasing numbers of algal blooms which depressed the oxygen levels and inhibited sunlight penetration to aquatic vegetation. A massive educational strategy was developed for helping to deal with the problem, including theme selection and logo development, promotional items, a campaign kickoff, newspaper articles, radio releases, television releases, generation of fact sheets, slide programs, state fair exhibit, and an information kit. This program was aimed particularly at the agricultural industry and entitled Maryland Farmers: Partners with the Bay Campaign. While the campaign is only 6 months old, progress to date looks encouraging, and the future of the campaign seems good. (Baker-IVI)
W85-05953

ORGANIZING AN INFORMATION PROGRAM FOR NONPOINT POLLUTION CONTROL,
Eau Claire, WI.
D. D. Sorenson.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 82-83, January-February, 1985.

Descriptors: *Nonpoint pollution sources, *Wisconsin, *Public participation, Education, Planning, Water pollution control, Agricultural watersheds.

While there is a wealth of experience about the role of information in adoption of individual farm practices, much less is known about how an information program encourages adoption of best management practices in targeted watersheds to accomplish specific water quality objectives. Wisconsin's legislature in 1978 created the Nonpoint Souce Water Pollution Abatement Program under which four or five new watersheds are selected annually until a total of about 125 are funded for nonpoint source pollution abatement work. As of 1984 26 watersheds were in the program. Among the specific elements of a good program are detailed identification of the audience and project objectives, planned financing and staffing, a long-range schedule of activities, interagency coordination, creating public awareness, motivating people to action and convincing them to change their land management activities. In a survey designed to evaluate the program thus far, two main ponts were identified: start an intensive education effort early in the project and get more assistance from the state extension staff. (Baker-IVI)
W85-05954

BELGRAVE CREEK: A SUCCESSFUL NONPOINT POLLUTION CONTROL PROJECT IN RURAL ONTARIO,
Credit Valley Conservation Authority, Meadowvale (Ontario).
M. Puddister.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 84-86, January-February, 1985. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Belgrave Creek, *Ontario, *Nonpoint pollution sources, *Erosion control, Fish habitats, Cattle, Fences, Planning, Management, Watersheds, Water pollution control.

The Belgrave Creek subbasin is located in the western portion of the Maitland River watershed, 20 miles from Lake Huron. Land uses are primarily agricultural with about 41% in pasture, 33% in cultivation, 21% forested and about 3% of the subbasin is in minor urbanized areas. Cattle access to the creek appeared to be the major cause of erosion, so remedial works were begun to focus primarily on this problem. Barbed wire fencing, properly constructed access points and other alternatives for watering and reforestation along the creekbank were the major solutions. Landowner cooperation was high. A high degree of interagency cooperation was also achieved. Fish surveys showed a significant rise in fish population. Several key principles attributing the success of the project include a detailed background inventory, site prioritization, landowner cooperation, interagency cooperation, adequate funding, clearly defined program administration, effective program evaluation, communication of results, and post project monitoring. (Baker-IVI)
W85-05955

MANAGING RIPARIAN ECOSYSTEMS TO CONTROL NONPOINT POLLUTION,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. Lowrance, R. Leonard, and J. Sheridan.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 87-91, January-February, 1985. 4 Fig, 37 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Riparian land, Wetlands, Conservation, Riparian vegetation, Nutrients, Sediments, Management.

Riparian ecosystems are complex assemblages of organisms and their environment existing adjacent to and near flowing water. They have two essential characteristics: laterally flowing water that rises and falls at least once within a growing season, and a high degree of connectedness with other ecosystems. The effects of riparian wetlands on nonpoint source pollution hinge largely on how riparian zone hydrology affects watershed response. Freshwater wetlands can filter out nutrients and improve water quality. If riparian wetlands exist in agricultural watersheds where upland fields are heavily fertilized, nutrient filtering in streamside areas can help control agricultural nonpoint-source pollution. Riparian zone factors that affect nutrient outputs include physical, vegetative, and soil processes. A case study was conducted on the Little River watershed near Tifton, Georgia where the internal nutrient cycling dynamics of the riparian forest ecosystem was quantified and sediment delivery ratios were developed to estimate nutrient and sediment deposition in the riparian ecosystem. Management options for riparian ecosystems range from strict preservation of the forest ecosystem to complete removal of the native vegetation and alteration of hydrologic conditions. Future management policies for riparian ecosystems should recognize inherent and man-made regional differences. (Baker-IVI)
W85-05956

NONPOINT POLLUTION CONTROL ON PUBLIC LANDS,
Bureau of Land Management, Lakewood, CO. Denver Service Center.
B. P. Van Haveren, E. B. Janes, and W. L. Jackson.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 92-94, January-February, 1985. 3 Fig, 16 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Public lands, Land management, Grazing, Riparian land, Forest management, Water quality, Land use.

The Bureau of Land Management meets its water quality responsibilities various ways: water quality improvement objectives are integrated into landuse plans; funding for soil and water programs is used mainly for project level activities; and watershed rehabilitation projects, many of which include nonpoint source water pollution control objectives, are implemented throughout the western United States. Additional resource management strategies, including improved livestock grazing systems, intensive riparian area management, and good forest management practices, all contribute indirectly to improved water quality. Continued resource monitoring assures that water quality management ojectives are being achieved. (Baker-IVI)
W85-05957

COLIFORMS AS AN INDICATOR OF WATER QUALITY IN WILDLAND STREAMS,
Malheur National Forest, John Day, OR.
For primary bibliographic entry see Field 5A.
W85-05958

LOGGING AND WATER QUALITY; STATE REGULATION IN NEW ENGLAND,
Maine State Planning Office, Augusta.
L. C. Irland.
Journal of Soil and Water Conservation, Vol. 40, No.1, p 98-102, January-February, 1985. 3 Fig, 2 Tab, 52 Ref.

Descriptors: *Logging, *Forest management, *Water quality, Land use, Regulations, Management, Watershed protection, Water pollution control, Nonpoint pollution sources.

Timber harvesting and associated roadbuilding can affect water quality in New England. Because affected streams are important for water supply and fisheries and because the waters are state property, there is basis for public policy concern. Maine, Connecticut, Massachusetts, and Vermont employ contrasting strategies. Maine regulates logging and major haul roads by standards and permits in selected areas. Connecticut has no state program, but some towns are regulating logging. Massachusetts recently established a statewide, advance permit requirement for all operations above a minimum size. And Vermont has established an innovative cooperative program designed to mitigate sedimentation through cooperation with a loggers' organization. These programs labor under several difficulties: landowner and logger resistance; lack of adequate enforcement resources; an inadequate base of technical knowledge about logging effects, fishery impacts of sedimentation, and the effectiveness of prescribed mitigating measures. The states have made only minimal staff committments to education and enforcement. At present there is no basis for saying which approach is superior. A top priority should be additional field research on effective sediment control practices and their costs, on the impacts of sedimentation or fisheries, and on low impact logging machinery and systems. (Baker-IVI)
W85-05959

COST-EFFECTIVE TARGETING OF AGRICULTURAL NONPOINT-SOURCE POLLUTION CONTROLS,
Tennessee Valley Authority, Knoxville. Environmental Quality Staff.
A. M. Duda, and R. J. Johnson.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 108-111, January-February, 1985. 2 Fig, 19 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Agriculture, *Cost analysis, Economic aspects, Water quality, Policy, Soil conservation, Agricultural watersheds.

Investigations conducted under the Clean Water Act and the Soil and Water Resources Conservation Act found agriculture to be the most significant contributor of nonpoint source pollutants to the nation's waters. Interagency, cooperative programs must be targeted to pollution hot spots in watersheds with priority water quality problems if Clean Water Act goals are to be attained. Not only is the problem of concern in so far as water quality and environmental impact go, but the failure to use best management practices on agricultural land also causes an appreciable drain on the nation's economy. In the 1960s hydrologic research conducted by the Tennessee Valley Authority on agricultural watersheds in western North Carolina yielded important information on the effectiveness of soil conservation practices and on the source of runoff and pollution from agricultural land. Specific areas where work was needed were isolated. There are four basic policy options for targeting agricultural water quality management programs to pollution hot spots: continuing the existing voluntary/educational programs, expanding cost-sharing/educational efforts, using a system of incentives and disincentives (including cross-compliance), and a national regulatory program for implementation of agricultural BMPs. (Baker-IVI)
W85-05960

AGRICULTURAL NONPOINT POLLUTION CONTROL: VOLUNTARY OR MANDATORY,
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
D. J. Epp, and J. S. Shortle.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 111-114, January-February, 1985. 8 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Agriculture, Conservation, Regulations, Management, Soil conservation.

Efforts to accelerate the adoption of soil conservation practices will come by moving from voluntary to mandatory implementation of regulations. Mandatory pollution control programs can take a number of forms. One alternative is to require a specific technique for achieving the desired abatement, for example, requiring the use of specified erosion control practices to reduce sediment delivery. To be efficient in achieving national goals for nonpoint pollution abatement, a mandatory program for agriculture must focus on the social value of damages caused by the pollution and consider the costs of the program to agricultural producers and governmental units that administer the program. A socially efficient abatement program has two key features: the program distributes costs of water quality improvements among pollutant sources in a manner that minimizes society's costs, and it strikes an appropriate balance between society's abatement costs and the social benefits of abatement. An efficient nonpoint pollution abatement program for agriculture must focus on what to plant and how to plant rather than on measuring actual discharges of pollutants into a waterway. The only practical solution is to develop accurate models of pollution from various cropping practices by soil type, slope, climate, and proximity to waterways. (Baker-IVI)
W85-05961

SOIL LOSS REDUCTION IN FINLEY CREEK, INDIANA: AN ECONOMIC ANALYSIS OF ALTERNATIVE POLICIES,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
J. G. Lee, S. B. Lovejoy, and D. B. Beasley.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 132-135, January-February, 1985. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Soil conservation, *Erosion control, *Finley Creek, *Indiana, *Economic aspects, Crop production, Tillage, Public policy, Subsidies, Costs, Soil erosion.

One policy proposed to reduce agricultural sediment yields is the targeting of federal resources to areas with high soil loss rates. There is a need to evaluate the physical and economic impacts of of targeting policies at the local level. The Finley Creek watershed is fairly representative of farming operations and cropping patterns in central Indiana. A survey was conducted of 15 owner/operators in the Finley Creek watershed to determine: current production practices; attitudes towards soil conservation practices and policies designed to reduce sedimentation from cropland; cropping patterns and tillage practices; and willingness to change cropping patterns and tillage practices, and the subsidy required to make a voluntary change. Alternative policies analyzed include: nontargeted minimum tillage; targeted minimum tillage; and targeted conversion. Of the three alternative policies, the targeted minimum tillage subsidy program appears to be the most cost-effective means of reducing sediment for various levels of participation rates and discount rates greater than 4%. While the efficiency of a microtargeting program may seem obvious, the difference in costs of targeting versus nontargeting may be as large as 5 to 10 times. (Moore-IVI)
W85-05963

ACCELERATED IMPLEMENTATION PROGRAM FOR REDUCING THE DIFFUSE-SOURCE PHOSPHORUS LOAD TO LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Agronomy.
D. L. Forster, T. J. Logan, S. M. Yaksich, and J. R. Adams.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 136-141, January-February, 1985. 4 Fig, 8 Tab, 9 Ref.

Descriptors: *Erosion control, *Phosphorus, *Conservation tillage, *Lake Erie Basin, Agricultural runoff, Water pollution control, Economic aspects, Soil erosion, Fertilizers.

The U.S. Army Corps of Engineers Lake Erie Wastewater Management Study (LEWMS) identified P as the nutrient most affecting the extent of eutrophication in Lake Erie, and showed that the rural, primarily agricultural, diffuse P load needed to be reduced by about 26% to reduce eutrophication significantly. Accelerated implementation of conservation tillage, including no-till, on soils suited to these practices on the U.S. side of the Lake Erie Basin can achieve the required reduction in the diffuse P load. Based on economic analyses, widespread adoption of conservation tillage on suitable soils and better fertilization management practices will not be detrimental to net farm income; practices should improve net income if recommended management practices are followed. Under the existing management program, farmers would employ conservation tillage practices on 59% of Lake Erie Basin cropland by the year 2002. The accelerated program proposed would increase that adoption rate to 76%. The 1982 basinwide cropland erosion rate is 16.3 million t/yr. Under the accelerated program, erosion ultimately will decline to 8.5 million t/yr. Between 1982 and 2002, total P loadings to Lake Erie in the U.S., with the accelerated conservation tillage program, would be reduced by 33,000 tons, compared to 12,600 tons under the existing program. (Moore-IVI)
W85-05964

BEST MANAGEMENT PRACTICES FOR CONTROLLING NONPOINT-SOURCE POLLUTION ON FORESTED WATERSHEDS,
Pennsylvania State Univ., University Park.
J. A. Lynch, E. S. Corbett, and K. Mussallem.
Journal of Soil and Water Conservation, Vol. 40, No. 1, p 164-167, January-February, 1985. 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Watershed management, *Water pollution control, *Forest management, *Nonpoint pollution sources, Roads, Logging, Forest watersheds, Clear-cutting.

Controlling nonpoint-source pollution during and following silvicultural activities is an essential part of any sound forest management plan. A set of best management practices (BMPs) was developed by the Pennsylvania Department of Environmental Resources, Bureau of Forestry, to limit and/or control nonpoint-source pollution. Among the BMPs used are the following: protective buffer strips; a prohibition on skidding over streams; supervision of logging by a qualified forester; division of timber sales into blocks with cutting restricted to one block at a time; no disposal of tops or slash within 8 m of streams; proper location of haul roads, skid trails and log landings; retirement

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of skid trails, haul roads and culverts after logging; posting of a performance bond prior to logging. A watershed study conducted in central Pennsylvania suggested that the BMPs were effective in controlling nonpoint-source pollution from a 44.5-hectare commercial clearcut. Slight increases in stream temperature, turbidity, and nitrate and potassium concentrations were observed, but these increases did not exceed drinking water standards. The increases in temperature and nutrients were possibly temporarily beneficial to the aquatic ecosystem. (Moore-IVI)
W85-05971

ZURICH FASTIDIOUS ABOUT ITS WATER.
Engineering News Record, Vol. 214, No. 12, p 108 and 111, March 21, 1985. 3 Fig.

Descriptors: *Water supply development, *Zurich, *Switzerland, Groundwater, Drinking water, Water quality control.

Zurich's Hardhof complex was carefully designed to protect the quality of drinking water for the city. Making use of buried water resources was another of the goals. The system is able to protect water supplies in the event of natural disaster, sabotage or war. The site itself is landscaped such that there are 62 acres of space, laid out with open fields, shrub-covered mounds and newly planted trees. Underneath, pumps gather as much as 40 million gallons of groundwater per day and dispatch it to consumers throughout the city. Details of the construction are provided. (Baker-IVI)
W85-05978

GROUNDWATER PROTECTION: A CONTRAST IN STATE STYLE,
Kellogg Corp., Littleton, CO.
J. L. Moorhouse.
Water Engineering and Management, Vol. 132, No. 3, p 23-25, March, 1985. 1 Tab, 1 Ref.

Descriptors: *Groundwater management, *Water pollution control, *New Mexico, *Connecticut, Regulations, Water quality control, Groundwater pollution, Land use.

A review was made of the groundwater quality protection programs of New Mexico and Connecticut. These states have programs which have been in effect long enough to be evaluated and they represent contrasting approaches to the same problem. New Mexico's program was implemented in February of 1977. The groundwater quality protection program was designed to protect groundwater which has a total dissolved solids value of fewer than 10,000 ppm. Designated groundwater is protected by imposition of numerical standards for 35 pollutants. Seventy-six potentially toxic pollutants are identified, but are not regulated through the use of numerical standards. Rather they are considered toxic if they are present in concentrations which are shown by scientific literature currently available to unreasonably threaten health of plants, animals or humans. A Discharge Plan is the permit used to enforce the New Mexico groundwater quality protection program. Connecticut's program was implemented in September 1980 and is unique in that it is implemented by the establishment of land use policy. The program is based on the classification of groundwater into four possible classes. A nondegradation approach is used for three of the classes. An extensive hydrogeologic, geographic, biological, and land use data collection program was completed in order to classify Connecticut's groundwater. The system establishes water quality goals and general criteria limits but does not control actual discharges. These are controlled through administration of the Connecticut Discharge Permit, which existed prior to the groundwater classification program. (Baker-IVI)
W85-05979

PROGRESS IN MUNICIPAL PHOSPHORUS CONTROL,
Windsor Univ. (Ontario). Great Lakes Inst.
J. H. Hartig.
Water Engineering and Management, Vol. 132, No. 3, p 32-33, March, 1985. 1 Fig, 7 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Michigan, Municipal wastes, Eutrophication, Phosphorus, Nutrients, Detergents, Combined sewer overflows.

One major initiative adopted in Michigan attempts to meet requirements of the Clean Water Act of 1972 was a 1 mg/l effluent total phosphorus standard for all municipal wastewater treatment plants with design flow capacities greater than or equal to 1 mgd. Phosphorus removal is practiced at most municipal treatment facilities in Michigan, 79 of the 93 surveyed have such treatment systems. Of these 79, 65 use an iron salt, 11 an aluminum salt, and 3 use lime. In the mid 1970s a survey indicated that 39% of the major plants with phosphorus removal were achieving effluent total phosphorus concentrations of less than or equal to 1 mg/l. One effective component of Michigan's phosphorus management program to control cultural eutrophication has been its phosphorus detergent ban which limits the elemental phosphorus content of household laundery detergents to 0.5% by weight. Combined sewer overflows in many of Michigan's large urban areas continue to be a source of phosphorus discharges to surface waters. During wet weather a portion of the combined storm and sanitary flow that exceeds interceptor or treatment plant capacities is discharged directly to receiving water bodies. (Baker-IVI)
W85-05981

DEMANDS PLACED ON PROCESSING PLANTS BY DEVELOPMENTS IN LEGISLATION FOR THE PROTECTION OF WATER (ANFORDERUNGEN AN VERFAHRENSTECHNISCHE ANLAGEN DURCH DIE WEITERENTWICKLUNG DER GEWASSERSCHUTZVORSCHRIFTEN),
Hoechst A.G., Frankfurt-am-Main (Germany, F.R.).
For primary bibliographic entry see Field 6E.
W85-05982

ECOLOGICAL ASPECTS OF THE DESIGN AND OPERATION OF CONDUITS OF HYDROELECTRIC SCHEMES,
S. I. Egorshin, N. A. Ivanov, S. N. Lozhkin, L. M. Mikots, and V. M. Semenkov.
Hydrotechnical Construction, Vol. 18, No. 6, p 254-259, June, 1984. 5 Fig, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 16-20, June, 1984.

Descriptors: *Dam design, *Hydroelectric plants, *Intakes, *Ecological effects, Stratification, Eutrophication, Reservoir operation, Thermal storage, Reservoir releases, Water quality control.

This paper reviews the influence of stratification on the physical, chemical, and biological properties of water stored in large reservoirs. These include effects on blooms of algae, particularly the bluegreens, and on the storage of heat in the reservoir. In order to prevent negative ecological consequence, it is recommend that reservoirs be designed with multilevel service intakes making it possible to regulate the thermal, hydrochemical, and hydrobiological regimes in the upper and lower pools. The principal of withdrawal of water from various layers can become the basis for creating an automated water-quality management system of the reservoir and the lower pool. (Keenan-IVI)
W85-05986

SOME ECOLOGICAL EFFECTS OF ARTIFICIAL CIRCULATION ON THE PHYTOPLANKTON,
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Ecology and Freshwater Biology.
M. Rybak.
Hydrobiologia, Vol. 122, No. 1, p 89-96, March, 1985. 2 Fig, 54 Ref.

Descriptors: *Artificial circulation, *Phytoplankton, *Ecological effects, *Lake Mutek, *Poland, Aeration, Destratification, Water circulation, Lake restoration, Mixing, Biomass, Algae.

Studies were carried out in Lake Mutek (Mazurian Lakeland, Poland) on the effect of artificial destratification induced by direct aeration, upon quantitative changes in the phytoplankton from 1977 until 1983. Two different methods of aeration were used. Low intensity mixing resulted in 1978 in a two-fold, and in 1979 in a four-fold increase of the phytoplankton biomass, in relation to the control year 1977. Increase of phytoplankton biomass during lake aeration was due to the development of Ceratium hirudinella. Use of a highly effective air-compressor in 1981-1983 caused an inhibition of algal development, so that biomass dropped to levels noted in the control year. The effect of aeration depended on the ratio between lake area and effectiveness of the aerator. Only intensive mixing of the water masses resulted in an inhibition of the development of algae. Water mixing caused translocation of the algae to the abiotic zone, and this affected significantly the utilization of light by the algae. The effect of artificial destratification was also reflected in changes of the species structure, seasonal succession of the algae, and physiological state of the phytoplankton. Artificial circulation stimulated development of algae characterized by relatively high specific weight, i.e. Pyrrophyta, Bacillariophyceae and some species of Chlorophyta. (Moore-IVI)
W85-06009

DETERMINISTIC LINEAR PROGRAMMING MODEL FOR ACID RAIN ABATEMENT,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
J. H. Ellis, E. A. McBean, and G. J. Farquhar.
Journal of Environmental Engineering, Vol. 111, No. 2, p 119-139, April, 1985. 5 Fig, 10 Tab, 18 Ref.

Descriptors: *Water pollution control, *Acid rain, *Linear programming, *Mathematical models, Air pollution, Decision-making, Sulfur dioxide, Economic aspects.

The development of acid rain abatement strategies must deal with large land masses and contend with international complications, due to the nature of atmospheric pollutant transport. A deterministic Linear Programming (LP) model is presented for development of acid rain abatement strategies in eastern North America. Pollutant (SO2) sources are categorized as either controllable or noncontrolled, (i.e., area sources). The model determines the least-cost set of SO2 removal levels at each of the 235 largest point sources in eastern North America, such that stipulated maximum wet surface deposition rates are not exceeded at 20 predetermined sensitive receptor locations. The LP model consists of an objective function and a set of linear constaint equations. The objective function measures the monetary expenditure arising from pollutant removal across all sources. The model is flexible with respect to input data requirements and is able to conveniently and efficiently accommodate varying constraint formulations. Model applications are presented which involve five different constraint formulations. A relatively large and complex modeling exercise can be summarized, using the LP model and accumpanying interpretation routines, into a concise, comprehensive and understandable form for use by decision-makers. (Moore-IVI)
W85-06017

1-D POLLUTANT MIGRATION IN SOILS OF FINITE DEPTH,
University of Western Ontario, London. Faculty of Engineering Science.
For primary bibliographic entry see Field 5B.
W85-06024

CONTROLLING ACIDIC-TOXIC METAL LEACHATES FROM SOUTHERN APPALACHIAN CONSTRUCTION SLOPES: MITIGATING STREAM DAMAGE,
E. L. Morgan, W. F. Porak, and J. A. Arway.

Transportation Research Record, Vol. 948, p 10-16, 1984. 3 Tab, 23 Ref.

Descriptors: *Construction, *Appalachian Mountains, *Metals, *Leachates, Drainage, Streams, Toxicity, Acidity, Water pollution control, Pyrites, Tellico-Robbinsville Highway, Tennessee, North Carolina.

The scenic Tellico-Robbinsville Highway traverses ridges and peaks of the southern Appalachian Mountains from Tellico Plains, Tennessee, to Santeetlah Gap in North Carolina. Highway construction activities exposed geological formations that contain pyritic materials, and drainage from slope and fill caused considerable change in streams that receive these toxic leachates. These drainages which mobilize high levels of free acidity and various toxic metals have destroyed aquatic ecological systems in reaches of mountain streams. Mitigation procedures were initiated in 1977 in the North River drainage of the Tellico River to seal exposed Anakeesta road fill of the Tellico-Robbinsville Highway with soil blankets and temporary sodium hydroxide neutralization. The effectiveness of this treatment has been evaluated. Mitigated streams showed a general improvement in physicochemical water quality during the period when NaOH neutralization measures were used. After the completion of more permanent surface sealing of road embankments and the subsequent termination of sodium hydroxide treatments, the physicochemical water quality of mitigated streams degraded in comparison with that of reference streams. (Baker-IVI)
W85-06064

WATER RESOURCES DEVELOPMENT AND MANAGEMENT PLANS, PART VIII: WATER-QUALITY CONTROL MODELS - AN ASPECT OF THE WATER-QUALITY MANAGEMENT STUDY 'BEWIRTSCHAFTUNGSPLAN LEINE' (BEWIRTSCHAFTUNGSPLANE, TEIL VIII: ENTSCHEIDUNGSMODELLE IN DER WASSERGUTEWIRTSCHAFT - EIN TEILASPEKT DER PILOTSTUDIE BEWIRTSCHAFTUNGSPLAN LEINE),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
R. G. Cembrowicz.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 5/6, p 146-158, December, 1984. 10 Fig, 29 Ref.

Descriptors: *Model studies, *Water quality management, *Water pollution control, *Water management, Water use, Computer models, Economic aspects, Wastewater treatment, Canals, Planning.

Control models devised or employed in the Leine Pilot Project were designed with the purpose of implementing planning objectives employing public means most economically. The models were developed as computer programs based upon Operations Research algorithms, incorporating water quality and economic considerations. Their general concept allows for the use of a model in any river basin. Modeling approaches have proved superior to planning methods used in practices. Computations were performed using three control models. The first assumes the perspective of a river basin authority; optimal measures, costs and benefits related to specific quality standards are determined for a given basin. In a second version the results are compared to the optimal waste discharge strategy of individual discharge control, subject to effluent charges and treatment costs. The third model deals with the optimal regional allocation of wastewater treatment plants; large ones offer economies of scale but necessitate transportation canals which may be omitted for smaller plants at the expense of cost degression. The optimal sizing and allocation of the treatment plants determined with the aid of the model is laid down in the State Waste Water Disposal Plan. (Baker-IVI)
W85-06156

WATER QUALITY VARIATIONS AND CONTROL TECHNOLOGY OF YAMUNA RIVER,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W85-06171

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

OPTIMAL EXPANSION OF WATER DISTRIBUTION SYSTEMS,
Visvesvaraya Regional Coll. of Engineering, Nagpur (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W85-06020

IRRIGATION SYSTEM STUDY IN INTERNATIONAL BASIN,
Indian Inst. of Tech., New Delhi. Dept. of Applied Mechanics.
M. C. Chaturvedi, and U. C. Chaube.
Journal of Water Resources Planning and Management, Vol. 111, No. 2, p 137-148, April, 1985. 4 Fig, 1 Tab, 4 Ref, 1 Append.

Descriptors: *Irrigation systems, *International basins, *Ganga Basin, *India, *Bangladesh, Regional development, Water resources development, Model studies, Developing countries, Water conservation, Conjunctive use, Artificial recharge, Water demand.

Before taking up a comprehensive study of regional irrigation development, it is necessary to identify and understand the technological options, the physical process and the allocation of water resources to pertinent projects. Linear programming models have been used for such a reconnaissance study of the Indo-Nepal region of the Ganga basin with boundary conditions by Bangladesh. The region is a very large system in terms of resources' potential, developmental options and associated constraints. The irrigation model study is carried out at the sub-basin level (Level I) and at the basin level (Level II). The issues analyzed at level I are: (1) Implications of scale of project developments, (2) implications of resource conservation measures such as reducing seepage and evaporation losses and improving irrigation efficiency, (3) implications of conjunctive surface water, natural recharge and artificial recharge use, and (4) implications of crop water demand. At level II the issue is the implication of water demand at Ferakke (by India and Bangladesh). The study identifies the operating constraints and relative impact of various issues and options on the irrigation development in physical terms. (Author's abstract)
W85-06027

CAPACITY EXPANSION OF SAO PAULO WATER SUPPLY,
Sao Paulo Univ. (Brazil). Dept. de Hidraulica.
B. P. F. Braga, Jr., J. G. L. Conejo, L. Becker, and W. W.-G. Yeh.
Journal of Water Resources Planning and Management, Vol. 111, No. 2, p 238-252, April, 1985. 4 Fig, 9 Tab, 22 Ref, 1 Append.

Descriptors: *Water resources development, *Water supply, *Planning, *Capacity expansion, *Sao Paulo, *Brazil, Juquia River, Reservoirs, Simulation, Model studies, Pumped storage, Optimization, Water demand, Dynamic programming.

Sao Paulo (Brazil) water requirements are rapidly increasing due to growth in both industry and population, and the current firm water supply must be approximately doubled by the year 2040. Sufficient water is available from the Juquia River system through construction of a network of storage and pondage reservoirs, dams, pumping stations and canals. Much of the natural flow must be pumped back to the distribution point, and at the site of greatest elevation change, a pumped storage plant is contemplated for generation of peaking power as well as pumping for water supply. A capacity expansion model has been developed to facilitate the planning and the optimal timing and sizing of the proposed Juquia River system. A monthly simulation model that utilizes rational operation rules and simulates the optimal operation mode is imbedded in the capacity expansion model so that the optimized results are consistent and hydrologically feasible. Forty-two years of historical streamflows are used in the simulation model. Future water demands up to a time horizon are specified, and a forward dynamic programming algorithm is used to minimize the present worth of total project costs. The proposed Sao Paulo water supply network requires a capacity expansions model that contains a number of complications not generally encountered in the usual capacity expansion applicaton. These complications can be accommodated by relatively simple modifications of model sizing and dynamic programming procedures. (Moore-IVI)
W85-06034

CO-ORDINATED APPROACH TO SMALL HYDRO DEVELOPMENT,
Strafford Regional Planning Commission, Dover, NH.
R. Moldoff.
International Water Power and Dam Construction, Vol. 37, No. 4, p 37-40, April, 1985. 2 Fig, 1 Tab.

Descriptors: *Hydroelectric plants, *Small hydro, *Planning, *Salmon Falls, *Maine, *New Hampshire, Water resources development, Decision making, Management planning, Economic aspects, Environmental effects, Licencing.

A case study is presented of an area where an association of dam owners and hydro developers was formed to promote the coordinated development of small scale hydro plants. Rather than each site being evaluated independently, the entire Salmon Falls river basin in Maine and New Hampshire was studied, the aim being to reduce time delays and increase economic incentives for development. The Salmon Falls approach emphasized the interrelated nature of all potential hydro sites within the Salmon Falls basin. To maximize hydro production, decrease regulatory time lags, and increase economic incentives for development, the approach urged joint completion of hydro projects within the basin. Information sharing, combined permit and licence applications, and joint purchasing of equipment and services were some of the areas of cooperation. A five part plan was approved which included a computerized river flow simulation model, a multi site environmental impact study, a multi site financial analysis, a multi site Federal Energy Regulatory Commission licence application, and a river basin management system which would provide a mechanism for managing water releases from the Milton Three Ponds dam to maximize hydro generation within competing water use constraints. After some initial research, the advantages of a formal association became clear including political leverage, contracting, and resolving conflicts. (Baker-IVI)
W85-06131

6B. Evaluation Process

WATER RESOURCE PLAN PRODUCES MULTIPLE BENEFITS,
Water Services, Redhill (England).
V. French.
Water Engineering and Management, Vol. 132, No. 3, p 28-30, March, 1985. 2 Fig.

Descriptors: *Water resources development, *Water management, *Kielder Dam, *England, Dam construction, Planning, Cost benefit analysis, Hydroelectric plants, Wastewater treatment, Water supply.

The Kielder Dam project will be one of Europe's largest water resource projects and is almost completed. The plan has as its core objective the supply of water for the area's future. Cleverly arranged interchanges of water within the region are initiated on demand, and telemetry links all the components of the system, including wastewater treatment facilities far downstram. Water released from Kielder flows for 36 mi down the North Tyne and the Tyne. At Riding Mill it is abstracted by the Northumbrian Water Authority at one of

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Britain's largest pumping stations. Power from the hydroelectric power station is transmitted to Spaeadam in Cumbria where it enters the distribution network. For the first 3 mi it travels by a 33,000 V power transmission line underground. Income derived from the power at Kielder Water will be divided between the CEGB and the Northumbrian Water in proportion to the financial contributions made by the Board and the Authority. The capital cost of the scheme was about $7.5 million and the anticipated income will be in the area of $900,000 at present day prices. (Baker-IVI)
W85-05980

SMALL HYDRO PROGRESS IN MALAYSIA,
National Univ. of Malaysia, Bangi. Faculty of Economics.
U. A. Malik.
International Water Power and Dam Construction, Vol. 37, No. 4, p 25-27, April, 1985. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Malaysia, *Hydroelectric power, *Small hydro, Pilot plants, Water resources development, Turbines, Economic aspects.

The recent dramatic increase in oil prices has turned interest back to small hydro schemes. More than 120 sites have been identified for mini hydro projects, although, because of a shortage of funds in Malaysia, only a small percentage of these have been developed. Various turbine types have been developed and tested and several have been selected as being particularly suitable for local conditions. Hydrological information, especially rainfall and stream flow characteristics, are important considerations for planning the small schemes. Another major consideration is siltation. Increasing encroachment into catchment areas may increase the silt load at intake points and cause severe damage to the turbines. Economics is the overriding consideration as far as the development of mini hydro in Malasia is concerned. The common approach is to consider the form and capacity of alternative energy sources in terms of economics and practicality. The other options that have been considered are extensions to the existing power grid, and isolated diesel generating stations. Economically the major weakness of a mini hydro project is its relatively high initial capital investment per unit of output. (Baker-IVI)
W85-06129

CO-ORDINATED APPROACH TO SMALL HYDRO DEVELOPMENT,
Strafford Regional Planning Commission, Dover, NH.
For primary bibliographic entry see Field 6A.
W85-06131

WATER RESOURCES DEVELOPMENT AND MANAGEMENT PLANS, PART VIII: WATER-QUALITY CONTROL MODELS - AN ASPECT OF THE WATER-QUALITY MANAGEMENT STUDY 'BEWIRTSCHAFTUNGSPLAN LEINE' (BEWIRTSCHAFTUNGSPLANE, TEIL VIII: ENTSCHEIDUNGSMODELLE IN DER WASSERGUTEWIRTSCHAFT - EIN TEILASPEKT DER PILOTSTUDIE BEWIRTSCHAFTUNGSPLAN LEINE),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
For primary bibliographic entry see Field 5G.
W85-06156

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PAYING THE NONPOINT POLLUTION CONTROL BILL,
Michigan State Univ., East Lansing. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W85-05944

SUBSIDY AND TAX EFFECTS OF CONTROLLING STREAM SEDIMENTATION IN SOUTH CAROLINA,
Mississippi State Univ., Mississippi State. School of Forestry.
For primary bibliographic entry see Field 4D.
W85-05966

IMPACT OF CONSERVATION ON RATES AND OPERATING COSTS,
Dauphin Consolidated Water Supply Co., Harrisburg, PA.
N. R. Bhatt, and C. A. Cole.
Journal of Water Resources Planning and Management, Vol. 111, No. 2, p 192-206, April, 1985. 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Water conservation, *Water rates, *Operating costs, *Utilities, Water use, Water storage, Construction costs, Capital costs.

Abrupt water conservation measures often require an increase in unit costs (rates) of water utilities. The potential impact of 20% reduction in water usage through water conservation is investigated for a small investor owned utility serving a rural residential community. The analysis of short-term impact shows that the average bill would be reduced by 16% if rates had not been changed; the company's operating expenses would only have been reduced by 2%. A present worth comparison was made between additional source and storage requirements of the water company throught the year 2020, with and without conservation. Comprehensive and continued 20% water conservation would have postponed source facility and storage facility expansion by 3 and 4 yr, respectively. A 20% reduction in water use would save $71,280 in present worth (1976) for storage and source facilities and operating costs. The savings in capital and operating and maintenance costs would eventually translate into savings in water bills of the customers over the years. Water conservation has definite economic benefits for communities in terms of freeing money for use on other public works, etc. (Moore-IVI)
W85-06031

6D. Water Demand

OPTIMAL OPERATION OF CALIFORNIA AQUEDUCT,
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 4A.
W85-06033

CAPACITY EXPANSION OF SAO PAULO WATER SUPPLY,
Sao Paulo Univ. (Brazil). Dept. de Hidraulica.
For primary bibliographic entry see Field 6A.
W85-06034

6E. Water Law and Institutions

WATER AS AN ARTICLE OF COMMERCE: STATE EMBARGOES SPRING A LEAK UNDER SPORHASE V. NEBRASKA,
Boston Coll., Chestnut Hill, MA.
E. B. Schwartz.
Boston College Environmental Affairs Law Review, Vol. 12, No. 1, p 103-169, 1985. 361 Ref.

Descriptors: *Legal aspects, *Water supply, *Sporhase vs Nebraska, *Commerce Clause, State jurisdiction, Water export, Water rights, Water shortages, Water supply development, Police power.

In July of 1982 the US Supreme Court struck down, in part, a Nebraska statute which greatly limited the right of its citizens to export ground water to another state. This article examines the limitations imposed on state police powers by the commerce clause. The development and nature of state water embargo statutes are reviewed. The Supreme Court's past decisions when faced with a commerce clause challenge to a state water embargo statute are recounted. The Supreme Court's decision in Sporhase is summarized and the likely impact of that decision on state water embargoes and on federal regulation of water is evaluated. Possible arguments in support of removing water embargo statutes entirely from the scope of the commerce clause are examined with focus on the state ownership theory, the argument that water is not an article of commerce, the exceptional police powers argument, the state as market participant exception, and the concept of state sovereignty. While the Supreme Court was correct in finding that there are no available arguments which would entirely exempt water embargo statutes from commerce clause treatment, the commerce clause is a clumsy tool with which to balance the complex, competing federal and state interests in this area. The more appropriate decision might have been to defer to the Congress to resolve this dispute. (Baker-IVI)
W85-05915

POLICIES FOR NONPOINT-SOURCE WATER POLLUTION CONTROL,
Resources for the Future, Inc., Washington, DC. Quality of the Environment Div.
For primary bibliographic entry see Field 5G.
W85-05943

STATE INITIATIVES IN NONPOINT-SOURCE POLLUTION CONTROL,
Association of State and Interstate Water Pollution Control Administrators, Washington, DC.
For primary bibliographic entry see Field 5G.
W85-05946

NONPOINT POLLUTION CONTROL: THE WISCONSIN EXPERIENCE,
Wisconsin Dept. of Natural Resources, Madison. Nonpoint Source and Land Management Section.
For primary bibliographic entry see Field 5G.
W85-05947

CONSERVATION DISTRICT ROLE IN NONPOINT POLLUTION CONTROL,
National Association of Conservation Districts, Washington, DC.
For primary bibliographic entry see Field 5G.
W85-05948

SETTING AGRICULTURAL POLLUTION CONTROL PRIORITIES,
Idaho Soil Conservation Commission, Boise.
For primary bibliographic entry see Field 5G.
W85-05949

SUCCESSFUL WATER QUALITY PLANNING: AN AREAWIDE PERSPECTIVE,
Southern California Association of Governments, Los Angeles. Water Quality and Waste Management Program.
For primary bibliographic entry see Field 5G.
W85-05952

LOGGING AND WATER QUALITY; STATE REGULATION IN NEW ENGLAND,
Maine State Planning Office, Augusta.
For primary bibliographic entry see Field 5G.
W85-05959

COST-EFFECTIVE TARGETING OF AGRICULTURAL NONPOINT-SOURCE POLLUTION CONTROLS,
Tennessee Valley Authority, Knoxville. Environmental Quality Staff.
For primary bibliographic entry see Field 5G.
W85-05960

AGRICULTURAL NONPOINT POLLUTION CONTROL: VOLUNTARY OR MANDATORY,
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5G.
W85-05961

SOIL LOSS REDUCTION IN FINLEY CREEK, INDIANA: AN ECONOMIC ANALYSIS OF ALTERNATIVE POLICIES,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W85-05963

GROUNDWATER PROTECTION: A CONTRAST IN STATE STYLE,
Kellogg Corp., Littleton, CO.
For primary bibliographic entry see Field 5G.
W85-05979

DEMANDS PLACED ON PROCESSING PLANTS BY DEVELOPMENTS IN LEGISLATION FOR THE PROTECTION OF WATER (ANFORDERUNGEN AN VERFAHRENSTECHNISCHE ANLAGEN DURCH DIE WEITERENTWICKLUNG DER GEWASSERSCHUTZ-VORSCHRIFTEN),
Hoechst A.G., Frankfurt-am-Main (Germany, F.R.).
H.-O. Braubach, E. Sommer, and K. Zellman.
Chemie Ingenieur Technik, Vol. 57, No. 2, p 113-118, February, 1985. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Water pollution control, *Legislation, *Germany (Federal Republic), Oil pollution, Industrial plants, Hazardous materials, Materials storage, Regulations.

Initial legislation for protection of water against pollution was limited to general regulations ensuring safe storage of mineral oil products, especially fuel oil. In the course of time, the requirements became more and more detailed and extended to cover all substances representing a potential source of danger to water (not only liquids) and plants serving purposes other than the storage of water-endangering substances. The developments from the Federal Republic of Germany 1st Water Ecology Act dating from 1960 to the state regulations concerning plant for the storage, filling, and transferring of water-endangering substances are described. (Author's abstract)
W85-05982

MINIMUM FLOW PROTECTION IN RIPARIAN STATES,
Patterson (J.W.) and Associates, Inc., Denver, CO.
W. D. Dixon, and W. E. Cox.
Journal of Water Resources Planning and Management, Vol. 111, No. 2, p 149-156, April, 1985. 30 Ref.

Descriptors: *Minimum flow, *Legal aspects, Instream use, Water management, Riparian lands, Riparian law, Legislation, State jurisdiction, Water use.

Maintenance of minimum flows necessary for protection of instream water uses has been recognized as a significant water management issue in some of the eastern states. The riparian doctrine, a primary component of the water law of several eastern states, offers some protection to instream uses since its offers protection to riparian land values and requires a sharing of water among landowners along the length of each stream. In addition, legal provisions for recognition of instream uses in federal water management programs apply, and many of the eastern states have adopted applicable legislative measures such as direct controls over water use, programs for preservation of scenic rivers, and minimum release requirements for impoundments. However, such measures do not apply uniformly among the riparian states, and existing legal mechanisms may be inadequate in some cases. Therefore, additional institutional development will likely be necessary to assure continuance of a socially desirable balance between instream and offstream water uses as water demand increases over time. (Author's abstract)
W85-06028

SATISFYING INSTREAM FLOW NEEDS UNDER WESTERN WATER RIGHTS,
Utah Water Research Lab., Logan.
J. M. Bagley, D. T. Larson, and L. Kapaloski.
Journal of Water Resources Planning and Management, Vol. 111, No. 2, p 171-191, April, 1985. 18 Ref.

Descriptors: *Instream flow, *Water rights, Appropriation, Litigation, State jurisdiction, Legal aspects, Environmental effects.

The appropriation system of water rights has been criticized for failure to provide adequate protection of instream flow values. The appropriation system is measured against 13 fundamental principles of good state water law. Within the context of this comparison, the implications with respect to accommodating instream flow uses are examined. It is concluded that the appropriation system can equitably incorporate instream flow uses, but is constrained by lack of 'litigation proof' methodologies and technologies to project impacts and tradeoffs. The integration of instream flow rights is also retarded by lack of proper recognition of certain hydrologic imperatives that must be observed in order to correctly define the instream flow right. Instream flow rights must not upset the integrity of other rights within the common system. (Author's abstract)
W85-06030

EXPORTING COLORADO WATER IN COAL SLURRY PIPELINES,
Wisconsin Univ.-Madison. Law School.
D. T. Massey.
Journal of Water Resources Planning and Management, Vol. 111, No. 2, p 207, 221, April, 1985. 59 Ref, 1 Append.

Descriptors: *Water exporting, *Coal slurry pipelines, *Colorado, *Water law, Diversion, Legal aspects, Water supply, Commerce clause, State jurisdiction, Interstate commerce.

The San Marco Pipeline Company has proposed a 1,000-mile (1,610-km) pipeline system to move coal slurry from southeastern Colorado to several electrical generating plants in the Texas Gulf Coast area. This area of Colorado is experiencing severe water shortage problems due to the large amount of water used for irrigation. Colorado statutes restrict the diversion of both surface and ground water for out-of-state use unless such water is credited to interstate compacts. Water has been found by the courts to be a commodity or article of commerce, therefore subject to federal constitutional scrutiny under the commerce clause. The constitutionality of Colorado's statutes depends upon the nature of the restrictions imposed, the severity of the burden created, and the local purposes served by the statutes. Statutes will be upheld only where they incidentally burden or discriminate against interstate commerce. States may impose severe restrictions on diverting water for out-of-state uses provided the same type of restrictions are imposed on in-state use. (Author's abstract)
W85-06032

6F. Nonstructural Alternatives

CALCULATING EFFECTIVENESS OF WATER CONSERVATION MEASURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski, W. G. Richards, D. J. McCall, A. K. Deb, and J. M. Morgan.
Journal of Environmental Engineering, Vol. 111, No. 2, p 209-221, April, 1985. 1 Fig, 4 Tab, 25 Ref, 1 Append.

Descriptors: *Water conservation, *Effectiveness, *Water demand, Utilities, Water treatment facilities, Pumping capacity, Algorithms, Computers.

As it becomes more expensive to develop new water sources and expand treatment and pumping capacities, water utilities are considering water conservation to reduce the need for capacity expansion for municipal and industrial water uses. Engineers and planners working with utilities need to be able to predict the reduction in water requirements (i.e., effectiveness of water conservation) that will result from implementation of water conservation measures. A procedure that was developed to help water conservation effectiveness for typical conditions is presented. To adequately detemine the efectiveness of water conservation measures, the engineer or planner must determine the effectiveness of each measure on each use sector and dimensions while accounting for coverage of each measure and interaction between measures. The algorithm described in this paper provides the framework; tables provide typical values; and the MAPS computer program greatly simplifies calculations. (Moore-IVI)
W85-06021

6G. Ecologic Impact Of Water Development

RESPONSES OF FISH POPULATIONS TO MITIGATION STRUCTURES IN TWO SMALL CHANNELIZED STREAMS IN OHIO,
Ohio Cooperative Fishery Research Unit, Columbus.
R. F. Carline, and S. P. Klosiewski.
North American Journal of Fisheries Management, Vol. 5, No. 1, p 1-11, 1985. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Ohio, *Fish populations, *Channelization, *Mitigation structures, *River Styx, *Chippewa Creek, *Ohio, Riffles, Deflectors, Deflection, Fish reproduction.

Responses of fish populations to mitigation structures (rock deflectors and artificial riffles) were compared in two small channelized streams in Ohio to determine potential recreational benefits of such structures. In Chippewa Creek, fish populations were compared 1 and 3 years after construction in sections with and without rock deflectors. In River Styx, previously altered around 1950, fish fauna were compared 1 year before and 1 year after channelization in sections with and without mitigation devices. Sections with rock deflectors in Chippewa Creek supported significantly more species and higher numbers and biomass of fish than did sections without structures. In River Styx, fish populations before construction and 1 year afterwards were similar; low flows prior to channelization and above-average flows afterwards probably had more influence on fish populations than the habitat changes. Stations with deflectors or artificial riffles tended to support greater densities of fish than stations without mitigation structures, although differences were not statistically significant. Deflectors created apparently favorable habitat for centrarchid species, yet their small sizes (primary juveniles) and low densities in both streams provided limited sport fishing opportunities. The primary limiting factor for the centrarchids may have been reproductive failure due to erratic flows rather than inadequate habitat. (Author's abstract)
W85-05877

GENERALIZED MODEL FOR PREDICTING SPAWNING SUCCESS OF FISH IN RESERVOIRS WITH FLUCTUATING WATER LEVELS,
Virginia Cooperative Fishery Unit, Blacksburg.
D. H. Bennett, O. E. Maughan, and D. B. Jester, Jr.
North American Journal of Fisheries Management, Vol. 5, No. 1, p 12-20, 1985. 2 Fig, 2 Tab, 27 Ref.

Descriptors: *Fisheries, *Computer models, *Spawning, *Reservoirs, *Water levels, *Leesville Lake, *Roanoke, *Virginia, Model studies, Water temperature, Bluegills, Ecological effects.

A computer model (SUCCESS) was developed to predict spawning success of centrarchid fishes in a pumped storage reservoir. The model was quantified by conducting field and laboratory studies with bluegills (Lepomis macrochirus) from Leesville Lake, the lower impoundment of the Smith Mountain Pumped Project near Roanoke, Virginia. Eight modifiable subprograms were used to increase the generality and utility of the model. Data

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necessary for use in the model are hourly water levels, water temperature regimens, and a distribution describing the depth of spawning activity in the reservoir. A sensitivity analysis of the model suggested that data in hatchability and rates of hatching and development from the fry to free-swimming stage had the greatest effect on the estimates of spawning success. SUCCESS should allow a reservoir fishery manager to predict the impact of water level fluctuations on spawning success of sport fishes or predict spawning success of undesirable species under various water level fluctuation regimens. (Author's abstract)
W85-05878

MORTALITY OF ADULT AMERICAN SHAD PASSING THROUGH A 17-MEGAWATT KAPLAN TURBINE AT A LOW-HEAD HYDROELECTRIC DAM,
Massachusetts Cooperative Fishery Research Unit, Amherst.
C. E. Bell, and B. Kynard.
North American Journal of Fisheries Management, Vol. 5, No. 1, p 33-38, 1985. 3 Fig, 1 Tab, 21 Ref.

Descriptors: *Shad, *Fish mortality, *Turbines, *Hydroelectric dams, *Holyoke Dam, *Connecticut River, *Massachusetts, Radio telemetry, Fish behavior.

The mortality of pre-spawning American shad (Alosa sapidissima) was investigated in May 1982 over a 5-hour period after passage through the 17-megawatt Kaplan turbine at Holyoke Dam, Connecticut River, Massachusetts. Radio telemetry was used to determine the survival of 36 test fish during 7 experiments by comparing their movement patterns with those of 21 sacrificed fish that were also passed through the turbine. Sixty-nine control fish fitted with dummy tags were released and held in an instream net for direct observation of mortality due to handling, tagging, and introduction procedures. The mean turbine mortality (N sub T) was 21.5% (95% confidence limits of 3.3-36.2%). Similar preliminary experiments with post-spawned American shad indicated that mortalities during their normal outmigration should be higher than the mortality estimate for prespawned fish. (Author's abstract)
W85-05879

AQUATIC INSECT ABUNDANCE IN A REGULATED STREAM UNDER FLUCTUATING AND STABLE DIEL FLOW PATTERNS,
Washington Univ., Seattle. Fisheries Research Inst.
For primary bibliographic entry see Field 2H.
W85-05880

IRON MIGRATION IN SANDY PODZOLIC SOILS UNDER INCREASING HYDROMORPHISM PRODUCED BY A RESERVOIR,
Moskovskaya Sel'skokhozyaistvennaya Akademiya (USSR).
A. D. Fokin, V. A. Varlamov, and T. S. Man'kova.
Soviet Soil Science, No. 6, p 72-80, May-June, 1984. 3 Fig, 2 Tab, 14 Ref. Translated from Pochvovedeniye, No. 6, p 31-39, 1984.

Descriptors: *Soil water, *Path of pollutants, *Iron, *Environmental effects, *Podzolic soil, *Reservoirs, Dam effects, Wetting, Groundwater movement, Aluminum, Humus, Solute transport, Water table.

Under the effect of a change in the wetting regime in the reservoir zone, a considerable change was noted in the direction of conversion and migration of substances. This change lead to the destruction of Al-Fe humus horizons and to the removal and redeposition of the products of this destruction in the area. The increase in the wetting of the area surrounding a reservoir has a significant effect on iron migration in sandy Podzolic and Bog Podzolic soils when the groundwater table stands higher than the depth of soil horizons a considerable part of the time. The change in the regime of iron migration in soils is apparently intensified by irregular groundwater level variations, accompanied by lateral water inflow or outflow, and also by a high water table in summer. A change in groundwater regime significantly changes the migration regime of precipitation water and, correspondingly that of dissolved substances primarily in AO horizons. The change consists mainly in a sharp reduction of vertical soil wetting and intensification of lateral flows, which predominate even in summer. Illuvial horizons are destroyed and the products of destruction are removed under conditions of prolonged excessive wetting of soil horizons by groundwater and also of irregular groundwater inflow and outflow. Experimental investigations and calculations show that it requires 20-45 years for a horizon to change by 90%. The destruction of illuvial horizons is accompanied by the bleaching of the mineral layer of Podzolic soils to a considerable depth (of about 1 m or more), by considerable removal of iron from the area, and by the formation of different forms of contemporary iron accumulations along the paths of migration (at the soil surface, in the plant cover, in thalwegs, in the eluvial part of the profile, etc). The regime of migration of atmospheric water modified by a rise in the groundwater table promotes the irreversible removal of various substances from AO horizons because of the increased duration and intensity of surface runoff. All the observations suggest that changes in the soil under the influence of increasing hydromorphism are generally directed toward a considerable decrease in the water-holding capacity and water-regulating function of soils as a result of the destruction of illuvial horizons and also toward a considerable loss of all the elements from litter. These changes may cause a further deep transformation of all the elements of the area's landscape. (Baker-IVI)
W85-05909

SALINATION OF ORGANIC SOILS IN THE SACRAMENTO-SAN JOAQUIN DELTA OF CALIFORNIA,
California Univ., Stockton. Cooperative Extension Service.
For primary bibliographic entry see Field 3F.
W85-05927

EFFECT OF IRRIGATION PRACTICES IN THE BREE RIVER VALLEY ON THE SALT CONTENT OF A SMALL RIVER,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 5B.
W85-05928

REGIONAL WATER QUALITY IMPACTS OF INTENSIVE ROW-CROP AGRICULTURE: A LAKE ERIE BASIN CASE STUDY,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 5B.
W85-05962

CHANNEL CHANGES AND INVERTEBRATE FAUNAS BELOW NANT-Y-MOCH DAM, RIVER RHEIDOL, WALES, UK,
Loughborough Univ. of Technology (England). Dept. of Geography.
G. E. Petts, and M. Greenwood.
Hydrobiologia, Vol. 122, No. 1, p 65-80, March, 1985. 7 Fig, 4 Tab, 47 Ref, 2 Append.

Descriptors: *Dam effects, *Ecological effects, *Invertebrates, *Rheidol, *Wales, Channel morphology, Sedimentation, Hydraulic sorting, Aggradation, Fauna, Environmental effects.

Since 1961, runoff from 93% of the catchment of the Rheidol above the study area has been controlled by the Nant-y-Moch reservoir, which releases a compensation flow of only 0.16 cu m/s. The flow varies rarely, rising to a maximum of 40 cu m/s on only three occasions. The marked reduction of flow variability along the mainstream initiated a sequence of morphological changes, manifested by channel sedimentation at tributary confluences. Sedimentation is particularly apparent at the confluence of the Peithnant tributary. Channel sedimentation below the tributary confluence, resulting from reduced flow competence and capacity within the regulated mainstream, produced morphological changes associated with substrate particle-size alteration. Four physical compartments are identified, each representing a different stage of readjustment to the hydrological conditions imposed by the dam. The four channel compartments within the regulated river reflect four stages of channel response: the stabilized, relic form downstream forms the limit of current sedimentation; a form in the early stages of channel change associated with bed aggradation of fine gravels and sands; a late stage, braided form undergoing both aggradation and lateral accretion by coarse gravels; and an adjusted quasi-equilibrium section nearest the sediment source. Each stage has a characteristic fauna. Hydraulic sorting during the early stages of channel form adjustment created a new diversity of micro-habitats. As the channel width is reduced and slope increased (as the channel attains a new quasi-equilibrium form, the species diversity declines and finally approximates that of the natural river above the dam. (Moore-IVI)
W85-06007

EVALUATION OF ARTIFICIAL WETLANDS IN NORTH DAKOTA: RECOMMENDATIONS FOR FUTURE DESIGN AND CONSTRUCTION,
J. A. Rossiter, and R. D. Crawford.
Transportation Research Record, Vol. 948, p 21-25, 1984. 3 Fig, 29 Ref.

Descriptors: *Artificial wetlands, *Design criteria, *Highways, *North Dakota, Construction, Wetlands, Waterfowl, Habitats, Aquatic plants.

Eighteen artificial wetlands were evaluated in North Dakota in 1979 and 1980. Several recommendations are presented for artificial wetland design and construction based on both the results of the 2 year study and the habitat requirements of breeding waterfowl. It is recommended that a series of wetlands of varying sizes be built rather than one large wetland; that multisided, variable-depth wetlands be excavated instead of rectangular, uniformly deep borrow pits; that bank gradients not exceed a 10:1 to 20:1 slope; that nesting islands be constructed in the center of the wetland when possible; that adjacent upland areas be seeded with dense cover to support nesting and reduce erosion and runoff; that, if necessary, wetlands be sealed with a clay layer to retain water; and that topsoil be set aside and respread to provide an adequate substrate for the growth of aquatic plants. What is currently needed is a long term study of a natural wetland before highway construction and, later, an evaluation of the artificial wetland that replaced it. Only then can it be determined how well habitat can be reconstructed. (Baker-IVI)
W85-06066

IMPACT OF BRIDGING ON FLOODPLAINS,
Y. A. Yousef, M. P. Wanielista, H. H. Harper, and E. T. Skene.
Transportation Research Record, Vol. 948, p 26-30, 1984. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Water pollution sources, *Bridges, *Environmental effects, *Floodplains, Metals, Algal growth, Eutrophication, Organic compounds, Path of pollutants, Lead, Zinc, Copper, Iron, Nickel, Chromium, Cadmium,.

Three bridge sites in central Florida were selected to study the feasibility of treating highway runoff by using floodplains beneath these bridges and the impact of bridging on biological diversity and productivity. Soil and plant samples were collected from bridge areas affected by highway runoff as well as control areas upstream and downstream of the bridge areas. These samples were analyzed for extractable heavy metals to study the capacity of floodplain areas to retain these metals. The concentrations of several heavy metals extracted from soil samples at the bridge areas were significantly higher than concentrations of similar metals extracted from the control areas upstream and downstream of each bridge site. Most of the extractable heavy metals were found in the highest amounts in

soils areas where the average daily traffic count and percentage of organic and clay content were highest. The existing levels of lead in soils from the study sites were far below the lead uptake capacity determined by slurry tests from lab experiments. Heavy metals retained by floodplain soils can be released back to solution by lowering pH values, reducing environments, and soluble chelating organic complexes. A fraction of heavy metals retained by floodplain soils is available for biological uptake by plants and other forms of life. Plant communities at bridge areas and control areas were generally similar. Bridge areas appeared to be dominated by fewer species than control areas. There were more individuals of any common plant species in the bridge areas than in other control areas. The algal bioassay experiments have shown that bridge runoff has the potential to increase algal production in nearby streams considerably. The use of floodplain systems in treating bridge runoff appeared to be feasible, and there were no noticeable detrimental effects in the study areas. (Baker-IVI)
W85-06067

ENVIRONMENTAL IMPLICATIONS OF THE FUNDY BAY TIDAL POWER DEVELOPMENT,
Acadia Univ., Wolfville (Nova Scotia). Dept. of Biology.
G. R. Daborn.
International Water Power and Dam Construction, Vol. 37, No. 4, p 15-19, April 1985. 3 Fig, 14 Ref.

Descriptors: *Tidal powerplants, *Environmental effects, *Bay of Fundy, *Nova Scotia, *New Brunswick, Flooding, Estuarine environment, Harbors, Fisheries, Tidewaters, Barrages, Water resources development.

The massive tides in the Bay of Fundy represent approximately 1% of the global tidal energy. Many proposals have been advanced for harnessing this power over the past 7 decades. The Cumberland basin proposal calls for a 1.5 km long barrage built of concrete caissons, containing 37 turbines about 7 m in diameter, each having a rated output of 31 MW. The installed capacity would be 1147 Mw and the yield 3183 GWh. Construction of the proposed tidal power barrage would introduce major changes to this dynamic environment. Problems thus far identified include flooding of coastal property, increased flushing of estuaries, changed current and sedimentation patterns, interference with the use of harbors, increased shoreline erosion and increased impact of storm surges. On the positive side, increasing the tidal range should improve dispersion of effluents from estuaries, improve accessibility of some harbors at high water, increase intertidal areas and their shellfish resources, and increase tidal mixing over shallow banks where the major fisheries occur. (Baker-IVI)
W85-06127

IMPACT OF HYDRAULIC WORKS ON WATER QUALITY,
Electricite de France, Chatou. Direction des Etudes et Recherches.
R. Gras, and J. P. Albignat.
International Water Power and Dam Construction, Vol. 37, No. 4, p 45-48, April, 1985. 5 Fig.

Descriptors: *Hydraulic structures, *Water quality, *Environmental effects, Reservoirs, Weirs, Dam effects, Tidal powerplants, Ecosystems, Plankton, Fish, Pumped storage, Hydroelectric plants.

Various types of hydraulic projects are reviewed to examine their impact on the environment, and in particular on water quality and aquatic life. Particular attention is paid to the canalization of streams or rivers, construction of dams for power generation and navigation; and reservoirs and pumped storage stations. Some information is also given on estuarine projects, such as tidal powerplants. The main water quality parameters are considered with special attention to thermal behavior. Physico-chemical parameters are considered as well as those concerning aquatic flora and fauna (plankton and fish resources). Specific examples are examined for most of these type of projects. An analysis is offered of the way in which the operating mode can affect the quality of the water and the downstream section of the stream is analyzed as for a reservoir. (Baker-IVI)
W85-06132

ENVIRONMENTAL IMPACT OF DAMS,
World Commission on Environment and Development, Geneva (Switzerland).
E. Monosowski.
International Water Power and Dam Construction, Vol. 37, No. 4, p 48-50 and 61, April, 1985. 1 Fig, 3 Ref.

Descriptors: *Environmental impact statement, *Dam effects, *Environmental effects, Social aspects, Ecological effects, Water resources development.

In addition to their benefits, water projects in many countries have been the source of significant environmental change, unexpected diseases, the impoverishment of aquatic fauna and decrease of water quality. Local people have been seriously affected by resettlement. Cases studied illustrate some common problems faced in the practice of Environmental Impact Assessment (EIA) on dams. Environment is generally identified with natural physical systems. The studies often adopt limited time and space boundaries for impact evaluation. All the studies analyze the effects on water quality, on biotope, and the resettlement of populations. A strong emphasis is also given to the direct impacts of the project over the physical elements of environment. Less importance is accorded to the indirect impacts of the project at the regional level and social organization, or its interaction with other large-scale development projects in the region. Very different levels of priority are given to the social impacts among the case studies. (Moore-IVI)
W85-06133

7. RESOURCES DATA

7B. Data Acquisition

COMPARISON OF METHODS USED TO ESTIMATE EVAPOTRANSPIRATION FOR LEACHING CONTROL,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
D. Devitt, W. A. Jury, P. Sternberg, and L. H. Stolzy.
Irrigation Science, Vol. 4, No. 1, p 59-69, April, 1983. 5 Fig, 3 Tab, 11 Ref.

Descriptors: *Evapotranspiration, *Leaching, *Crop yield, Irrigation management, Water use, Water application, Wastewater irrigation, Irrigation, Penman Equation.

Procedures were analyzed for minimum leaching fraction irrigation management based upon weekly averaged evapotranspiration feedback. Of all the methods tested for maintaining uniform leaching fraction, the Doorenbos and Pruitt weekly averaged Penman equation proved to be the most accurate. This method had a +/- 15% error which when coupled with the natural spatial variability of the water application regime would give significant variation in leaching fraction across the field even when high technology methods for water application such as solid set sprinklers are used. Such natural limitations to maintaining constant leaching factions will become progressively more severe when smaller leaching fractions are required. There seems to be a practical lower limit to the lowest leaching reaction that can be maintained on a field while also maintaining high crop yields. If the water is being managed primarily for disposal, then little concern need be raised over the part of the field which receives a leaching fraction which would reduce crop yields. (Baker-IVI)
W85-05926

CHLOROPHYLL FLUORESCENCE INDUCTION: A SENSITIVE INDICATOR OF WATER STRESS IN MAIZE PLANTS,
Universite Libre de Bruxelles (Belgium).Lab. de Physiologie Vegetale.
For primary bibliographic entry see Field 2I.
W85-05931

ON-SITE TESTS OF A SEGMENTAL CONSTRICTION AS A FLOWMETER IN LARGE DIAMETER PIPES,
For primary bibliographic entry see Field 8A.
W85-05985

CHLOROPHYLL DIFFERENCES IN MONO LAKE (CALIFORNIA) OBSERVABLE ON LANDSAT IMAGERY,
California Univ., Santa Barbara. Dept. of Geography.
For primary bibliographic entry see Field 2H.
W85-06004

MULTIPURPOSE HEAD DETECTION AND MONITORING UNIT,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, and A. R. Dedrick.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 6, p 1825-1828, November-December, 1984. 3 Fig, 2 Tab, 3 Ref.

Descriptors: *Head detection, *Water level, *Monitoring, Data acquisition, Data processing, Water management, Channel flow.

A water level (head) detection unit was developed which is versatile in its application. The system used an inexpensive pressure transducer and double-bubbler scheme for sensing water head. The double-bubbler scheme provides a method for continual calibration of the pressure transducer (offset and gain compensated). Head detection accuracy was within + or - 1 mm over a wide temperature range. This scheme is monitored and controlled by a hand-held programmable electronic calculator. The calculator and peripheral devices can be used to compute a variety of parameters of interest. This unit has been used along with a measuring flume or weir to record and accumulate flow. It had also been used to monitor infiltration for a flowing furrow infiltrometer. The unit can also be adapted to record water levels from several locations. Since the unit is programmed by simple calculator functions, it is rather simple to convert to new applications. (Author's abstract)
W85-06094

RIVER GAUGING BY ULTRASONICS IN OPEN CHANNELS: INSTRUMENTS AND EXPERIENCE ABROAD (ABFLUSSERMITTLUNG IN OFFENEN GERINNEN MITTELS ULTRASCHALLMESSUNG: IM AUSLAND EINGESETZTE GERATE UND GEWONNENE ERFAHRUNGEN),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
For primary bibliographic entry see Field 2E.
W85-06157

7C. Evaluation, Processing and Publication

RESOLVING THIESSEN POLYGONS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2A.
W85-06054

8. ENGINEERING WORKS

8A. Structures

ON-SITE TESTS OF A SEGMENTAL CONSTRICTION AS A FLOWMETER IN LARGE DIAMETER PIPES,
B. M. Levin, V. M. Nekrasov, B. A. Chavtaraev,

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A. N. Lopatin, and I. K. Dudenko.
Hydrotechnical Construction, Vol. 18, No. 6, p 248-253, June, 1984. 4 Fig, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 12-16, June, 1984.

Descriptors: *Flowmeters, *Segmental constriction, *Pipelines, Flow measurement, Pressurized flow.

On-site tests of a flowmeter with a segmental constriction were conducted on a 3.6 m diameter pressure pipeline at flow rates of 36 to 40 cu m per s. The difference between the results of measuring the flow rate by the segmental meter and the velocity-area method did not exceed 1 to 2%. On the basis of these tests, segmental constrictions are recommended for wide use as flowmeters of pressurized (included suspension transporting) flows in pipes of any diameter. (Keenan-IVI)
W85-05985

ECOLOGICAL ASPECTS OF THE DESIGN AND OPERATION OF CONDUITS OF HYDROELECTRIC SCHEMES,
For primary bibliographic entry see Field 5G.
W85-05986

FINITE ELEMENT ANALYSES OF LOCK AND DAM 26 COFFERDAM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
G. W. Clough, and T. Kuppusamy.
Journal of Geotechnical Engineering, Vol. 111, No. 4, p 521-541, April, 1985. 14 Fig, 3 Tab, 15 Ref, 1 Append.

Descriptors: *Cofferdams, *Design criteria, *Finite element analysis, Model studies, Sheet-piles, Soil mechanics, Construction, Simulation, Seepage, Cellular cofferdams.

Replacement of the old Lock and Dam 26 on the Mississippi River involves construction of one of the largest systems of cellular cofferdams ever built. Preliminary analyses using conventional theories led to sometimes contradictory recommendations about the cofferdam design. To help resolve outstanding issues, instrumentation was placed on the first-stage cofferdam, and finite element procedures were developed for analysis of the cofferdam. Three different two-dimensional finite element procedures were generated, including axisymmetric, vertical slice, and generalized plane-strain models. The alternative approaches allowed prediction of cofferdam response for the most important design conditions and at the critical locations. In all models, allowances were made for nonlinear soil response, slippage on the sheet-pile-soil interfaces, staged construction simulation and seepage effects where appropriate. Further, a means was provided to accommodate the effect of sheet-pile interlock yielding, which led to an orthotropic response of the cellular cofferdam. Predicted behavior from the finite element models was found to be consistent with observed trends. The models appear to have considerable potential for use in future designs. (Author's abstract)
W85-06025

UNDERGROUND DESIGN AT ANDEKALEKA HYDROELECTRIC DEVELOPMENT,
Montreal Engineering Co. Ltd. (Quebec).
R. W. Humphries, and L. T. Jory.
Canadian Geotechnical Journal, Vol. 22, No. 1, p 25-31, February, 1985. 11 Fig, 7 Ref.

Descriptors: *Underground structures, *Design criteria, *Andekaleka Hydroelectric Development, *Malagasy Republic, *Madagascar, Hydroelectric plants, Tunnels, Penstocks, Underground powerplants, Excavation, Laterites, Geological formations.

Andekaleka Hydroelectric Development is located on the Vohitra River, Madagascar, Republic of Malagasy. The hydroelectric development comprises an 8 m high intake dam, a 4 km long unlined power tunnel, a surge shaft, a concrete-lined penstock, four steel-lined branch penstocks, an underground powerhouse, and a 0.5 km long tailrace tunnel. The scheme develops a 235 m fall in the Vohitra River. Two 29 MW Francis turbines have been installed, with space left in the underground powerhouse for two more identical units. Standard drill-and-blast, full-face techniques, and haulage by rubber-tired trucks were used for all underground excavations. The predominant rock type is good quality granitic gneiss, which required minimal underground support and lining. Of particular geotechnical interest are the successful construction of the powerhouse arch supported by rockbolts and reinforced shotcrete; the crane beams supported on rock shoulders; the steel lining of the penstocks restricted the branch penstocks; and the above-ground pipe crossing into laterite slopes, of the power tunnel over the Sahantsiva River. Laterite slopes in key areas have remained stable since watering up. (Moore-IVI)
W85-06043

HYDRAULIC DESIGN OF STORMWATER PUMPING STATIONS: THE EFFECT OF STORAGE,
R. H. Baumgardner.
Transportation Research Record, Vol 948, p 63-70, 1984. 15 Fig, 4 Tab, 2 Ref.

Descriptors: *Hydraulic design, *Design criteria, *Storage, *Storm water, *Pumping stations, Basins, Sediment, Storm drains.

Design guidance is provided for sizing storage facilities used to reduce peak rates of flow at stormwater pumping stations. Estimation of required storage and pumping rates are worked out in an example. Mass curve routing procedures may be used to analyze the design problem once the interrelationships among the following three factors are known: (1) the inflow hydrograph for the contributing watershed, (2) the volumetric storage capacity of the storage facility, and (3) the stage-discharge curve of the pumps. Appropriate formulas and methods must be used for finding the stage-storage relationships in natural earth basins, trapezoidal basins, storm drains, or storage boxes. In application of the mass curve routing procedure, the inflow hydrograph is a fixed design component, and the storage capacity and pumping discharge rates are variables. A design pumping discharge rate may be assigned based on environmental or downstream capacity considerations, with the required storage being determined by various trials of the routing procedure. An inflow mass curve and pump discharge curve are used to determine the amount of required storage capacity. In the final design, the mass curve routing procedure can be fine-tuned after the pumps have been selected. Handling of sediment remains a difficult problem in pumping station design. The storage pipe and wet well should be designed to handle sediment; the pumping system should be designed to carry sediment-laden stormwater in case sediment removal does not occur in the wet well. (Rochester-IVI)
W85-06072

CASE HISTORIES OF SCOUR PROBLEMS AT BRIDGES,
S. R. Davis.
Transportation Research Record, Vol. 950, No. 2, p 149-155, 1984. 8 Fig, 6 Ref.

Descriptors: *Scour, *Bridges, Design criteria, Mathematical models, Streambeds, Bridge design, Bridge failure, River beds.

Designing bridge foundations to resist scour is still a technical area that requires engineering judgment by experienced bridge and hydraulic engineers, and evidence indicates that additional attention to designing for scour is needed. Formulas and mathematical models are still based primarily on theoretical approaches and laboratory tests because of the lack of verifiable field data. Ten case histories of scour problems at bridges were analyzed as a review of the various factors contributing to the problems, corrective actions taken, and the influence of the events on current design practices. Designing bridge foundations remains a technical area that requires use of sound engineering judgement to evaluate field conditions and to apply state of the art knowledge of river mechanics to arrive at a cost effective foundation design. Both of these aspects should be applied on a case by case basis to a degree commensurate with the potential risks and consequences of the loss of the bridge to scour. Analyzing case histories should be used as a means of understanding the conditions and events that contribute to bridge scour and ways to avoid or alleviate scour problems. (Collier-IVI)
W85-06107

ASSESSMENT OF CHANNEL STABILITY AT BRIDGES SITES,
J. C. Brice.
Transportation Research Report, Vol. 950, No. 2, p 163-171, 1984. 11 Fig, 15 Ref.

Descriptors: *Channel morphology, *Bridges, *Aerial photography, *Erosion, Streambeds, River beds, Bank erosion.

Assessment of channel stability from field study and the comparison of time-sequential aerial photographs provides information that is needed in site selection, bridge design, and countermeasure placement. Channel instability is indicated by bank erosion, progressive degradation (or aggradation) of the streambed, or natural scour and fill of the streambed. Bank erosion rates are related to stream type and are proportional to stream size. Predictions of future rates are based on past rates, as measured on time-sequential photographs or maps, and on the typical behavior of meander loops. Significant degradation of the streambed can usually be detected from indirect field evidence. The sites of greatest potential scour along a channel can be identified from channel configuration. Shift of the thalweg, which is a factor in the alignment of piers, is related to stream type and can be assessed from aerial photographs. (Author's abstract)
W85-06109

USE OF SPURS AND GUIDEBANKS FOR HIGHWAY CROSSINGS,
E. V. Richardson, and D. B. Simons.
Transportation Research Record, Vol. 950, No. 2, p 184-193, 1984. 13 Fig, 1 Tab, 48 Ref.

Descriptors: *Road consruction, *Highway crossings, *Bridge construction, Stream morphology, Spur dikes, Dikes, Jetties, Guidebanks, Erosion control, Scour.

Bridge engineers often need to protect bridge abutments from scour; maintain, stabilize, and improve the alignment of a stream approaching a bridge crossing; protect the bank of a stream along a highway; maintain a stream in a given location; maintain or decrease the width of a stream; protect highway approaches to a bridge crossing across flood plains; and improve the hydraulic characteristics of the bridge opening. Spurs and guidebanks are structures river engineers use to fill this need. Other names for spurs are dikes, jetties, spur dikes, retards, and dyke fields. Spurs and guidebanks are described and design recommendations based on a literature review are given. (Author's abstract)
W85-06111

DESIGN GUIDELINES FOR SPUR-TYPE FLOW-CONTROL STRUCTURES,
S. A. Brown.
Transportation Research Record, Vol. 950, No. 2, p 193-201, 1984. 9 Fig, 5 Ref.

Descriptors: *Design criteria, *Spurs, *Channel flow, *Bank protection, Bank stabilization, Stream stabilization, Scour.

Spurs are defined as permeable or impermeable linear structures that project into a channel to alter flow direction, induce deposition, or reduce flow velocities along a channel bank. Spurs can be classified by function as retardance structures (permeable), retardance-diverter structures (permeable), and diverter structures (impermeable). The applicability and design of spur-type flow-control and stream-bank stabilization structures was studied to

establish design guidelines for the use of spurs. The study was conducted jointly by the Sutron Corporation and the Pennsylvania State University for FHWA. Recommendations for the general application of spur-type flow-control structures are given in relation to the function of the spur, the erosion mechanisms that are countered by spurs, the environmental conditions best suited for the use of spurs, and potential negative impacts produced by spurs. Possible design shapes for the head or riverward tip of the spur include straight, T-head, L-head, hocky, and inverted hocky; the recommended form is the simple straight spur-head. The spur tip should be as smooth and rounded as possible; smooth, well-rounded spur tips help minimize local scour and flow velocities at the spur tip. (Collier-IVI)
W85-06112

RIPRAP STABILITY ANALYSIS,
For primary bibliographic entry see Field 2J.
W85-06114

ANALYSIS OF COMMONLY USED RIPRAP DESIGN GUIDES BASED ON EXTENDED SHIELDS DIAGRAM,
For primary bibliographic entry see Field 2J.
W85-06115

ASSESSING VULNERABILITY OF BRIDGES TO FLOODS,
E. M. Laursen.
Transportation Research Record, Vol. 950, No. 2, p 222-229, 1984. 9 Fig, 29 Ref. FHWA Research Project HRP-1-19(184).

Descriptors: *Flood damage, *Bridges, *Design criteria, Evaluation, Construction, Scour, Hydraulic properties, Mathematical equations, Damage.

Efforts are made to lessen the vulnerability of bridges to flood damage. In the design phase of new bridges, hydraulics and scour should be duly considered in planning, site selection, and final design. In the matter of existing bridges, new and old, it is much more difficult to work out solutions. A program is needed to assess the vulnerability of every existing bridge and to contrive remedial measures to lessen vulnerability of those worth saving. Due to the vast number of bridges that would be involved as well as questions which remain in the hydrological aspects of the situation, such a program would be difficult to accomplish. The results of lab investigations of the scour at the toe of sill structures are given in the form of scour predicting equations for a vertical well and for a sloping sill. (Baker-IVI)
W85-06116

GUATEMALAN GREMLINS WREAK HAVOC UNDERGROUND,
D. Martin.
Tunnels and Tunnelling, Vol. 17, No. 1, p 14-19, January, 1985. 5 Fig.

Descriptors: *Guatemala, *Hydroelectric plants, *Quixal, *Tunnel construction, Geology, Tunnels, Tunneling, Lithology, Engineering geology, Construction equipment.

A 300 MW hydroelectric station has recently been completed in Guatemala. The tunneling contract included driving a 26 km long water supply tunnel from the reservoir at Pueblo Viejo to the power station at Quixal. This was in two parts: a 7600 m long tunnel from Pueblo Viejo to Agua Blanca and a 17,880 tunnel from Agua Blanca to the power plant, with the stipulation that 11,400 m of this be driven from Aqua Blanca. At Pueblo Viejo the work included building an intake structure, trash rake, inspection building and 55 m high valve tower. Extensive geological and hydrological investigations were carried out with special attention to areas of expected groundwater ingress in areas of high rainfall at Quixal and Pampur. However, samples were not studied under the microscope in the high rainfall area and insuffienctly detailed knowledge of the strata's mineralogy contributed to the problems that followed. The difficult faulted and folded karstic lithology brought extreme problems of water ingress and rockfalls causing the loss of a TBM at one stage. The inflow of water at up to 1000 liter/s was concentrated in confined spaces and created a difficult environment for many months. The construction work was finally completed in November 1982 in spite of additional rockfalls and colllapses in the tunnel and, of course, the water. The TBMs used were subject to the most difficult wear and strain and effects of water. The fullface TBM drive proved superior to the other methods used in these conditions. (Collier-IVI)
W85-06121

BALSAM MEADOW HYDRO PROJECT BEATS TIME AND HOLDS BUDGET,
D. Martin.
Tunnels and Tunnelling, Vol. 17, No. 3, p 19-22, March, 1985. 7 Fig.

Descriptors: *Tunnels, *Hydroelectric plants, *Construction, *Balsam Meadow, *California, Water resources development, Pumped storage.

The Balsam Meadow hydroelectric and pumped storage project will utilize most of the elevation head of water from Huntington Lake by transferring it to the lower Shaver Lake, located in southern California in the Sierra Nevada Mountains. Water will be diverted from an existing tunnel through a new 5868 ft long diversion tunnel into Balsam Meadow forebay, from where it will enter the power plant via a 282 ft upper power tunnel, a 959 ft vertical power shaft and a 1276 ft lower power tunnel. There is no classified support system for the upper power tunnel as a whole, and support will be provided only as required. Records have been set in raiseboring and some skilled shaft sinking is being carried out in the hard Sierra Granite to bring about the completion of this project. (Baker-IVI)
W85-06122

SMALL HYDRO SUPPLEMENTS IRRIGATION SCHEME,
Sacramento Municipal Utility District, CA.
G. Rummel, and B. Van Weele.
International Water Power and Dam Construction, Vol. 37, No. 4, p 19-25, April, 1985. 5 Fig.

Descriptors: *Water resources development, *Hydroelectric plants, *Irrigation programs, *California, Tunnels, Construction, Reservoirs, Small hydro, Dams.

A number of unusual engineering problems were encountered during the addition of a small scale hydro station to an existing irrigation scheme in California. One of these included driving a tunnel under an operating reservoir. The 6.8 MW Camp Far West hydraulic project was conceived as an addition to an existing dam and reservoir. The project is 40 miles northeast of Sacramento on the Bear River, with a catchment area of 285 sq miles and the headwaters of which originate at the lower eastern slope of the Sierra Nevada mountains. A feasibility study concluded that the existing dam and low level outlet works proved suitable for such a project and identified 12 project configurations which were possible. Preliminary designs and layouts were conducted during the planning, licensing, exploration, and design phases that greatly aided in the organized approach and sound development of the project. Detailed preliminary designs were performed to determine the foundation, elevation, and best type of cofferdam. (Baker-IVI)
W85-06128

CONSTRUCTION OF RIDING MILL WEIR,
D. J. Banks, I. Brooks, and W. M. Johnson.
Proceedings of the Institution of Civil Engineers, Vol. 77, p 195-216, February, 1985. 12 Fig, 1 Tab, 3 Ref, 1 Append.

Descriptors: *Weirs, *Construction, *Riding Mill Weir, *River Tyne, *England, Cofferdams, Piles, Costs, Sheet piles, Secant piles.

Construction of a concrete weir across the River Tyne is described, particularly the problems encountered and how they were overcome in driving sheet pile cofferdams and secant piles through densely packed large boulders. The weir was constructed as an integral part of the Kielder Water Scheme. It is required to provide an intake pond for Riding Mill Pumping Station which will transfer up to 1180000 cu m/day of water to the rivers Wear and Rees, to maintain minimum downstream flows, and to enable accurate low flow measurement of the Tyne. The proposed method had to be altered because of difficulties encountered in driving piles, which resulted in additional costs. There were areas where densely packed boulders in a matrix of sand could neither be split nor pushed aside. Boulders were removed by excavating in advance a trench up to about 2.5 m deep below river bed and backfilling this with compactable granular material. Then the sheet piles could be driven to the required depth. (Moore-IVI)
W85-06172

EMPINGHAM RESERVOIR PROJECT (RUTLAND WATER),
A. J. H. Winder, R. G. Cole, and G. E. Bowyer.
Proceedings of the Institution of Civil Engineers, Vol. 78, p 219-246, April, 1985. 13 Fig, 2 Tab, 29 Ref, 3 Append.

Descriptors: *Empingham Reservoir Project, *England, Legislation, Dam design, Construction, Tunnels, Pipelines, Reservoirs, Landscaping, Archaeology.

The need for the Empingham Reservoir Project arose from a steady increase in demand for water in the East Midlands (England) in the 1960s, accelerated by five planned special expansion areas. The paper briefly describes the promotion of the Parliamentary Act, the organization established to design and construct the project, the river intakes, the supply tunnels and pipelines, and the reservoir, together with some of the difficulties overcome. There are also comments on the landscaping and archaeological findings on the site. It is intended as a general introduction to the project, and to the other papers being presented. (Author's abstract)
W85-06173

8B. Hydraulics

HYDRAULICS OF THE LOWER POOL OF THE DUBOSSARY HYDROELECTRIC SCHEME,
K. S. Popova.
Hydrotechnical Construction, Vol. 18, No. 6, p 260-264, June, 1984. 3 Fig, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 20-24, June, 1984.

Descriptors: *Hydroelectric plants, *Hydraulic properties, *Dubossary Hydroelecric Plant, *USSR, Dniester River, Reservoir operation, Turbulence, Hydraulic roughness, Dissipators, Spillways, Velocity, Dam design.

A study of the current regimes in nonuniform opening of dam gates and of erosion occurring the the lower pool is of great importance for designing new hydraulic structures and operating existing hydraulic structures. The operating experience at the Dubossary hydroelectric station on the Dniester River (USSR) is reviewed. The hydroelectric scheme is composed of an overflow dam with eight 13-m-wide bays with vertical lift gates, a powerhouse with four units combined with outlets above the spiral casings, and left-bank and right-bank earth dams. Since the first year of operation (1955), considerable problems have occurred due to erosion in the lower pool. The causes included insufficient dissipating and distributing action of the roughness ridges; the formation of additional turbulence due to a triangular dissipator located at the end of the rigid apron; nonuniform discharge along the spillway front; flow velocities greater than the design values; poor quality of early repair efforts; and, increase of the unit discharges on the apron of the dam compared with those calculated with closed bottom outlets of the hydroelectric station. (Keenan-IVI)
W85-05987

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CHARACTERISTICS OF THE DRAG ON BAFFLE BLOCKS,
D. V. Shterenlikht, and A. B. Maslov.
Hydrotechnical Construction, Vol. 18, No. 6, p 265-268, December, 1984. 3 Fig, 13 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 24-26, June, 1984.

Descriptors: *Baffles, *Drag, *Hydraulics, Kinematics, Hydraulic structures, Hydraulic jump, Velocity, Cavitation, Design criteria.

The diversity of hydraulic phenomena in the lower pool of hydraulic structures, flow transition regimes, types of revetments and designs of dissipators in combination with the different geology and topography of the site of a hydroelectric scheme under construction considerably hamper the development of a general method of calculating and designing dissipators of the excess kinetic energy of the flow. Experimental investigations were performed to determine the relationship between the drag coefficients of baffle blocks and the kinematic characteristics of the flow and geometric parameters of baffle platforms. A laboratory-scale flume with a vertical lift gate and two rows of baffle blocks was employed to determine the required parameters. Three possible flow movement schemes on the horizontal baffle platform were examined. A change in the regimes of the fluid results in a change in the velocity characteristics of the flow, which in turn affects the reaction of the baffle blocks. The values of the drag coefficient increases as the baffle blocks approach the vena contracta. As the submergence of the baffle block increases, the drag coefficient of the block begins to decrease to a minimum value. In this case the hydraulic jump is in a limit state. A further increase in the natural depth and transition to a submerged hydraulic jump is accompanied by an insignificant increase in the values of the drag coefficient. A decrease in the relative height of the baffle block leads to an increase in the drag coefficient. An increase in the Froude number in the vena contracta leads to some decrease in the drag coefficient of the baffle block. The experimental results obtained can be used for calculating the geometry of the baffle plates of outlet works before the start of cavitation under two-dimensional conditions of their operation. (Shieh-IVI)
W85-05988

STAGE-FREQUENCY ANALYSIS AT A MAJOR RIVER JUNCTION,
Army Engineer District, St. Louis, MO.
For primary bibliographic entry see Field 2E.
W85-06035

HYDRODYNAMIC PRESSURES ACTING UPON HINGED-ARC GATES,
Wroclaw Technical Univ. (Poland). Inst. of Geotechnical Science.
For primary bibliographic entry see Field 8C.
W85-06036

8C. Hydraulic Machinery

HYDRODYNAMIC PRESSURES ACTING UPON HINGED-ARC GATES,
Wroclaw Technical Univ. (Poland). Inst. of Geotechnical Science.
R. Rogala, and J. Winter.
Journal of Hydraulic Engineering, Vol. 111, No. 4, p 585-599, April, 1985. 5 Fig, 3 Tab, 21 Ref, 2 Append.

Descriptors: *Hydrodynamics, *Hinged-arc gates, *Gates, Mathematical models, Mathematical equations, Pressure pulsation, Turbulence, Velocity.

The major load acting upon a hinged gate is hydrodynamic water pressure, the values of which must be determined if the structural members are to be dimensioned. A new method for calculating the mean value of the local hydrodynamic pressures acting upon a hinged gate and a mathematical model of pressure pulsation are developed. The mean hydrodynamic pressure at an optional point on the surface of a hinged gate is obtained by using the Bernoulli equation and model test data. The problem of the pulsation phenomenon of hydrodynamic pressure is solved by considering the random character of the process and by making measurements of pressure fluctuation. The experimental results and the characteristics of the processed signals obtained from the numerical analysis confirm theat the major cause of hydrodynamic pressure pulsations is flow-velocity pulsation due to turbulence. The pulsation frequency structure is not dependent on the position of the point examined on the gate. At any given point, the pulsation process varies only in its intensity, which increases along with the increase in flow intensity. A normalized power density spectrum equation, which characterized the frequency of the pressure pulsation, is derived. (Moore-IVI)
W85-06036

SMALL HYDRO PROGRESS IN MALAYSIA,
National Univ. of Malaysia, Bangi. Faculty of Economics.
For primary bibliographic entry see Field 6B.
W85-06129

DESIGNING GATES FOR SMALL HYDRO SCHEMES,
Watson and Noble Consulting Engineers, Auckland (New Zealand).
B. W. Leyland, G. R. Jessup, and S. R. Berry.
International Water Power and Dam Construction, Vol. 37, No. 4, p 33-37, April, 1985. 8 Fig, 3 Ref.

Descriptors: *Hydroelectric plants, *Design criteria, *Gates, *Small hydro, Penstocks, Intake gates, Spillways, Flip gates, Sluice gates, Engineering.

Small unattended hydro schemes pose special problems to the gate designer - how to design a gate that is cheap to build, easy to install and at the same time highly reliable. The loads on the gate must be calculated under all operating conditions. Lifting equipment should be designed to operate reliably under all operating conditions, with an adequate margin of safety. Gate seals can be a cause of difficulty. For intake gates, opening and closing times are dictated by the requirement of the turbine and any constraints imposed by the penstock. The level of reliability required for the gate operating system depends largely on the function of the gate. In all designs, tolerance to allow for correction of manufacturing errors should be included. Specifics are offered for penstock intake gates radial spillway gates, flap gates, sluice gates, automatic water level control gates, gate control and lifting gear, gate seals, installation and operation. While past experience should not be cast aside lightly, with the continuing development of materials and construction methods, an innovative approach can often be justified by the potentially large savings in cost. Care should be exercised to ensure that the resulting design is not over complicated. (Baker-IVI)
W85-06130

8D. Soil Mechanics

TENSILE AND COMPRESSIVE STRENGTH OF CLAYS FOR ASSESSING CRACKING CONDITIONS IN DAMS,
I. M. Vasilev.
Hydrotechnical Construction, Vol. 18, No. 6, p 241-247, June, 1984. 6 Fig, 1 Tab, 13 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 8-12, June, 1984.

Descriptors: *Clay, *Earth dams, *Soil strength, *Compressive strength, *Cracking, Mathematical equations, Soil physical properties, Strength, Linear deformation.

The traditional methods of checking a soil mass for cracking usually results in a considerable overestimation of the zones of possible discontinuity. Therefore, a need exists for a broader study of soil behavior under various tensile-compressive loading conditions. Experimental investigations were performed to establish the relationship expressing the theoretical construction of the total limit surface of strength, which is essential for the assessment of cracking conditions of a structure. Based on the values of the tensile and compressive strength of the homogeneous isotrophic soils as well as the relationships of the breaking linear deformations in tension and compression, approximate mathematical equations of the total limit surface of strength for any combinations of tensile-compressive loadings were derived. The applicability of the proposed mathematical equations for engineering problems was checked by experiments. (Shieh-IVI)
W85-05984

EXPERIENCE IN THE OPERATION OF HYDRAULIC STRUCTURES AND EQUIPMENT OF HYDROELECTRIC STATIONS; LEFT-BANK DAM OF THE BRATSK HYDROELECTRIC STATION,
Z. I. Solov'eva, and Yu. A. Zhebelev.
Hydrotechnical Construction, Vol. 18, No. 6, p 278-284, June, 1984. 5 Fig, 2 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 33-38, June, 1984.

Descriptors: *Earth dams, *Bratsk Hydroelectric Station, *USSR, Seepage, Drainage, Soil physical properties, Strength, Cracks, Shear, Stress, Soil consolidation.

The behavior of the left-bank earth dam of the Bratsk hydroelectric station was examined based on on-site observations and investigations performed during 1967-1983. The earth dam was constructed of gravel-sand filled with a loam core. The maximum height is 41 m, crest width 22 m. The gradients of the upstream slope and the downstream slope are 1:2.75 and 1:2 to 1:2.5, respectively. The upstream slope of the dam rests against a rock heel. Settlement of the dam due to consolidation of its soils has not ended, but is already noticeably decreasing. Settlement of the downstream slope is less intensive and more uniform. The seepage regime at the dam site meets the calculated condition, but differs from the design forecast because of the anisotropy of the sandstones which was not taken into account during modeling of the dam foundation. The drainage system at the left-bank dam is operating satisfactorily in conformity with the design criteria. Two tunnels were repaired in 1979 and are presently in good condition. No work as carried out on the other two tunnels during operation. The tunnels are in good condition. The data collected during 1967-1983 indicate that the left-bank dam of the Bratsk hydroelectric station is operating satisfactorily. The experimental results obtained indicated that the boundary, which separates the limit surface of strength into forms of fracture by extension and shear, can be approximated by a linear relation. Two conditions of limit equilibrium should be included in the calculation for extension, in order to assess the behavior of soil in the case of occurrence of tensile stresses; and for shear, in order to determine the depth of propagation of the extension crack. Once the size of the first crack and the corresponding state of stress and strain are established, the calculation cycle should be repeated for determination and consideration of the formation of the second, third, etc. cracks until a stable state of extension of the entire soil mass. (Shieh-IVI)
W85-05990

SETTLEMENT ANALYSIS OF EMBANKMENTS ON SOFT CLAYS,
Illinois Univ. at Urbana-Champaign.
G. Mesri, and Y. K. Choi.
Journal of Geotechnical Engineering, Vol. 111, No. 4, p 441-464, April, 1985. 17 Fig, 24 Ref.

Descriptors: *Clay, *Embankments, *Settlement, Compressibility, Soil mechanics, Interstitial water, Pressure dissipation, Computers, Consolidation, Permeability coefficient.

Highly realistic analysis of the consolidation of soft clays is possible within the framework of the traditional concepts of soil mechanics. A practical method is described for predicting the magnitude and rate of settlement and pore water pressure dissipation. Detailed interpretation and evaluation

of the consolidation properties of soft clays, including the compressibility parameters, preconsolidation pressure and coefficient of permeability are presented. These properties can be determined from the standard oedometer test with direct permeability measurements. Computer procedure ILLICON, using multi-layer analysis, includes any variation of consolidation parameters with depth. The proposed method for evaluating the consolidation parameters, and settlement and pore water pressure analyses is illustrated using case histories of two test fills on soft clays. Excellent agreement is obtained between the computed behavior and field observations. (Author's abstract)
W85-06023

INVESTIGATION OF MOISTURE-INDUCED VARIATION IN SUBGRADE MODULUS BY CROSS-CORRELATION METHOD,
S. S. Bandyopadhyay, and J. A. Frantzen.
Transportation Research Record, Vol. 945, p 10-15, 1984. 8 Fig, 1 Tab, 21 Ref.

Descriptors: *Soil water, *Construction, *Subgrade modulus, Soil properties, Soil mechanics, Highways, Precipitation, Rainfall.

The change in moisture content of subgrade soils and its resultant effects on structural pavement performance are of interest to many highway engineers. One of the primary sources of moisture in the subgrade is water from precipitation. The feasibility of statistically relating the variation in subgrade modulus with the corresponding time history of precipitation was investigated. The study showed that the subgrade modulus is directly affected by precipitation. The time required for the subgrade to reach its weakest state after a rainfall is quite long; depending on local factors, it might be as long as 3 weeks. At the 95 and 99% confidence levels a correlation is found to exist between the two time series - precipitation history and corresponding variation in subgrade modulus. (Baker-IVI)
W85-06063

8E. Rock Mechanics and Geology

RELIABILITY OF ROCK FOUNDATIONS OF CONCRETE DAMS AND SOME RECOMMENDATIONS ON THEIR ASSESSMENT,
E. G. Gaziev, and E. S. Kalustyan.
Hydrotechnical Construction, Vol. 18, No. 6, p 274-277, June, 1984. 3 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 30-33, June, 1984.

Descriptors: *Dam foundations, *Foundation failure, *Concrete dams, Flood damage, Reservoir operation, Earthquakes, Shear strength, Erodibility.

The operating reliability of a dam, including the reliability of its foundation at the contact with the dam and at depth, can be evaluated on the basis of criteria characterizing the final state of the structure (failure or damage) as a result of its interaction with the environment. Based on the historical record of rock foundations of concrete dams the probability of failure is 0.3% and the probability of damage is 2.7%. Combining failures with damage, 78% of such incidents occur during filling of the reservoir, 16% as a result of floods, 2% related to earthquakes and 4% as a result of other forces. These incidences were due to increases in permeability of the foundation (57%), nonuniform deformability of the foundation (22%), disturbance of the shear strength of the rock in the foundation (9%) and erodibility of the rocks of the lower pool (12%). (Keenan-IVI)
W85-05989

UNDERGROUND DESIGN AT ANDEKALEKA HYDROELECTRIC DEVELOPMENT,
Montreal Engineering Co. Ltd. (Quebec).
For primary bibliographic entry see Field 8A.
W85-06043

8F. Concrete

ATTRITION RATES OF SOIL-CEMENT SUBJECTED TO WATER JETS,
L. L. Litton, and R. A. Lohnes.
Transportation Research Record, Vol. 941, p 18-23, 1984. 7 Fig, 4 Tab, 2 Ref.

Descriptors: *Cement, *Erosion control, *Soil-cement, Channel improvement, Stream stabilization, Alluvium, Strength, Loess, Freezing, Velocity.

Laboratory erosion tests on cement-stabilized alluvium and alluvium-sand mixtures from western Iowa produce attrition rates that decrease with time at a constant water velocity. In laboratory tests, specimens lost 54-97% of their total weight loss during the first 30 min of a 5 hr test at a constant water velocity. Apparently, the basic soil cement erosion resistance is greater than any erosive force applied to the laboratory test specimens thus far. The material lost under the erosive forces was presumably that which deteriorated during the freezing and thawing cycles, and the reduction in the rate of erosion was a consequence of reaching material that was weathered to a lesser degree. As anticipated, the attrition rate decreased with increasing relative durability of the soil-cement. Although the results of the laboratory tests cannot be used to predict directly the attrition rate of soil cement used in a stream channel grade-stabilization structure, the general time-loss behavior is thought to be valid. The implications of the laboratory tests as they relate to field implementation are: soil cement composed of loess derived alluvium and sand with alluvium will withstand high water velocities. At any given flow rate, the attrition rate of the soil-cement will decrease rapidly; therefore, the soil-cement will reach a stable configuration relatively early in the flow event and subsequent material loss will be minimal. (Baker-IVI)
W85-06062

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 18, NUMBER 12
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 18, NUMBER 12
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W85-06174 -- W85-07164

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

HYDROLOGIC ENGINEERING CENTER PLANNING MODELS,
Hydrologic Engineering Center, Davis, CA.
D. T. Ford, and D. W. Davis.
Water Resources Bulletin, Vol. 21, No. 1, p 135-143, February, 1985. 5 Fig, 37 Ref.

Descriptors: *Hydrologic models, *Model studies, *Computers, *Reviews, Statistical models, Planning, Water resources development, Catchments, Channels, Alluvial plains, Data management.

The US Army Corps of Engineers has broad, nationwide water resources planning and management responsibilities. In response to the needs of Corps professionals, the Hydrologic Engineering Center has developed and supports a family of computer programs designed to aid them in their work. These programs include catchment, channel, alluvial, and statistical process models, system operation models, plan evaluation models, and data management programs. These models individually and collectively have been used throughout the Corps in wide ranges of water resources planning studies. Future plans include improving existing models, converting existing models to execute on microcomputers, and developing new models to meet the needs of Corps study requirements. All new models developed now follow software engineering guidelines that are intended to yield programs that are reliable, easily transported from one computer system to another, readily modified, and easily supported and maintained. (Baker-IVI)
W85-06247

INVENTORY OF COURT CREEK WATERSHED CHARACTERISTICS THAT MAY RELATE TO WATER QUALITY IN THE WATERSHED,
Illinois State Water Survey Div., Peoria. Water Quality Section.
D. Roseboom, R. L. Evans, J. Erickson, and L. G. Brooks.
Illinois Department of Energy and Natural Resources, Document No. 83/23A. SWS Contract Report 322, August 1983, 102 and 135 p, 32 Fig, 30 Tab, 30 Ref, 8 Append (in separate volume).

Descriptors: *Land use, *Aerial photography, *Wildlife conservation, *Time series analysis, *Cropland, *Land classification, *Channeling, Land development, Strip mines, On-site data collections, Wildlife habitats, Surveys.

Land use changes in 98-sq. mile watershed are detailed on the basis of aerial photographs made from 1940 to 1979. The photographic analysis for 1979 was checked with ground surveys of the watershed. The major land use changes in agricultural watersheds were the conversion of pastures to row crops or wooded area. One large tributary, Sugar Creek, was altered from agriculture to strip mining and real estate development. Extensive stream channelization occurred in the broad glacial-alluvial valley in order to maximize row crop field size. Major bank erosion sites were apparent in the aerial photographs in the channelized areas. The study involved performing an inventory of the watershed, selecting stream sampling stations, installing measuring devices, and reconnoitering streams and terrain. The watershed will support about 280 whitetail deer, and quail populations will likely reach their highest counts per site (30-40) on woody stream corridors with a diversity of timber and pasture. The watershed will produce about 2,040 raccoons annually at an estimated value of $52,000. A Canadian goose population has been established in the strip mining area, and is starting to move into surrounding impoundments. Any conservation practices that will lead to more diversity of habitat will improve the quantity and quality of wildlife in the watershed. There are no known rare or endangered species using the watershed on a permanent basis. (Hawkins-Omniplan)
W85-06331

SPECIAL GROUND WATER STUDY, BASIN-WIDE REPORT AND EXECUTIVE SUMMARY.
Delaware River Basin Commission, West Trenton, NJ.
December 1982. 148 p. 27 Fig.

Descriptors: *Delaware River Basin, *Regional analysis, *Surface-groundwater relations, *Groundwater movement, *Confine aquifers, *Drilling, *Wells, Groundwater flow, Stream discharge, Groundwater storage, Artesian aquifers, Aquifers, Regional planning.

The surface and ground water resources of the Delaware River Basin are interrelated and act as a unit. Ground water constitutes a major portion of the flow of perennial streams. When wells are located farther from streams, flow impacts resulting from induced infiltration lessen. The unconsolidated Coastal Plain formations, and the glacial outwash deposits and carbonate aquifers in the Uplands are, in general, more easily recharged and have greater storage capacity than the remaining aquifers in the basin. Conjunctive use schemes that employ seasonal use of ground and surface water could minimize localized water supply and streamflow depletion problems associated with ground water development. Withdrawal limits guidelines for confined aquifer systems in the Coastal Plain should consider the extensive regional flow patterns characterized by these systems. These regional flow patterns preclude management on a watershed basis. Withdrawal limits guidelines for aquifer systems other than these confined aquifers should consider the interrelationship of surface water and ground water, and treat the resource as a single hydrologic system. Waste plume contamination problems are found in all aquifer groups. The Cohansey-Kirkwood aquifer and corbonate aquifers sensitive to dissolution are most likely to be adversely affected. Solutions for long-term management depend on detailed knowledge of the occurrence and movement of ground water. (Hawkins-Omniplan)
W85-06337

MEASURED EVAPORATION IN HIGH RAINFALL AREAS, LEEWARD KO'OLAU RANGE, OAHU, HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 2D.
W85-06345

ROCKY MOUNTAIN ACIDIFICATION STUDY,
Colorado State Univ., Fort Collins. Natural Resources Ecology Lab.
For primary bibliographic entry see Field 5C.
W85-06359

AUTOMATIC CALIBRATION OF CONCEPTUAL CATCHMENT MODELS USING DERIVATIVE-BASED OPTIMIZATION ALGORITHMS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
V. K. Gupta, and S. Sorooshian.
Water Resources Research, Vol. 21, No. 4, p 473-485, April, 1985. 11 Fig, 4 Tab, 30 Ref, 2 Append.
DOE grant DEACO 180RA50256, NWS grant NA 83AAA 02788, NSF grant CEE-8217823.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Algorithms, *Optimization, Catchment area, Model studies, Simulation, Calibration, Structural identifiability.

This paper examines the possibility of using derivative-based optimization algorithms for automatic calibration of conceptual rainfall-runoff models with threshold structures. A method is discussed for explicit computation of the derivatives based on an analysis of the modality of behavior present in such models. In the method the threshold structures are not replaced by smoothing functions, thereby preserving the conceptual integrity of these models. The discussion includes a theoretical analysis of a single linear reservoir (with threshold) model which provides some insights into the issue of threshold parameter identifiability. Simulation study comparisons of the Newton (derivative based) and the Simplex (direct search) optimization algorithms indicate that the former is more efficient, especially when the number of parameters to be optimized is large. However, the results indicate that careful study of the issues related to model identifiability is required if any significant progress is to be achieved in the area of automatic calibration of conceptual rainfall-runoff models. (Author's abstract)
W85-06502

ANALYSIS OF STRUCTURAL IDENTIFIABILITY: THEORY AND APPLICATION TO CONCEPTUAL RAINFALL-RUNOFF MODELS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. Sorooshian, and V. K. Gupta.
Water Resources Research, Vol. 21, No. 4, p 487-495, April, 1985. 3 Fig, 7 Tab, 24 Ref, 2 Append.
NSF grant CEE-8217823.

Descriptors: *Structural identifiability, *Rainfall-runoff relationships, *Mathematical models, Hydrologic models, Model studies, Parameter estimation.

The identification of a conceptual hydrologic model involves two stages: selection of a suitable model structure and parameter estimation. These two stages cannot be treated as distinct, and it is important that the limitations of available parameter estimation methodologies be given serious consideration during the procedure of model structure selection. This paper focuses on the concepts and tools necessary for the evaluation of whether the structure of a hydrologic model is such that its parameters can be successfully identified. A definition of structural identifiability is advanced that is based purely on model properties and is independent of the stochastic nature of the output observation errors. The approach is used to develop a measure of local structural identifiability which is useful in the analysis of parameter sensitivity. A measure, called the sensitivity ratio, is introduced which is suitable for studying parameter interactions in the multidimensional parameter space. Also, the use of allowable reparameterizations to improve identifiability is discussed. The utility of the concepts discussed in this paper are demonstrated by a simulation example using a conceptual rainfall-runoff model. (Author's abstract)
W85-06503

STOCHASTIC STREAMFLOW MODEL BASED ON PHYSICAL PRINCIPLES,
Portland State Univ., OR. Dept. of Civil Engineering.
R. W. Koch.
Water Resources Research, Vol. 21, No. 4, p 545-553, April, 1985. 8 Fig, 3 Tab, 29 Ref.

Descriptors: *Streamflow, *Stochastic process, *Model studies, *Rainfall-runoff relationships, Precipitation, Drainage, Storm seepage, Soil water, Hydrologic models.

Based on hydrologic arguments, a stochastic model for discretized streamflow from rainfall is proposed in the form of an averaged filtered Poisson process (FPP). Using a two-component description with excess precipitation and drainage as inputs to the surface and subsurface flow systems, simplified models are presented for the physical processes. The mean, variance, and covariance function of discretized streamflow are computed in terms of the first and second moments of excess precipitation and drainage which are derived analytically. The behavior of the stochastic properties of streamflow is evaluated for various soil types, basin travel times, and effective initial soil water contents. Where there is an intuitive feeling for the interaction of physical characteristics and stochastic properties, such as the mean, the model appears to produce qualitatively correct results. Prediction of stochastic properties is limited by the selection of an effective initial soil moisture value. (Author's abstract)
W85-06508

APPLICATION OF A CELL MODEL TO THE BELLEBEEK WATERSHED,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W85-06638

HYDROLOGICAL DATA-MODEL WORK IN GREENLAND,
Greenland Technical Organization, Copenhagen (Denmark).
Th. Thomsen, and G. H. Jorgensen.
Nordic Hydrology, Vol. 15, No. 1, p 39-56, 1984. 11 Fig, 3 Tab, 7 Ref.

Descriptors: *Hydrologic models, *Greenland, *Rainfall-runoff relationships, *Ablation runoff, Precipitation, Ice, Drainage basins, Melting, Rainfall, Snow, Freezing, Glaciers.

The hydrological regions vary greatly in Greenland, depending on whether the drainage basin is influenced by ablation runoff. To describe a runoff time series from these areas, a hydrological model calibration is made, followed by a simulation. In drainage basins influenced by rain and snow only, a slightly modified version of the precipitation runoff model (NAM) is applied. The parameter transfer for the determination of model input is found by intensive data analysis work between Nuuk and Kangerluarsunnguup Tasersua for temperature and precipitation along with detailed investigation in the basin. This is to ensure that a too short calibration period in connection with the adaption of a hydrological model to the basin data is balanced in such a manner that these adapt the hydrological model, and not vice versa. In drainage basins also influenced by ablation runoff it is not possible to use a traditional precipitation runoff model but a hydrological ablation model has been developed in cooperation with the Geological Survey of Greenland. The hydrological ablation model describes the transfer of the temperature after heating and cooling factors as well as snow mobility on the ice, melting density criteria, and refreezing. The model is applied to the hydrological basin of Paakitsup Akuliaruserua at Ilulissat where 90% of the drainage basin is covered by the ice cap. (Baker-IVI)
W85-06639

RUNOFF PATTERN AND PEAK FLOWS FROM MOVING BLOCK RAINS BASED ON A LINEAR TIME-AREA CURVE,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 2E.
W85-06647

LAND ENVIRONMENTS OF WATER RESOURCE MANAGEMENT,
Georgia Univ., Athens. School of Environmental Design.
B. K. Ferguson.
Journal of Environmental Systems, Vol. 14, No. 3, p 291-312, 1984-85. 9 Fig, 4 Tab, 27 Ref.

Descriptors: *Resources management, *Water management, *Landforms, Hydrologic properties, Soil properties, Bedrock, Water resources development, Planning, Physiography.

This article attempts to look across a broad range of hydrologic disciplines in order to compare the types of hydrologic phenomena and processes that occur in different types of land environments, and to develop a conceptual framework for basic hydrologic classification of land. It emphasizes the qualitative types of hydrologic processes that may occur in the landscape, rather than quantitative rates of flow. The framework was developed by reclassifying physiographic land forms according to hydrologic characteristics, and examining different landform types in photographs and on the ground. The framework is based around landform, hydroclimate, and regional aquifers and rivers. Landforms are characterized as hydrologically 'positive' or 'negative,' with positive landforms being further broken down by permeability of soil and bedrock. Such a framework could help to guide early water resource planning decisions by aiding the comparison of contrasting needs and potentials of different areas. It can thus have important implications for the types of solutions to water resource issues that are attempted. (Author's abstract)
W85-06695

NEW MATHEMATICAL MODELING SYSTEM,
University of the Pacific, Stockton, CA. Dept. of Civil Engineering.
R. C. Johanson.
ACS Symposium Series, Vol. 259, p 125-147, 1983. 12 Fig, 13 Ref.

Descriptors: *Hydrologic models, *Mathematical models, *Simulation, Sedimentation, Pesticides, Fate of pollutants, Hydrolysis, Photolysis, Oxidation, Streams, Rivers, Lakes.

The Hydrological Simulation Program - Fortran (HSPF) simulates the movement of water, sediment and many associated constituents over and under the land surface, and through streams, rivers and shallow lakes. It is a relatively new package, funded by the EPA. There are two classes of operating module in HSPF: application modules - which simulate the behavior of processs which occur in the real world, and utility modules which perform housekeeping operations on time series. The Pervious Land-segment Module (PERLND) is discussed with emphasis on hydrologic simulation, sediment simulation, and pesticide simulation. Other modules discussed include the Impervious Land-segment module (IMPLND); the Reach/reservoir module (RCHRES), with emphasis on hydraulic routing, sediment routing, and pesticide simulation; utility modules; software design considerations; and operation of the model. Experience with HSPF shows that programming errors are rare, and the code is easy to follow. Operating modules and individual subprograms have been added or modified with relative ease. Adaptation of HSPF to computers with widely differing memory configurations and word lengths has been relatively simple. The program has been used in a variety of situations ranging from simple single land-segment simulations to studies involving complex networks. (Baker-IVI)
W85-06767

BASIC HYDROLOGY,
Memorial Univ. of Newfoundland, St. John's.
J. J. Sharp, and P. G. Sawder.
Butterworth, Boston. 1984. 150 p.

Descriptors: *Hydrology, *Computer programs, *Precipitation, *Runoff, Surface runoff, Rainfall, Hydraulic engineering, Engineering, BASIC, Depth-area-duration analysis, Evaporation, Evapotranspiration, Frequency analysis, Streamflow, Hydrographs, Reservoir design.

The basic elements of the computer language BASIC and hydrology are combined for undergraduate students and practicing engineers. The essential theory and examples of computer programs are given for precipitation, evaporation, frequency of rainfall, stream flow and surface runoff, the unit hydrograph, and reservoir design.
W85-06931

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 4: DIEL PERIODICITY OF BENTHIC MACROINVERTEBRATE DRIFT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. R. Bingham, S. P Cobb, and A. D. Magoun.
Miscellaneous Paper E-80-1, December 1980. Report 4 of a Series. 31 p, 11 Fig, 1 Tab, 15 Ref, 1 Append.

Descriptors: *Benthos, *Rivers, *Macroinvertebrates, *Benthic fauna, *Diurnal distribution, *Species composition, *Species diversity, *Aquatic habitats, Biological samples, Baseline studies, Habitats, Dikes, Fisheries, Fish management, Ecological effects, Lotic environments.

A diel periodicity study of drifting benthos resulted in the collection of 5090 macroinvertebrates consisting of 80 taxa. Average drift density over all sampling times was 140 organisms/100 cu m of water filtered. Concentrations of organisms collected were significantly lower at dawn than at other sampling times. The lack of pronounced diel periodicity in total drift resulted from off-setting of dominant day active versus night active species. Hydropsyche spp., the most abundant taxon, was nocturnally active. Hydra sp., a diurnal drift component, was the second most dominant taxon. Species diversity was significantly lower during daylight hours and highest at dusk, midnight, and dawn. Of the nine most dominant taxa, five were most abundant at midnight, two most abundant at dusk, one most abundant at afternoon, and one most abundant at noon. Various taxa displayed behavioral drift characteristics. The total transport of benthic drift downstream in a 24-hr period was calculated as 1.5 times ten to the 9th power organisms/day based on a river discharge of 12,063 cu m/sec. Total diel drift standardized by river discharge was 120,000 organisms/day/cu m/sec, slightly higher than reported for other rivers but of the same order of magnitude.
W85-06995

REGRESSION ANALYSIS OF RIVER PROFILES,
Kentucky Univ., Lexington. Dept. of Geology.
R. G. Shepherd.
Journal of Geology, Vol. 93, No. 3, p 377-384, May, 1985. 5 Fig, 3 Tab, 24 Ref.

Descriptors: *Least squares method, *Regression analysis, *River profiles, *Texas, Bedrock streams, Flow profiles, Profiles, Flow, River beds, Curvature, Rugosity.

The longitudinal profile of a river is a plot of bed elevation versus distance along the channel. Least squares regression statistics were plotted for 13 profiles of bedrock streams in the Llano region of central Texas for the purpose of comparing the relative merit of each of Strahler's (Strahler, A.N., 1964, Quantitative Geomorphology, in Chow, V. T. ed., Handbook of Applied Hydrology, New York, McGraw-Hill, Chap. 4) four equations as a profile descriptor using a variety of natural profiles. The least square regression comparison of linear, exponential, logarithmic, and power functions for the profiles demonstrated that: a standard method of plotting profiles from source to mouth should be followed; the exponential function is preferred for profiles ending downstream in aggradational areas; the logarithmic function is preferred for profiles that terminate upstream at scarps or steep divides; the power function is inadequate for most longitudinal profiles; a composite function is recommended for complete profiles; and a power regression of slope against distance provides the most useful method of describing and comparing curvature and rugosity, two basic properties of profiles. (Baker-IVI)
W85-07037

INVENTORY OF THE WORLD'S WATER,
F. H. Forrester.
Weatherwise, Vol. 38, No. 2, p 82-86 and 105, April, 1985. 4 Fig.

Descriptors: *Hydrologic cycle, *Water budget, Atmosphere, Oceans, Precipitation, Rainfall, Rivers, Streams, Groundwater, Glaciers.

The sheer volume of our planet's water - locked in glaciers, stored in lakes, detained in underground rocks, or moving in the atmosphere, river and seas - almost defies the imagination. Views of the earth from space confirm that water covers about 70% of the earth's surface. Usable fresh water amounts to less than 1% of the total. The approximately 320 million cu mi of sea water constitute about 97.2% of the planet's total water supply. The amount of water stored in frozen form represents 2.15% of the world's water. Below the vadose water, the planet contains a water reservoir - groundwater. The volume of all the large freshwater lakes in the world aggregate nearly 30,000 cu mi. Five hundred cubic miles is the amount estimated to be present in river channels throughout the world at any given moment. Considering the atmospheric

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ocean as the last source of water, on the average about once every 12 days or so, the water in the air falls and then is replaced. About 102,000 cu mi of water rise into the air annually. Of this amount 78,000 cu mi fall directly back into the oceans. Streams and rivers collect and return to the oceans some 9,000 cu mi of water, including a large quantity that has percolated down into the ground and that, as ground water, moves slowly to natural outlets in the banks and channels of rivers. (Baker-IVI)
W85-07077

2B. Precipitation

COMPARISON OF RAINFALL REGIMES AT SIX SITES IN NORTHERN SYRIA,
Reading Univ. (England). Dept. of Agricultural Botany.
M. D. Dennett, J. D. H. Keatinge, and J. A. Rodgers.
Agricultural and Forest Meteorology, Vol. 31, No. 3/4, p 319-328, June, 1984. 9 Fig, 2 Tab, 6 Ref.

Descriptors: *Rainfall, *Syria, *Model studies, Precipitation, Statistical methods, Rainfall intensity, Rainfall distribution.

Daily rainfall data for six sites in northern Syria was obtained for from 11 to 25 complete rainfall years. Mean average rainfall at the sites ranged from 214 to 479 mm. The rainfall regimes at the six sites are compared by fitting a model of daily rainfall for each site. The components of the model, the probability of rain and the mean amount of rain per rainday, vary systematically between sites. Statistics describing a number of agriculturally important rainfall characteristics are derived from the models. The fitted models provide a concise, clear summary of the rainfall regimes and visual comparisons of sites can easily be made. Comparison of the rainfall models provides a clear overall assessment of the importance of the various factors contribution to annual rainfall totals. Thus it is possible to see rapidly whether sites differ in the duration and timing of the rainy season or in the intensity and persistence of rainfall within this season. (Baker-IVI)
W85-06194

PALMER DROUGHT SEVERITY INDEX AS A MEASURE OF HYDROLOGIC DROUGHT,
Geological Survey, Reston, VA.
W. M. Alley.
Water Resources Bulletin, Vol. 21, No. 1, p 105-114, February, 1985. 4 Fig, 4 Tab, 27 Ref.

Descriptors: *Drought, *Hydrologic drought, *Palmer Drought Severity Index, Streamflow, Groundwater, Climate, Hydrologic properties.

The Palmer Drought Severity Index (PDSI) is perhaps the most widely used regional drought index. However, there is considerable ambiguity about its value as a measure of hydrologic drought. In this paper the PDSI for climatic divisions in New Jersey is compared to the occurence within each climatic division of streamflows in their lower quartile for the month (streamflow index), and ground-water levels in their lower quartile for the month (ground-water index). These indices are found to have distinct properties. It is not uncommon for PDSI values to indicate 'severe' or 'extreme' drought at times when the streamflow or ground-water index is above its lower quartile at many stations within the climatic division. The PDSI values and groundwater index indicate more persistent subnormal conditions than the streamflow index for truncation levels yielding the same total duration of drought over a period. The ground-water index tends to indicate a later beginning to droughts and of the three indices is the most conservative indicator of a drought's end. Drought timing and duration properties for the ground-water index are found to be highly influenced by the average depth to water in the well. Overall, the three indices of drought can provide three very different characterizations of drought. In particular, the results indicate that considerable caution should be exercised in drawing conclusions about hydrologic drought from the PDSI. (Author's abstract)
W85-06245

CLIMATE FLUCTUATIONS IN ILLINOIS: 1901-1980,
Illinois State Water Survey Div., Champaign.
S. A. Changnon, Jr.
Illinois State Water Survey Bulletin 68, 1984, 77 p, 68 Fig, 8 Tab, 20 Ref.

Descriptors: *Climatology, *Wet climates, *Climatic data, *Precipitation intensity, *Rainfall intensity, *Snow depth, *Time series analysis, Fluctuations, Temperature, Thunderstorms, Frost, Freezing, *Illinois.

Changes in climate directly affect four areas of major activity and concern in Illinois --water, energy, agriculture, and transportation. Selected Illinois records are presented for 1901-1980 on a variety of atmospheric conditions. The data reveal moderate to large fluctuations with time, and in many cases notable trends over part or the entire 80-year period. The recent precipitation data reveal a period of relatively wet conditions. The 1961-1980 period had relatively heavy annual precipitation, more days of precipitation at all levels (ranging from 0.01 inch to more than 2 inches), more snowfall and deeper snow depths, and more freezing rain days than earlier years. The tendency to a wetter climate was found in all seasons. Temperatures in the last 20 years show a marked trend toward colder conditions, but only in winter and summer. In contrast to winter and summer, the climate changes in spring and fall have been much less, except to become slightly wetter. The slightly warmer Springs in the last 25 years have made the average date of the last freeze occur slightly earlier than before, producing a slight increase in the growing season length during the last 20 years. Visibilities have generally decreased, particularly in the summer. Thunderstorms decreased in the southern half of the state. (Hawkins-Omniplan)
W85-06346

EXPLORATORY ANALYSIS OF PRECIPITATION EVENTS WITH IMPLICATIONS FOR STOCHASTIC MODELING,
National Center for Atmospheric Research, Boulder, CO. Environmental and Societal Impacts Group.
B. G. Brown, R. W. Katz, and A. H. Murphy.
Journal of Climate and Applied Meteorology, Vol. 24, No. 1, p 57-67, January, 1985. 10 Fig, 19 Ref.

Descriptors: *Precipitation, *Model studies, *Selma, *Oregon, Mathematical studies, Erosion control, Statistical analysis, Rainfall intensity.

The use of a concept called a percipitation event to obtain information regarding certain statistical properties of precipitation time series at a particular location and for a specific application (e.g., for modeling erosion) is described. Exploratory data analysis is used to examine several characteristics of more than 31 years of primitive precipitation events based on hourly precipitation data at Salem, Oregon. A primitive precipitation event is defined as one or more consecutive hours with at least 0.01 inches (0.25 mm) of precipitation. The characteristics of the events that are considered include the duration, magnitude, average intensity and maximum intensity of the event and the number of hours separating consecutive events. By means of exploratory analysis of the characteristics of the precipitation events, it is demonstrated that the marginal (i.e., unconditional) distributions of the characteristics are positively skewed. Examination of the conditional distributions of some pairs of characteristics indicates the existence of some relationships among the characteristics. For example, it is found that average intensity and maximum intensity are quite dependent on the event duration. The existence and forms of these relationships indicate that the assumption commonly made in stochastic models of hourly precipitation time series that the intensities (i.e., hourly amounts within an event) are independent and identically distributed must be violated. Again using exploratory data analysis, it is shown that the hourly intensities at Salem are, in fact, stochastically increasing and positively associated within a precipitation event. (Author's abstract)
W85-06427

RADAR DETERMINATION OF SNOWFALL RATE AND ACCUMULATION,
Air Force Geophysics Lab., Hanscom AFB, MA.
R. J. Boucher, and J. G. Wieler.
Journal of Climate and Applied Meteorology, Vol. 24, No. 1, p 68-73, January, 1985. 5 Fig, 2 Tab, 16 Ref.

Descriptors: *Snow, *Precipitation, *Radar, Estimating, Storms.

A unique method that provides for relating radar-measured reflectivity factors to snowfall rates at the ground is presented. Data were provided by a CPS-9, 3.2 cm radar from six 1978 Massachusetts snowstorms. A best-fit power-law relationship between hourly-averaged snowfall rate (depth) and radar reflectivity factor is determined. This derived relationship is found to be $Z = 5.07S(1.65)$ with a correlation coefficient of 0.91. With this relationship hourly snowfall rates are found to be accurate to within +41 to -29% and total storm snowfall accumulation to within +44 to -31%. (Author's abstract)
W85-06428

PRECIPITATION INTENSITY AND VARIABILITY AT CHILTON VALLEY, NEAR CASS, SOUTHERN ALPS,
Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
A. P. Sturman, and J. M. Soons.
Journal of Hydrology, Vol. 23, No. 1, p 10-20, 1984. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Precitipation intensity, *Chilton Valley, *Southern Alps, *South Island, *New Zealand, Time series analysis, Seasonal variation, Cyclonic precipitation.

The precipitation regime of the Chilton Valley in the Southern Alps, South Island, New Zealand, is examined using monthly and half hourly data. Missing monthly totals are estimated using data from nearby stations to produce a complete time series from August 1964 to December 1982. Monthly precipitation totals indicate marked wet and dry periods. The annual precipitation regime has two distinct maxima: a maximum in spring and a sub-maximum in April. Minima are observed during February and March, and in July. There are generally weak but statistically significant links between cyclonicity, westerly airflow and precipitation. Analysis of half hourly precipitation confirms earlier studies quoting relatively low intensities, with lowest values in July, August and September. Although cyclonicity is most important for the monthly totals, westerly airflow is more important for higher intensities. (Author's abstract)
W85-06433

STOCHASTIC MODEL OF DIMENSIONLESS THUNDERSTORM RAINFALL,
Agricultural Research Service, Tucson, AZ.
D. A. Woolhiser, and H. B. Osborn.
Water Resources Research, Vol. 21, No. 4, p 511-522, April, 1985. 12 Fig, 4 Tab, 31 Ref.

Descriptors: *Stochastic process, *Model studies, *Rainfall, *Thunderstorms, *Arizona, Storms, Precipitation, Rainfall distribution.

A concise stochastic model for the nondimensional thunderstorm rainfall process at a point is proposed. The accumulated precipitation process for individual thunderstorms is nondimensionalized by dividing the precipitation at any time by the total precipitation and the elapsed time by the total duration. The dimensionless process is divided into 100 equal time increments, and the depth increments are rescaled to range between 0 and 1. The sequence of rescaled increments Z1, Z2,..., Z9 are assumed to represent a nonhomogeneous Markov process in discrete time with continuous state space. The expected value of the kth rescaled

increment, given the k - 1st increment, is assumed to be a linear function of that increment, and the marginal distribution of the first increment and the conditional distributions are assumed to be described by the beta distribution. An analyses of data for 275 thunderstorms observed at the Walnut Gulch Experimental Watershed in southeastern Arizona showed that the proposed model structure is a good approximation for this region. The number of model parameters can be reduced from 26 to a minimum of 10 by approximating the 2 parameters in the conditional expectation function and the conditional beta parameter as polynomial functions of the dimensionless time. Likelihood ratio tests and the Akaike information criterion suggest that the dependence parameters are independent of storm amount and duration but the conditional beta parameter alpha sub k is larger for short-duration storms than for long-duration storms. A 13-parameter model is recommended for disaggregating thunderstorm rainfall in southeastern Arizona. (Author's abstract)
W85-06505

CLIMATIC CONSTRAINTS TO WATER RESOURCE DEVELOPMENT IN THE SUDANO-SAHELIAN ZONE OF NIGERIA,
Bayero Univ., Kano (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 6D.
W85-06546

DYNAMIC PROPERTIES OF RAINFALL IN LUND,
Lund Univ. (Sweden).
J. Niemczynowicz, and P. Dahlblom.
Nordic Hydrology, Vol. 15, No. 1, p 9-24, 1984. 11 Fig, 6 Tab, 6 Ref.

Descriptors: *Rainfall distribution, *Lund, *Sweden, *Rainfall-runoff relationships, Rainfall velocity, Storms, Storm velocity, Wind, Statistical analysis, Seasonal variation.

The shape of a runoff hydrograph depends on the dynamic properties of the rainfall. The possible range of impact of the rainfall movement on runoff generating process can only be judged if the rainfall velocity and direction are known in statistical terms. This paper gives the statistical characteristic of the rainfall movement in the city of Lund (Sweden). The probability distribution of rainfall velocities and relative frequencies of the rainfall direction are based on the analysis of 400 rainfall events observed in the city of Lund. A simple program for determination of the velocities and the directions of storm movement has been developed and tested. Results show that there are two main storm directions in Lund: the first, generally oriented to the east, is prevalent throughout the year except summer; the second, oriented to the north-north-east, occurs primarily during summer months. During summer rainfall velocity is lower and intensity higher than during the rest of the year. Rainfall velocity is lognormally distributed. A strong correlation between wind movement parameters at 700 mb height and storm velocity and direction was observed. (Author's abstract)
W85-06637

INVESTIGATION OF THE INFLUENCE OF RAINFALL MOVEMENT ON RUNOFF HYDROGRAPH. PART I - SIMULATION ON CONCEPTUAL CATCHMENT,
Lund Univ. (Sweden).
For primary bibliographic entry see Field 2E.
W85-06640

INVESTIGATION OF THE INFLUENCE OF RAINFALL MOVEMENT ON RUNOFF HYDROGRAPH. PART II - SIMULATION ON REAL CATCHMENTS IN THE CITY OF LUND,
Lund Univ. (Sweden).
For primary bibliographic entry see Field 2E.
W85-06641

CHANGES IN CHEMICAL COMPOSITION OF PRECIPITATION AS IT FALLS (OB IZMENENII KHIMICHESKOGO SOSTAVA ATMOSTERNYKH OSADKOV V PROTSESSE IKH VYPADENIYA),
For primary bibliographic entry see Field 5B.
W85-06808

COMPUTER-ASSISTED DATA PROCESSING AND ANALYSIS SYSTEM FOR GROUND-BASED METEOROLOGICAL DATA COLLECTION,
Atmospherics, Inc., Fresno, CA..
For primary bibliographic entry see Field 7C.
W85-06924

PRECIPITATION GAGE NETWORK OPERATIONS FOR WINTERTIME RESEARCH IN THE CENTRAL SIERRA NEVADA,
Atmospherics, Inc., Fresno, CA..
M. Henderson, S. Pinion, E. Pinion, T. Henderson, and M. Solak.
Technical Report AISCP-843, July 1984. 36 p, 3 Fig, 12 Photos, 10 Ref. Contract/Grant No. 9-07-85-V0020.

Descriptors: *Precipitation, *Network design, *Gages, *Weather modification, *Rain gages, Sierra Nevada, California, Cloud seeding, Orographic precipitation, Sierra Cooperative Pilot Project, Cloud physics, Snow, Ice, Measuring instruments.

This document describes the development, installation and maintenance of a precipitation gage network in the Central Seirra Nevada of California. Emphasis is given to calibration techniques performed on Belfort weighing rain gages. It contains detailed steps related to key aspects of gage maintenance, calibration, installation and operation important to meeting SCPP requirements. This report is intended to be a practical guide for those responsible for obtaining high quality precipitation records with a minimum of data loss under a variety of installation and climatic conditions, but particularly in wintertime applications. (Author)
W85-06925

SAHEL: THE CHANGING RAINFALL REGIME AND THE 'NORMALS' USED FOR ITS ASSESSMENT,
Missouri Univ.-Columbia. Dept. of Atmospheric Science.
A. V. Todorov.
Journal of Climate and Applied Meteorology, Vol. 24, No. 2, p 97-107, February, 1985. 8 Fig, 4 Tab, 13 Ref.

Descriptors: *Rainfall distribution, *Sahel, *Drought, *Senegal, *Mali, *Upper Volta, *Niger, Hydrologic data collections, Data interpretation, Climatology, Forecasting.

Rainfall amounts in the Sahel region of Africa began a decline around 1968 that has continued to the present. The drought of 1982-83 was more severe and devastating than the well-known drought of 1972-73. Most years between 1972 and 1983 experienced below to well-below normal rainfall. These 16 or so dry years make obsolete mean (or normal) rainfall data calculated for periods before the decline began. Despite this, the old normal values are still widely used for various national and international agricultural projects. Discrepancies between the old and new mean values for the amounts of rainfall, and differences in the duration of the rainy season, suggest that mean or normal rainfall data should be calculated for the last 30 and/or 16 years. The rapidly changing climate in the Sahel requires more frequent updating of the climatological normals. (Author's abstract)
W85-07066

PRECIPITATION TRENDS AND WATER CONSUMPTION RELATED TO POPULATION IN THE SOUTHWESTERN UNITED STATES, 1930-83,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
H. F. Diaz, R. L. Holle, and J. W. Thorn, Jr.
Journal of Climate and Applied Meteorology, Vol. 24, p 145-153, February, 1985. 7 Fig, 1 Tab, 22 Ref.

Descriptors: *Precipitation, *Water consumption, *Human population, *Colorado River Basin, *Utah, Population dynamics, Water supply, Drought, Climatology, History, Dendrochronology, Paleoclimatology.

The possible effects of climatic fluctuations on renewable water supplies in the western United States was examined, especially as it is impacted by the growth of population and water consumption in recent decades. Precipitation fluctuations in the Colorado River Basin states have differed depending upon their location, but have tended to fluctuate with a time scale of one to two decades. Longer-term regimes may also be operative. For example, the Upper Basin states (Colorado and Utah) experienced a prolonged wet interval from about the turn of this century to around 1930; from 1930 to around 1978, drier than normal years tended to outnumber wet ones; since 1978 the Upper Basin has been exceedingly wet. Lower Basin states also experienced the early wet period and drier conditions after the mid-1940's, but they undergo somewhat different alternations of wetness and dryness. However, from the point of view of water supply, precipitation variability in the Upper Basin, particularly in Colorado, is more critical. Reservoir capacity in the arid western states is expected to gain little in additional storage capacity during the next couple of decades; in addition, withdrawal of water from the Colorado River is approaching the legal limits. The effect of a future prolonged drought on the order of those which have occurred in recent decades, or in a worse case, those inferred to have occurred in past centuries from tree ring studies, could have far more serious consequences than any in previous experience due to the large population increases in the region. These population trends show all signs of continuing, at least in the near future. The impact of a drought, however, would depend on the level of reservoir capacity that is present at the time of drought onset as well as its intensity and longevity; reservoirs in the West are presently at or near capacity. (Author's abstract)
W85-07067

EFFECT OF SEASONAL VARIATION OF SERIAL CORRELATION ON THE EXTREME VALUE DISTRIBUTION OF RAINFALL DATA,
Royal Netherlands Meteorological Inst., De Bilt.
T. A. Buishand.
Journal of Climate and Applied Meteorology, Vol. 24, p 154-160, 1985. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Serial correlation, *Seasonal variation, *Rainfall distribution, *Extreme value distribution, Statistical analysis, Mathematical analysis, Statistics, Clustering.

For practical applications both the parent distribution of rainfall intensities and the distribution of their annual maxima are of interest. The relation between these two distributions cannot be obtained from classical extreme value theory because of seasonal variation and serial correlation in the data. Mathematical results for the distribution of maxima in m-dependent sequences (e.g., an mth order moving average process) are given to illustrate the effect of local dependence on the extreme value distribution. High-level exceedances occur in clusters when there is strong local dependence. The average number of exceedances in a cluster is an important parameter in the relation between the parent and extreme value distribution. For 5-min rainfall data from De Bilt, quantiles of the annual maxima are overestimated by about 10 mm/h if the effect of serial correlation is ignored. This bias can easily be removed by taking local clustering of large rainfall intensities in a rainy spell into account. It is not necessary to describe the seasonal variation in the rainfall process to correct for dependence. (Author's abstract)
W85-07068

RELATIONSHIP OF PRECIPITATION TO VERTICAL MOTION OBSERVED DIRECTLY BY A VHF WIND PROFILER DURING A

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SPRING UPSLOPE STORM NEAR DENVER, COLORADO,
National Oceanic and Atmospheric Administration, Boulder, CO. Aeronomy Lab.
K. S. Gage, and G. D. Nastrom.
Bulletin of the American Meteorological Society, Vol. 66, No. 4, p 394-397, April, 1985. 6 Fig, 12 Ref.

Descriptors: *Precipitation, *Wind, *Vertical motion, *Denver, *Colorado, Storms, Weather, Rainfall rate, Radar.

A comparison was made between directly measured vertical motion observed by the Platteville radar with rainfall rates measured at two locations downwind of the radar. An upwind site would not be expected to correlate as well since changes in upward motion must precede changes in rainfall rate observed at the source. Also, it takes time for the precipitation to reach the surface, so it is reasonable to expect a time lag of 15 minutes or more between a change in vertical motion and a change in rainfall rate observed at the surface. Since in this event snow was falling above 2 km MSL or so, the time lag should be closer to an hour. In view of all of this it would appear that mesoscale variability in vertical motion can be seen in rainfall rates if the scale of the variability is not too small and if the rain gauges are suitably located. In the present case there seems to be a fairly good correlation between the gross features of the vertical motion and the rainfall rates observed downwind. Even some of the variability in vertical motion and rainfall rates on time scales of a few hours seems to be correlated. This research is still in the exploratory stage and clearly more should be accomplished in planned experiments. (Baker-IVI)
W85-07075

AFRICA IN DROUGHT - A CHANGE OF CLIMATE,
National Acid Precipitation Assessment Program, Washington, DC.
D. Winstanley.
Weatherwise, Vol. 38, No. 2, p 74-81, April, 1985. 7 Fig.

Descriptors: *Africa, *Drought, *Climate, Rainfall, Weather, Precipitation, Sahel.

The possibility that recent droughts in Africa are part of a long term climatic change is investigated. New evidence that the climates of Africa have indeed been shifting, with startling consistency, over the past century or even longer is presented. Whereas most analyses of time series of annual rainfall in Africa have been restricted to twentieth century data, this research is based on a time series constructed back to the nineteenth century. Thus a 130 year index of changes in rainfall levels has been constructed in a continent wide zone to the south of the Sahara Desert. This longer time perspective provides a more confident basis for interpreting recent events than do twentieth century data alone. Over the past 20 years rainfall in this zone has averaged about 20% below normal. During the second half of the 19th century rainfall in this same zone had been about 20% above normal. The present droughts in this area are part of a long term trend toward lower rainfall, not merely short term climatic fluctuations. Rainfall levels in parts of equatorial Africa can be seen, through the same records, to be changing in the opposite direction. The area between the region showing a long term decline in rainfall and those showing a long term increase is characterized by marked climatic fluctuations from year to year and from decade to decade. The causes of these long term trends appear to be primarily, if not entirely, natural. The significance of a continuation of these natural trends to the welfare of the various African nations and people involved would seem to deserve very serious attention. (Baker-IVI)
W85-07076

SPECIFICATION OF UNITED STATES SEASONAL PRECIPITATION,
New Jersey Agricultural Experiment Station, New Brunswick.
R. P. Harnack, and J. R. Lanzante.
Monthly Weather Review, Vol. 113, No. 3, p 319-325, March, 1985. 1 Fig, 5 Tab, 12 Ref. NSF grant ATM-8217215.

Descriptors: *Precipitation, *Seasonal variation, Prediction, Sea surface temperature, Precipitation frequency, Empirical orthogonal function.

Seasonal precipitation is specified for the United States by matching various area-averaged precipitation statistics as predictands with three different predictors in turn: 700 mb heights, North Pacific SST (sea surface temperature) and North Atlantic SST. Predictors are in form of empirical orthogonal function (EOF) amplitude time series. The predictands used in trials include total precipitation and precipitation frequencies derived using three different critical values: 2.5, 12.7 and 25.4 mm. Screening multiple linear regression is used to relate predictands to predictors for samples ranging from 24 to 35 years in length; initially trials are compared in terms of area-averaged true skill and percent area of local significance. In order to assess specification skill on an independent sample, additional tests are made using a jackknife regression approach. Results suggest that skillful seasonal precipitation prediction will continue to be very difficult using predictors and methods presently in common use based on the use of specification equations on an independent sample. Generally, area-averaged explained variances are less than 10% and the area of significant local skill is less than 50%. Based on the low level of specification skill, predictive skill for precipitation using specification equations with imprecisely known specifier fields (like 700 mb heights) as input would be effectively zero. Other conclusions are: 1) 700 mb heights specify seasonal precipitation about equally well in winter, spring and summer, but worse in fall. 2) Among the three predictor types employed, 700 mb heights are best for all seasons but fall, when Pacific SST does best. Specification using Atlantic SST is poor in all instances and inferior to the use of the other predictor fields. 3) Overall among the four precipitation statistics used as predictands, the frequency statistics have a slightly better relationship with 700 mb heights or Pacific SST than do precipitation totals. (Author's abstract)
W85-07141

2C. Snow, Ice, and Frost

EFFECT OF GLACIERS ON STREAMFLOW VARIATIONS,
Geological Survey, Tacoma, WA.
For primary bibliographic entry see Field 2E.
W85-06512

UNIFIED DEGREE-DAY METHOD FOR RIVER ICE COVER THICKNESS SIMULATION,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
H. T. Shen, and P. D. Yapa.
Canadian Journal of Civil Engineering, Vol. 12, No. 1, p 54-62, March, 1985. NOAA contract NA 80RAC00147, St. Lawrence Seaway Development Corp. contract DRSL55-83-C0215.

Descriptors: *St. Lawrence River, *Ontario, *Ice cover, *Simulation, *Degree-days, Mathematical models, Thawing, Rivers, Frazil ice, Heat transfer.

The theoretical basis of the degree-day method is examined. A unified degree-day model for simulating the variations of river ice cover thickness throughout the entire winter is proposed, and applied to ice covers in the 160 km international section of the upper St. Lawrence River between Lake Ontario and Cornwall, Ontario. The thermal growth and decay of a river ice cover is affected by the meteorological conditions, the thickness of the snow and ice covers, the temperature and the flow conditions of the river water, the possible accumulation of frazil ice on the underside of the ice cover, and thermal properties of the ice cover. A simplified analytical procedure is used to examined the validity of the existing degree-day method, and factors that affect the value of the numerical constants. A new degree-day model is then proposed based on these analyses. The analysis shows the importance of the inclusion of the initial cover thickness. A variable coefficient is needed in order for the degree-day formula to be able to simulate the ice cover thickness continuously from the growth period to the decay period. The effect of the turbulent heat transfer from the river water can be accounted for by a simple linear function of time. A modified degree-day method is developed based on the theoretical analysis. The method is capable of simulating continuously the variation of the thickness of a river ice cover from formation to breakup. Application of the method to the upper St. Lawrence River shows that the simulated ice thickness compares well with the field observations. (Baker-IVI)
W85-06551

CHARACTERISTICS OF THE HYDROLOGY OF SIBERIAN RIVERS BASED ON EXPERIENCE IN THE DESIGN AND CONSTRUCTION OF HYDROELECTRIC STATIONS,
Ya. L. Gotlib.
Hydrotechnical Construction, Vol. 18, No. 2, p 86-90, February, 1984. 3 Fig, 17 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 36-39, February, 1984.

Descriptors: *Ice jams, *Dam construction, *Dam design, *Siberia, *USSR, Hydrology, Ice, Thermal regime, Reservoir management, Ice formation, Permafrost.

Among the characteristics of the hydrologic regime for designing and constructing Siberian hydrostations, problems related to the ice and thermal regime are very complex. These factors, and how they change, are also very important during operation of the hydrostations. The issues addressed in this paper include the effect of the thermal regime of river flows and reservoirs on the development of ice-forming processes, the main regularities of the formation of ice jams, the thickness of ice jams as a function of channel narrowing due to construction, high water levels caused by ice jams and ice dams, ice strength, passage of ice through partially constructed structure, regulation of ice conditions in the lower pools of hydrostations, and the thermal regime of reservoirs. Because a number of hydrostations are being planned, constructed, and operated in permafrost regions, it is necessary to greatly expand the study of the thermal regime of their reservoirs. (Keenan-IVI)
W85-06595

NIMBUS-7 SMMR POLARIZATION RESPONSES TO SNOW DEPTH IN THE MIDWESTERN U.S.,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
D. K. Hall, J. L. Foster, and A. T. C. Chang.
Nordic Hydrology, Vol. 15, No. 1, p 1-8, 1984. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Snow depth, *Microwave radiometry, *Satellite technology, Indiana, Brightness temperature, Remote sensing, Snowpack, Melting, Air temperature, Radiometry.

Analysis of January and February 1979 Scanning Multichannel Microwave Radiometer (SMMR) data has revealed discrepancies in the responses of vertically and horizontally polarized brightness temperature (TB) data to snow in the state of Indiana. Ten satellite overpasses were analyzed between January 8 and February 21, 1979. In four cases, the horizontally polarized TBS correlated with snow depth significantly better than did the vertically polarized TBS. These four overpasses occurred either when the snowpack was building up or when it had metamorphosed and/or was melting. For example, on February 17, the coefficient of correlation, R, between vertically polarized TB and snow depth was $R = -.46$ while it was $R = -.86$ for the horizontally polarized TB data. Just prior to February 17, air temperatures rose above 0 C in the study area causing melting of the snowpack. On February 17, air temperatures dropped well below 0 C and the snow and water in

the snowpack froze causing metamorphosis of the snowpack. It is concluded that horizontally polarized TB data may be more useful than vertically polarized data for analysis of snow in regions in which there are a range of snowpack conditions, or where a snowpack undergoes rapid metamorphosis. However, analysis of both polarizations may reveal information concerning the structure of a snowpack. (Author's abstract)
W85-06636

ROLE OF GROUND FROST, SNOW COVER, ICE BREAK-UP AND FLOODING IN THE FLUVIAL PROCESSES OF THE OULANKA RIVER, NE FINLAND,
Oulu Univ. (Finland). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W85-06806

GLACIATION DEVELOPMENT AND INTERSTADIAL SEA-LEVEL ON CENTRAL SPITSBERGEN, SVALBARD,
Bergen Univ. (Norway). Dept. of Geology.
J. Y. Landvik, and O. Salvigsen.
Polar Research, Vol. 3, No. 1, p 1-10, February, 1985. 6 Fig, 32 Ref.

Descriptors: *Glaciation, *Geology, *Sea level, *Spitsbergen, *Svalbard, *Norway, *Stratigraphy, Climatology, Sedimentology, Glaciers, Paleoclimatology.

A lithostratigraphical study at a site situated above the late glacial marine limit on central Spitsbergen (Norway) showed the development of at least two regional glaciations and an intermediate ice free period with a relatively high sea-level. A 20 m thick sequence of unconsolidated sediments occurs above the marine limit in Gangdalen, Nordenskiold Land. The top of the striated bedrock is composed of a 2 m thick till bed, a 15 m thick gravel interpreted to be deposited as a sandur, and another till bed on the top with a solifluction deposit capping the section. Fabric analyses and erratics in the two tills indicate a similar development in glacial transport directions during the two glaciations, starting with a local glaciation which subsequently turns into a larger glaciation centered over the eastern part of Svalbard. Co-existence of different ice domes over Spitsbergen is suggested by these observations. The sandur was deposited during an ice free period with a sea-level 40-80 m higher than at present but the section is undated. At present no glaciation of the entire Van Mijenfjorden area is dated. A firm correlation based on a high relative sea-level is impossible. (Collier-IVI)
W85-06843

2D. Evaporation and Transpiration

EVAPOTRANSPIRATION FROM PASTURE: A COMPARISON OF LYSIMETER AND BOWEN RATIO MEASUREMENTS WITH PRIESTLEY-TAYLOR ESTIMATES,
Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.
A. E. Green, B. E. Clothier, J. P. Kerr, and D. R. Scotter.
New Zealand Journal of Agricultural Research, Vol. 27, No. 3, p 321-327, 1984. 5 Fig, 17 Ref.

Descriptors: *Evapotranspiration, *Pastures, *Lysimeters, *Bowen Ratio, Energy balance, Soil heat flux, Air temperature, Estimation, Priestley-Taylor estimates.

The objectives of this study were to compare evapotranspiration (ET) data obtained using 2 independent measurement techniques, and to compare measured ET with ET estimates obtained using a commonly-applied formula. The measurements were made in a mixed-pasture paddock near Palmerston North (New Zealand). The soil, Manawatu fine sandy loam, contained adequate plant-available water during the study. One set of ET measurements was made using a weighing lysimeter with surface area 2 sq m and a soil depth of 1 m. The lysimeter had a suction-operated drainage system as its base. The other set of ET data was obtained using the Bowen ratio-energy balance technique, with duplicate sets of Bowen ratio apparatus, net radiometers, and soil heat flux sensors. Daily ET estimates were made with the Priestley-Taylor formula, using measured net radiation and air temperature values. The daily ET for well-watered, full-cover pasture measured by the lysimeter on rain-free days was in good agreement with the ET measured using the Bowen ratio-energy balance technique. The cumulative ET values over 35 such days differed by only 6%. When wet days were included in the comparson, larger discrepancies occurred. Over periods of less than a day there were sometimes quite large differences between the Bowen ratio and lysimeter ET measurements. Daily measurements of ET by the lysimeter agreed resonably well with Priestley-Taylor estimates; the agreement was even better over longer periods. The cumulative Priestly-Taylor ET value was 7% higher than the lysimeter ET values over 33 rain-free days. The estimated ET was 2% lower than the ET measured using the Bowen ratio method accumulated over 60 days. This agreement further confirms the usefulness of Priestly-Taylor estimates of ET from well-watered pasture in humid temperate climates. (Author's abstracts)
W85-06182

LUXURY WATER USE BY BERMUDAGRASS TURF,
Arizona Univ., Tucson. Coll. of Agriculture.
W. R. Kneebone, and I. L. Pepper.
Agronomy Journal, Vol. 76, p 999-1002, November-December, 1984. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Water use, *Grasses, *Bermudagrass, Evapotranspiration, Evaporation, Irrigation, Evaporative demand.

Use of luxury water by bermudagrass was investigated and the effect of high application rate on evapotranspiration (ET) was considered. The effects of three high irrigation levels (114, 243, and 364 mm/7 days) on evapotranspiration from seeded certified bergumagrass turf growing on three sand-soil substrates mixed with Pima clay loam were measured. The highest application rate on the two finest textured sand-soil mixes gave no significant increase in ET over that from the medium application level. Fluctuations in evapotranspiration paralleled evaporative demand, but the ratios of evapotranspiration to evaporative demand were higher during the low demand periods of winter and spring. Luxury use implies consumption far beyond need. In the past excessive watering was recognized as a waste of irrigation water lost by deep percolation and by surface runoff. These data show that with sufficient indulgence the turf itself can become a luxury user, and ET losses from bermudagrass turf can exceed pan evaporation by a considerable amount. (Baker-IVI)
W85-06189

EVAPORATION FROM EUCALYPTS GROWING IN A WEIGHING LYSIMETER: A TEST OF THE COMBINATION EQUATIONS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
A. R. Aston.
Agricultural and Forest Meteorology, Vol. 31, No. 3/4, p 241-249, June, 1984. 5 Fig, 13 Ref.

Descriptors: *Evaporation, *Plant growth, *Eucalypts, Evapotranspiration, Mathematical equations, Lysimeters, Forested watershed, Water loss, Leaves.

The combination equations for estimating evapotranspiration were tested using data obtained from a young eucalypt community growing in a weighing lysimeter. Measurements over a nine day period revealed discrepancies between observations and predictions during the morning. Significant improvement was obtained after the incorporation of an effective leaf area index rather than the measured leaf area index (LAI). The effective LAI was shown to change throughout the day and it is suggested that the changes were due to the particular distributions of trees and foliage around the study area and reflect the effect of changes in the solar radiation distribution through the canopy. (Baker-IVI)
W85-06191

WATER USE BY TAMARILLOS (CYPHOMANDRA BETACEA) WITHIN A SHELTERED ORCHARD ENVIRONMENT,
Ruakura Soil and Plant Research Station, Hamilton (New Zealand).
For primary bibliographic entry see Field 2I.
W85-06195

EVALUATION OF CANOPY TEMPERATURE-EVAPOTRANSPIRATION MODELS OVER VARIOUS CROPS,
Agricultural Research Service, Lubbock, TX. Plant Stress and Water Conservation Research Unit.
J. L. Hatfield, R. J. Reginato, and S. B. Idso.
Agricultural and Forest Meteorology, Vol. 32, No. 1, p 41-53, July, 1984. 10 Fig, 1 Tab, 20 Ref.

Descriptors: *Evapotranspiration, *Canopy temperature, Rainfall, Evaporation, Model studies, Air temperature, Energy balance, Crop production, Mathematical equations.

Evapotranspiration from a surface is a component of the partitioning of evergy received by that surface. Canopy temperature as an input to surface energy balance models provides a method for estimating actual evapotranspiration from a surface. Inclusion of canopy temperature with other meteorological data does not make a complete remote sensing approach but it does allow for dynamic coupling between the plant and atmosphere. Ground based net radiation, air temperature and windspeed are still needed as model inputs. Any collection of surface temperature from an air or spacecraft would represent an instantaneous evapotranspiration rate and this technique would have to be applied over a complete day to improve the utility of the information for agricultural management. (Baker-IVI)
W85-06196

SOIL SURFACE PSYCHROMETER FOR MEASURING HUMIDITY AND STUDYING EVAPORATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 7B.
W85-06197

STABILITY OF NON-WATER-STRESSED BASELINES,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
S. B. Idso, R. J. Reginato, K. L. Clawson, and M. G. Anderson.
Agricultural and Forest Meteorology, Vol. 32, No. 2, p 177-182, August, 1984. 4 Fig, 12 Ref.

Descriptors: *Water stress, *Vapor pressure, *Air temperature, *Leaves, Temperature effects, Plant growth, Wheat, Water hyacinth, Aquatic plants, Plant morphology.

Non-water-stressed baselines, plots of foliage-air temperature differential vs. air vapor pressure deficit, were obtained for seven different varieties of wheat and on a variety of water hyacinth having three different characteristic leaf sizes in experiments conducted at Phoenix, Arizona. The baseline of a species appears to be impressively stable if there are not large morphological differences among the varieties of that species. On the other hand, based on studies of a single variety of water hyacinth, the non-water-stressed baseline of a species can be dramatically dependent on leaf size. There is some evidence that aquatic plants may exhibit more variability in this regard than terrestrial plants. Thus more work needs to be done on terrestrial plants which can produce a wide range of leaf sizes within a single variety before a general statement can be made on this subject. (Baker-IVI)
W85-06198

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PORTABLE EVAPORIMETER FOR RAPID MEASUREMENT OF THE EVAPORATION RATE OF WATER,
RCA Labs., Princeton, NJ.
R. Williams, A. Zangvil, and A. Karnieli.
Agricultural and Forest Meteorology, Vol. 32, No. 3/4, p 217-224, September, 1984. 5 Fig, 1 Tab, 8 Ref.

Descriptors: *Evaporation, *Measuring instruments, *Evaporimeter, Agriculture, Water loss, Evapotranspiration.

A new portable evaporimeter has been developed and tested. The instrument consists of precision-bore glass capillary tubing joined to a round plate. Ordinary laboratory filter paper saturated with water is placed on the plate. As water evaporates from the paper's surface it draws water up from the capillary to replace it. The motion of the meniscus is then equal to the linear evaporation rate multiplied by the ratio of the surface area of the paper to the area of the capillary. Field experiments have been carried out to compare measurements of the new instrument with those of the Class-A evaporation pan. A high correlation has been found between the two instruments. The scatter of the points of 20 experiments is quite large mainly because of the difference in the size and construction of the two instruments. From field experiments it is concluded that fairly reliable estimates of the Class-A Pan evaporation can be obtained rapidly with the new portable instrument. This is important as in many applications the Class-A Pan evaporation rate is used as a standard. A method is also presented to use measurements of the new evaporimeter to estimate the potential evapotranspiration. In this method the instrument is used to obtain an estimate of the net radiation needed in the Penman equation for evapotranspiration in the absence of radiation data. (Baker-IVI)
W85-06199

MICROCLIMATE CONTROL OF FOREST PRODUCTIVITY: ANALYSIS BY COMPUTER SIMULATION OF ANNUAL PHOTOSYNTHESIS/TRANSPIRATION BALANCE IN DIFFERENT ENVIRONMENTS,
Montana Univ., Missoula. School of Forestry.
S. W. Running.
Agricultural and Forest Meteorology, Vol. 32, No. 3/4, p 267-288, September, 1984. 9 Fig, 2 Tab, 55 Ref.

Descriptors: *Model studies, *Forests, *Photosynthesis, *Transpiration, *Microclimate, Productivity, Conifers, Carbon dioxide, Seasonal variation, Computers, Simulation, Climate, Precipitation, Montana.

A simulation model combining photosynthesis and transpiration for coniferous trees, DAYTRANS/PSN, was used to explore carbon dioxide and water exchange efficiencies under different seasonal climatic conditions. The simulation model first evaluated an eight month photosynthetic season using measured meteorological data from a western Montana site. Elevation, slope, aspect, and region-related variations in precipitation, incoming shortwave radiation, and air temperature were then programmed into the meteorological data set and the model re-run a total of 42 times. The model calculations correctly predicted the patterns of forest productivity seen in mountains of the western United States, whereas north slopes and higher elevations are more productive in water limited Montana, low elevations and south slopes become more productive in ecosystems that are energy limited. The absolute magnitudes of annual photosynthesis (PSN) calculated are only reasonable for this hypothetical tree. The microclimates used to run the model, while reasonable, were fabricated. An annual PSN budget ignores the complexities of carbon allocation, potential for leaf area reduction, the realities of insect consumption, stand crowding, wind damage and other factors that are part of the stands seen. Calculation of annual PSN generalized for a young healthy tree may provide a useful measure of site quality, the term used for site productive potential in forestry. By generalizing tree size and age, the temporary influence of current stand condition could be eliminated, allowing biophysically based definition of site productive potential that could ultimately be mapped over large areas. (Baker-IVI)
W85-06201

QUANTIFYING EFFECTS OF ATMOSPHERIC CO2 ENRICHMENT ON STOMATAL CONDUCTANCE AND EVAPOTRANSPIRATION OF WATER HYACINTH VIA INFRARED THERMOMETRY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
S. B. Idso, B. A. Kimball, and K. L. Clawson.
Agricultural and Forest Meteorology, Vol. 33, No. 1, p 15-22, November, 1984. 4 Fig, 19 Ref.

Descriptors: *Evapotranspiration, *Carbon dioxide, *Stomatal conductance, *Water hyacinth, Infrared imagery, Thermometry, Water stress, Leaves, Temperature, Aquatic plants.

Stomatal conductance and evaporative water loss were determined for two tanks of water hyacinths, one under ambient conditions and one considerably enriched in atmospheric carbon dioxide. The reduction in stomatal conductance was very dramatic for initial increases in carbon dioxide concentration, as the mean mid-day conductance fell to 50% of its ambient condition value at a carbon dioxide concentration of only 550 ppm. The effects of atmospheric carbon dioxide enrichment on evapotranspiration of water hyacinth show that the greatest reduction in evaporative water loss occurred initially and the relationship defined by the data appears to be internally consistent all the way out to a carbon dioxide concentration of 1800 ppm. Reduction in actual water loss was not as great as the reduction in stomatal conductance, for as the stomates began to close in response to increasing carbon dioxide and the transpiration rate began to be reduced, leaf temperatures rose in response to reduced evaporative cooling, resulting in an increased leaf-air vapor pressure gradient. The consequent negative feedback thus tended to counteract the effect of decreasing stomatal conductance. The stomatal response to increasing atmospheric carbon dioxide was identical to that induced by removing water from the plant roots, and the reduction in evaporative water loss with increasing atmospheric carbon dioxide was an inverse linear function of the plant water stress index, both of which phenomena had previously been theorized but never before experimentally verified. (Baker-IVI)
W85-06202

DIURNAL CHANGES IN THE INSTANTANEOUS WATER USE EFFICIENCY OF A SOYBEAN CROP,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
B. Zur, and J. W. Jones.
Agricultural and Forest Meteorology, Vol. 33, No. 1, p 41-51, November, 1984. 4 Fig, 14 Ref.

Descriptors: *Diurnal variation, *Soybeans, *Water use efficiency, Transpiration, Soybeans, Water stress, Vapor pressure deficit, Photosynthesis, Irrigation effects, Climate.

Variations in the instantaneous transpirational water use efficiency for a soybean crop were evaluated as affected by time of day, water stress, and vapor pressure deficit (VPD). Canopy transpiration (TR) and photosynthesis (CER) rates were measured hourly during five days of a nine-day soybean field experiment. One treatment was subjected to a drying cycle and one treatment was well-irrigated during the nine-day period. Instantaneous water use efficiency (WUE-i) was calculated by dividing canopy CER by TR for each hourly measurement. The plant may have no means of controlling its instantaneous transpirational water use efficiency. Instantaneous WUE-i of the soybean decreased during water stress as stomatal resistance increased and transpiration decreased. It is quite probable that the concept of water use efficiency so important in agriculture is of no significance to the crop itself. It is doubtful whether seasonal WUE has any physiological justification. Representing the wide range of climatological conditions during a growing season by one number has no theoretical basis. In addition, results from this study and from other studies showed that there exists a wide range of climatic conditions where the changes in CER and TR may be essentially independent of each other. (Baker-IVI)
W85-06203

RELATIONS BETWEEN AVAILABLE AND EXTRACTABLE SOIL WATER AND EVAPOTRANSPIRATION FROM A BEAN CROP,
Lincoln Coll. (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W85-06279

WATER USE-YIELD RELATIONS FOR COWPEA AND MAIZE,
Ife Univ. (Nigeria). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W85-06281

MEASURED EVAPORATION IN HIGH RAINFALL AREAS, LEEWARD KO'OLAU RANGE, OAHU, HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
P. C. Ekern.
Technical Report No. 156, October 1983, 69 p, 18 Fig, 14 Tab, 41 Ref, 6 Append.

Descriptors: *Evaporation, *Pan evaporation, *On-site data collections, *Rainfall, Capillarity, Evaporimeters, Evaporation pans, *Local precipitation, *Rainfall-runoff relationships, Rainfall intensity, Precipitation, Forest hydrology, Pearl Harbor, Hawaii, Kipapa transect, Manoa transect, Oahu.

Pumpage from the Pearl Harbor groundwater basin provides two-thirds of the water for irrigation and urban needs of Oahu. Surface runoff from the entire watershed has been evaluated as 18 percent of the 74 inch/year annual rainfall. To assess the extent of storage withdrawal of this newly regulated Hawaiian groundwater basin, evaporation was measured along two transects across the leeward Ko'olau Range. An evaporating surface was made from a dark, porous carborundum stone, 6 inches in diameter, that was wetted by capillary rise from a plastic reservoir. This more nearly simulated evaporation from a wetted leaf than any open-pan evaporimeter might. Class A pan evaporation at five different sites was 0.6 the water loss from corresponding evaporimeters. Water use on the Kipapa transect was that predicted by the Priestly-Taylor relationship, while water use on the Mahoa transect exceeded that predicted with positive advection from the urban surroundings and probable subsidence of the air from the Ko'olau crest. Of the near-normal 1981 rainfall of 149 inches, runoff was 27 percent, evaporation 28 percent, and deep percolate 45 percent for the Kipapa watershed water balance. (Hawkins-Omniplan)
W85-06345

HEAT BALANCE COMPONENTS AND EVAPOTRANSPIRATION FROM A SEDGE-GRASS MARSH,
Ceskoslovenska Akademie Ved, Trebon. Dept. of Hydrobotany.
K. Priban, and J. P. Ondok.
Folia Geobotanica et Phytotaxonomica, Vol. 20, No. 1, p 41-56, 1985. 9 Fig, 2 Tab, 21 Ref.

Descriptors: *Heat balance, *Evapotranspiration, *Marshes, Seasonal variation, Radiation, Humidity, Wind, Plant growth, Czechoslovakia.

Daily course of heat balance components and evapotranspiration were computed from meteorological data recorded in a sedge-grass marsh in South Bohemia, Czechoslovakia. Evapotranspiration (E) was determined by three methods: direct tank measurements, the Bowen-ratio method and the aerodynamic method. The tank measurement generally gave higher values of evapotranspiration

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than the other two methods. The evapotranspiration from the tank was higher, on the average, mainly when groundwater level was lower than the water level in the tanks. When the water level in the tanks was kept low the difference was slight. Evapotranspiration was highest in May and June, in the period of the intense stand growth. Most of the net radiation was used for evapotranspiration, less for the sensible heat flux and least for the ground heat flux. The daily course of evapotranspiration calculated by the aerodynamic method showed the strongest correlation with wind velocity, and that calculated by the Bowen-ratio method with both global and net radiation. (Baker-IVI)
W85-06370

EVAPOTRANSPIRATION OF THE FOREST IN THE AMAZON REGION (EVAPOTRANSPIRACAO DE FLORESTAS DA REGIAO AMAZONICA),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
A. de Oliveira Marques Filko, M. de Nazare Gols Ribeiro, and E. Salati.
Acta Amazonica, Vol. 13, No. 3-4, p 519-529, July, 1983. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Evapotranspiration, *Amazon, *Forests, Energy, Evaporation.

Amazonia's forest evapotranspiration was calculated through an equation proposed by Thom and Olivier (Thom, A.S. and Olivier, H.R., 1977, On Penman's equation for estimating regional evaporation. Quarterly J. R. Meteorological Society, 103: 345-357). The data are taken from nineteen Weather Stations distributed in the region. The contribution of the aerodynamic term in the composition of evapotranspiration was confirmed to be similar to the contribution of the term associated with energy budget. The averaged value of potential evapotranspiration was found to be 7 mm/day. (Author's abstract)
W85-06450

MEASUREMENT AND PREDICTION OF EVAPORATION FROM FORESTED AND AGRICULTURAL CATCHMENTS,
Institute of Hydrology, Wallingford (England).
J. B. Stewart.
Agricultural Water Management, Vol. 8, No. 1-3, p 1-28, January, 1984. 2 Fig, 7 Tab, 41 Ref.

Descriptors: *Evaporation, *Evapotranspiration, *Forests, *Cultivated land, *Western Australia, Water table, Vegetation, Saline seeps, Land use, Saline soils, Land management, Surface roughness, Radiational energy balance.

In the wheatbelt of Western Australia the replacement of native forest by annual agricultural crops resulted in a rise in the water table, and the formation of saline seepage. Since there is no evidence of a change in the input of precipitation to this area, it is thought that the rise in the water table is solely due to a decrease in evaporation as a result of the change in vegetation. In the climate of that area, vegetation could evaporate at much higher rates than occurs at present, either from the agricultural crops or from the native forest; introduction of such vegetation could therefore lower the water table and reduce saline seepages. To achieve a significant decrease in the height of the water table would require that either the replacement vegetation had a very high rate of evaporation or a large proportion of the agricultural area had to be converted to the new vegetation. Physical characteristics which affect evaporation include radiational energy balance and surface roughness. Agricultural crops are generally monocultures and are therefore biologically simpler than mixed vegetation. They are shallow rooting in the majority of cases. Though the ground cover of annual crops varies during their life span, for about 2/3 of the time they are growing they completely cover the ground. Forests are generally much more complex. The majority of forests have numerous species and are multi-storied. Methods of measuring evaporation are briefly reviewed and compared. Methods of measuring evaporation from large areas and over periods of years can only be used to determine the total evaporation, whereas physically based methods used for smaller areas and shorter periods can measure the individual evaporation components and provide a sound basis for prediction of evaporation. The Monteith-Penman equation is most suitable for predicting the effects of changes in land use management. (Moore-IVI)
W85-06666

MEASURING EVAPOTRANSPIRATION BY HYDROLOGICAL METHODS,
Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
J. W. Holmes.
Agricultural Water Management, Vol. 8, No. 1-3, p 29-40, January, 1984. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Evapotranspiration, *Hydrologic equation, *Measuring instruments, Water storage, Aquifers, Unsaturated zone, Precipitation, Stream discharge, Lysimeters, Material balance.

The measurement of evapotranspiration using the methods of micrometeorology requires a sophisticated application of advanced technology. The simpler alternatives, though they are not always less costly, are discussed, namely (1) precipitation-minus-stream discharge, (2) estimates of the changes of the water storages, either in the water table aquifer or in the unsaturated zone of the soil, (3) lysimeters, and (4) material balance methods. The accuracies attainable by these methods vary. The most precise estimate can be got from a well-designed, weighable lysimeter, but the representativeness of the exposure is always a worry for the experimenter. The least precise estimate, on a month-to-month basis, is afforded by the precipitation-minus-stream discharge method, but this method can give a good estimate of annual total evapotranspiration. The range of evapotranspiration rates probably spans 0.7 mm/d in mid-winter, on occasions, to 5 mm/d in late spring if the season is a wet one. For reasonable definition of these rates on a daily basis, one is looking for a method that is accurate to +/- 0.2 mm/d. Only the weighing lysimeter can achieve this. The other methods variously provide mean rates for periods of five days or longer. (Author's abstract)
W85-06667

EVAPOTRANSPIRATION FROM A EUCALYPTUS COMMUNITY,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma.
Agricultural Water Management, Vol. 8, No. 1-3, p 41-56, January, 1984. 3 Fig, 2 Tab, 37 Ref.

Descriptors: *Evapotranspiration, *Eucalyptus, *Western Australia, Interception, Canopy, Evaporation, Rainfall, Forests, Soil water deficit, Root distribution.

Large areas of Australian forests are dominated by various species of the genus Eucalyptus. In southern Australia, clearing of native eucalypts has caused serious deterioration in water quality and as a result salinization of water resources has become the most serious environmental problem in Western Australia. Components of water balance were measured for a jarrah-marri (Eucalyptus marginata, E. calophylla) catchment over a period of five years and evapotranspiration was calculated. The catchment is located in a 1100 mm/yr rainfall region near Collie, Western Australia. Over a period of five years, annual evapotranspiration from a Eucalyptus catchment was more than 70% of the annual precipitation. During rainy winter periods, evapotranspiration far exceeded the available radiant energy. Monthly evapotranspiration rates were up to three times that of pan evaporation. Such losses may be due to large interception and evaporation of intercepted water at a rate considerably higher than the potential rate from a dry canopy. Evapotranspiration continued through the summer. Water extraction patterns suggest that eucalypts extracted water from depths down to 6 m, creating soil water deficits of up to 450 mm, compared to a water deficit of < 150 mm under annual pasture, under similar conditions. Interception and water extraction from deep soil horizons are the major factors responsible for high rates of water loss from eucalypt communities. (Moore-IVI)
W85-06668

DETERMINATION OF THE EVAPOTRANSPIRATION OF E. REGNANS FORESTED CATCHMENTS USING HYDROLOGICAL MEASUREMENTS,
Melbourne and Metropolitan Board of Works (Australia).
R. J. Morgan, and P. J. O'Shaughnessy.
Agricultural Water Management, Vol. 8, No. 1-3, p 57-76, January, 1984. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Evapotranspiration, *Forested watersheds, *Hydrologic budget, *Victoria, *Australia, Catchments, Streamflow, Eucalyptus, Catchment area, Radiation index.

Water balance investigations were conducted in Eucalyptus regnans forested catchments in the North Maroondah and Coranderrk Experimental Areas, Victoria, Australia. For the North Maroondah experimental catchments, variation in radiation index was the most important factor in accounting for differences in catchment loss, which is used as a measure of actual evapotranspiration. For the nine typical regrowth catchments, variation in radiation index is found to account for 45% of the variation in catchment loss. Loss also tends to increase with basal area and stocking, but the relationships are not statistically significant. If a method of reducing stand density can be developed that results in a permanent structure similar to that of a naturally open forest then increases in streamflow of significance to water supply may result. The old growth group of catchments has a significantly lower loss than that from each of three groups of regrowth catchments. These differences can not be explained in terms of radiation input alone, and there is a significant relationship between annual catchment loss and stocking rate for the 11 catchments. The stocking rate parameter serves to characterize both the differences in age between old growth and regrowth forest and the differences in density within each age class. The decrease in streamflow which would result from conversion of an open old growth forest to a dense regrowth forest is of the order of 215 mm which is important from a water supply point of view. The old growth Coranderrk catchments lose more water than would be expected on the basis of the behavior of the North Maroondah catchments. These enhanced losses may be attributable to greater inputs of advected energy in the Coranderrk situation. (Baker-IVI)
W85-06669

TERMINOLOGY AND CONCEPTS IN NATURAL EVAPORATION,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
I. C. McIlroy.
Agricultural Water Management, Vol. 8, No. 1-3, p 77-98, January, 1984. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Water management, *Evaporation, *Agriculture, Water supply, Evapotranspiration, Precipitation, Runoff, Infiltration, Interception, Drainage, Percolation, Radiant energy.

A systematic unified set of terms, definitions and symbols are presented which are applicable in the area of evaporation. A physical discussion of the evaporative process is offered, employing as its main tools the principal formulae used in evaporation measurement. The latter are tabulated using recommended terminology. For maximum insight into evaporative behavior under varying circumstances, attention is focussed on the combination method formulae, which are used to create a general picture of the interactions between evaporation and the many other factors which influence it. Specific topics discussed as part of the evaporative process include available water supply, surface energy supply, and vapor flow through the atmosphere. (Baker-IVI)
W85-06670

MEASUREMENT OF EVAPORATION BY METEOROLOGICAL METHODS,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
J. R. Garratt.
Agricultural Water Management, Vol. 8, No. 1-3, p 99-117, January, 1984. 3 Fig, 2 Tab, 50 Ref.

Descriptors: *Evaporation, *Energy budget, *Turbulent transfer, Forests, Canopy, Heat storage, Air temperature, Humidity, Surface resistance, Surface temperature, Eddy covariance, Wind.

Three methods based on energy budget and turbulent transfer formulations may be recommended for the determination of evaporation E from catchment areas. They all involve measurement of available energy R-G, R being net radiative flux and G the heat flux into the surface. When estimates from forests on an hourly to daily basis are made, the contribution from canopy heat storage should be included in G. The energy budget/Bowen ratio method requires no detailed specification of surface properties but involves relatively complex instrumentation to measure vertical differences of temperature and humidity in the air. Wtih the exclusion of eddy covariance, it is potentially the most accurate method and should be applicable for crops and forests, over a wide range of evaporation conditions. The residual energy budget method requires accurate estimates of atmospheric resistance and measurement of surface temperature. Where the latter is available (by airborne radiometer) the method is most reliable for surfaces of low roughness or in conditions of high evaporation. The combination method incorporates both energy budget and bulk relationships to eliminate surface temperature. It introduces surface resistance, which must be parameterized in terms of soil, plant species and atmospheric quantities, with allowance made for sub-canopy fluxes and evaporation of intercepted rainfall. The method is suitable for estimating daily or monthly evaporation using standard atmospheric observations. The eddy covariance method is not yet sufficiently developed to measure E reliably at the operational level over long periods of time and over less-than uniform terrain but, of all the methods to be described, it has the greatest potential to do so. Methods based on eddy covariance, wind and other profiles are more appropriate to research investigations. (Author's abstract)
W85-06671

EVAPOTRANSPIRATION - HOW GOOD IS THE BOWEN RATIO METHOD,
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
D. E. Angus, and P. J. Watts.
Agricultural Water Management, Vol. 8, No. 1-3, p 133-150, January, 1984. 66 Fig, 9 Ref.

Descriptors: *Evapotranspiration, *Bowen ratio method, Error analysis, Boundary conditions, Energy balance, Heat flux, Vapor pressure, Vegetation.

Under moist conditions, the energy balance approach to determining evapotranspiration from plant communities can give good results, but the method may not be nearly so accurate under very dry conditions, or with considerable advection of energy in moist conditions. In the former case, error analysis shows that the relative error in evapotranspiration can only be kept small provided that the relative error in the Bowen ratio is likewise small. In dry conditions, however, the absolute error in evapotranspiration is always fairly small, because of the small value of evapotranspiration itself. Analysis of the effect on the Bowen ratio of errors in the dry- and wet-bulb temperature gradients shows that in very dry conditions the required accuracy in the measurement of these gradients is an order of magnitude greater than could reasonably be expected for most Bowen ratio equipment. In the latter case, experimental results show that Bowen ratio measurements considered to be made, within the boundary layer, can give by day too small a value of evapotranspiration, and by night a latent heat flux direction which is inconsistent with the direction of the vapor pressure gradient. This raises the question as to what exactly is meant by adjustment of atmospheric properties to those of a new underlying surface when air passes over a boundary between two types of surface. (Author's abstract)
W85-06672

EVALUATION OF EVAPOTRANSPIRATION AND CANOPY RESISTANCE: AN ALTERNATIVE COMBINATION APPROACH,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
E. K. Webb.
Agricultural Water Management, Vol. 8, No. 1-3, p 151-166, January, 1984. 3 Fig, 1 Tab, 49 Ref.

Descriptors: *Evapotranspiration, *Canopy, *Surface resistance, Vegetation, Bowen ratio method, Penman-Monteith method, Aerodynamic properties, Heat budget, Surface temperature, Humidity.

This paper gives a preliminary outline of a suggested different type of combination method for evaluating evapotranspiration and surface resistance, with brief discussion of its application to vegetated surfaces. In the well known Penman-Monteith (P-M) combination method the surface temperature and humidity are eliminated by combining the bulk aerodynamic and heat budget relationships. In the method proposed the surface values are again eliminated, but by combining the bulk aerodynamic and Bowen ratio relationships (the B-B method). Whereas the P-M method may be applied using climatological data alone if desired, the B-B method is applicable only when the appropriate measurements are made including the Bowen ratio. The B-B method may be applied over short time intervals (e.g. 20 min) if required. The B-B formulation is more sensitive to the surface characteristics, bulk transfer coefficient and effective surface resistance, than is the P-M. Therefore it is suggested that for vegetated surfaces the main application of the B-B method would be in establishing empirically these surface characteristics for various types of vegetation at different stages of growth and under different conditions. In this role the capability of evaluation over small time intervals would be advantageous in studies with changing conditions, e.g. with soil drying out, with evaporation from wet foliage, or with changing illumination. (Author's abstract)
W85-06673

PLANT PHYSIOLOGICAL METHODS FOR STUDYING EVAPOTRANSPIRATION: PROBLEMS OF TELLING THE FOREST FROM THE TREES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
O. T. Denmead.
Agricultural Water Management, Vol. 8, No. 1-3, p 167-189, January, 1984. 10 Fig, 1 Tab, 36 Ref.

Descriptors: *Evapotranspiration, *Plant physiology, *Reviews, Micrometeorology, Eddy correlation, Tracers, Isotopic tracers, Microclimate, Evaporation, Transpiration, Chamber methods, Soil evaporation, Litter.

This review is concerned with methods for quantifying physical and physiological processes within plant communities which influence evapotranspiration. Micrometeorological approaches have not been very fruitful because of their reliance on classical flux-gradient relationships, but new perceptions and eddy correlation techniques promise real progress in the near future. Alternative plant physiological approaches including chamber systems, tracer techniques and so-called combination methods, are considered. Perceived problems with chamber systems are the difficulties of mimicking the natural environment inside the chamber and the effects of chamber air pressure on vapor transfer from the soil. Tracer techniques (using pulses of heat or radioactive isotopes) avoid these problems but require exact knowledge of the water pathway in the stem. Combination methods also do not disturb the natural environment, but any difficult measurements are required and the sampling problems are large. They can be applied with least equivocation to layers of leaves. Application to whole plant communities is circumspect because of changing microclimates within the community, the large vertical spread of sources and sinks, and the fact that much of the evaporated water may not pass through plants at all. Many physiological approaches measure only transpiration. Some attention is given to the neglected component, soil evaporation. An analysis of evaporation from the floor of a pine forest suggests that the litter limits the vapor loss to perhaps half what it might be if the soil surface was exposed. (Author's abstract)
W85-06674

EVAPOTRANSPIRATION OF FOUR MAJOR AGRICULTURAL PLANT COMMUNITIES IN THE SOUTH-WEST OF WESTERN AUSTRALIA MEASURED WITH LARGE VENTILATED CHAMBERS,
Western Australia Dept. of Agriculture, South Perth. Div. of Resource Management.
R. A. Nulsen.
Agricultural Water Management, Vol. 8, No. 1-3, p 191-202, January, 1984. 5 Fig, 3 Tab, 11 Ref.

Descriptors: *Evapotranspiration, *Crops, *Western Australia, Ventilation chambers, Agronomic practices, Saline soils, Wheat, Barley, Lupin, Clover, Water use, Groundwater recharge.

Reduced evapotranspiration as a result of replacing perennial native vegetation with annual crops and pastures leads to secondary salinization of agricultural soils in the south-west of Western Australia. Manipulating agronomic practices may significantly reduce the recharge and thus retard or halt salting or even reclaim salt affected land. Ventilated chambers were used to measure evapotranspiration of four common agricultural species: wheat, barley, lupins and subterranean clover. There was a large variation between successive years, but the relative water consumption by the various species was consistent. A barley-lupins rotation reduced recharge by 50% compared with a wheat-clover rotation. The ventilated chamber technique has some limitations, even for the comparative measurement of evapotranspiration. A reliable estimate of velocity is essential, but four methods of velocity measurement were tested and agreement between the four was not good. This casts some doubt on the validity of the results in absolute terms but the data probably can still be used for comparative purposes. There appears to be a good chance that agronomic manipulation can reduce recharge to the groundwater system and eventually restrict the rate of secondary salinization in the cereal growing areas of Western Australia. Because the proposed changes lie within the present agricultural technology of the State, once the technique has been shown effective, the chances of adoption by the farming community would seem reasonable. (Moore-IVI)
W85-06675

MODELLING EVAPOTRANSPIRATION: AN APPROACH TO HETEROGENEOUS COMMUNITIES,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
C. W. Rose.
Agricultural Water Management, Vol. 8, No. 1-3, p 203-221, January, 1984. 4 Fig, 33 Ref.

Descriptors: *Evapotranspiration, *Mathematical models, Transpiration, Penman-Monteith equation, Trees, Wind, Water vapor, Evaporation, Canopy, Forests.

The paper considers how evapotranspiration from a heterogeneous community of trees might be modelled. Relevant literature is reviewed, including the Penman-Monteith equation. New theory is developed for predicting transpiration from an isolated tree, which recognized the ability of such a tree to extract energy from and add water to air flowing laterally through the canopy. In this theory a tree is divided into a top and bottom part, with the top part assumed to lose water vapor both vertically to air above the canopy and horizontally to air passing through canopy; the only form of

water vapor loss from the bottom part is assumed to be horizontal. The Penman-Monteith equation is applied to estimate the 'vertical' evaporation, and theory developed to estimate 'horizontal' evaporation which recognizes the limitation on water loss imposed by stomatal and boundary layer resistances. One conclusion which follows from this analysis is that transpiration from an isolated tree will in general be less dependent on wind speed than the modest dependence on wind speed of transpiration from a (dry) canopy. Other implications of the theory are investigated using a numerical example. The theory developed allows estimation of the ratio of the transpiration rate for an isolated tree to that of a tree with the same relevant characteristics exposed to a similar environment. This capability is used to provide a framework for considering transpiration for heterogeneous tree communities. (Author's abstract)
W85-06676

MODEL OF CANOPY DRYING,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
E. Wronski.
Agricultural Water Management, Vol. 8, No. 1-3, p 243-262, January, 1984. 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Canopy drying, *Mathematical models, *Pine trees, Forests, Diffusion, Interception, Evapotranspiration, Airflow, Transpiration, Stomatal resistance.

There is evidence that the enhanced evaporation of intercepted water from forests can significantly reduce water yield relative to short vegetation. As intercepted water evaporates, some simply replaces transpiration which would otherwise have occurred had the canopy been dry. A one-dimensional diffusion model of canopy drying applied to a Pinus radiata forest yielded evapotranspiration rates during canopy drying less than those observed. The discrepancy indicated either there was a substantially greater interchange between the above and within canopy airflow than calculated assuming local diffusion, or there was a reduction in stomatal resistance caused by low transpiration demand when the canopy was wet. Most transpiration from a Pinus radiata canopy occurs below the main radiation sink, in a zone in the canopy where processes are strongly governed by the turbulent interchange between the airflow within and above the canopy. The net interception loss associated with daytime canopy drying was approximately 60% of the interception loss. Part of this net loss may be due to a reduction in stomatal resistance during canopy drying, associated with low transpiration and humidity deficits at that time. (Moore-IVI)
W85-06678

EVAPOTRANSPIRATION AND SOIL HETEROGENEITY,
Oak Ridge National Lab., TN. Environmental Sciences Div.
R. J. Luxmoore, and M. L. Sharma.
Agricultural Water Management, Vol. 8, No. 1-3, p 279-289, January, 1984. 5 Fig, 4 Tab, 10 Ref.

Descriptors: *Evapotranspiration, *Soil texture, Pore size, Simulation, Mathematical models, Soil physical properties, Water potential, Stomatal conductance, Soil water capacity, Soil hydraulic properties.

Soil hydraulic properties are likely to affect evapotranspiration through their effect on water availability to plants. By using scaling theory, effects of soil spatial heterogeneity on evapotranspiration of a grassland catchment were simulated by the Terrestrial Ecosystem Hydrology Model (TEHM). Scaling theory provides a basis for expressing soil heterogeneity in terms of a single variable, the mean pore size of a soil. Annual evapotranspiration was predicted to increase up to 22% for soils with smaller mean pore size (finer textured) than the reference silty loam soil. Water potential and stomatal conductance of foliage were generally higher for finer textured soils. This increased water supply to vegetation was related to higher water capacity of soils with smaller pore sizes in this instance. The soils with high water capacity at matric potential below field capacity store more water during recharge and provide more available water to plants during dry periods than soils with lower water capacity. Sequences of wetting and drying cycles favor higher transpiration and lower drainage from soils with higher water capacity. Spatial variation in soil hydraulic properties could significantly influence areal evapotranspiration. (Moore-IVI)
W85-06679

DEVELOPMENT AND PROVING OF MODELS OF LARGE SCALE EVAPOTRANSPIRATION: AN AUSTRALIAN STUDY,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
F. X. Dunin, and A. R. Aston.
Agricultural Water Management, Vol. 8, No. 1-3, p 305-323, January, 1984. 6 Fig, 2 Tab, 21 Ref.

Descriptors: *Evapotranspiration, *Model studies, *Australia, Climate, Topography, Soil properties, Vegetation, Runoff, Transpiration, Soil water, Forests, Leaves, Roots, Computers.

Areal evapotranspiration from an experimental catchment and a river basin was estimated by model, which was initially developed for point values measured by a weighing lysimeter. Modifications to the model framework to accomodate scale effects of variability in climate, topography, soils and vegetation were outlined. Model performance was assessed with satisfactory agreement in monthly values between computed and measured evapotranspiration of the experimental catchment. At the river basin level, acceptable estimates of evapotranspiration were inferred on the basis of general agreement between computed and measured values of monthly runoff. Evaluation of model performance included a comparison of lysimeter measurements with computed values for the small experimental catchment. It was concluded that extrapolation of point measurements can be questionable even on a local scale and this finding strengthened the case for model determinations as being a realistic approach to estimate areal evapotranspiration. Discussion of model results explored the generality of model assumptions for scaling meteorological inputs and particularly for descriptions of transpiration response to soil water supply. The efficacy of single-curve expressions inherent in the model to explain transpiration rate as function of soil water content, was examined in the context of additional data from a weighing lysimeter of a young eucalypt forest community. Analysis of the eucalypt data indicated a complex response in transpiration behavior. Critical levels of soil water supply changed with atmospheric demand, and morphological interactions of leaf area and root development influenced rates of soil water extraction in modifying patterns of transpiration dynamics. Thus an extended application of the present model study of evapotranspiration, albeit with realistic results, demands a critical appraisal of the underlying model assumptions to assess their relevance for a different suite of conditions either in time or space. (Author's abstract)
W85-06681

CROP WATER REQUIREMENTS FOR RAINFED AND IRRIGATED WHEAT IN CHINA AND KOREA,
California Univ., Los Angeles. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W85-06687

EVAPORATION AND DRIFT LOSSES FROM SPRINKLER IRRIGATION SYSTEMS UNDER VARIOUS OPERATING CONDITIONS,
Cukurova Univ., Adana (Turkey). Coll. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W85-06689

SPECTRAL CHARACTERISTICS OF THE GLOBAL MOISTURE DISTRIBUTION AND THEIR IMPORTANCE IN OBJECTIVE ANALYSIS OF MOISTURE FOR NWP MODELS,
Systems and Applied Sciences Corp., Riverdale, MD.
D. C. Norquist, and C. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA 120397. Scientific Report No. 1. AFGL-TR-82-0190. July 14, 1982. 61 p. 31 Fig, 8 Tab. Contract/Grant No. F19628-82-C-0023.

Descriptors: *Specific humidity, *Weather forecasting, *Model studies, Moisture, Baseline studies, Prediction.

Using data sets of observations of atmospheric variables on a global scale, the spectral distribution of atmospheric moisture was compared with that of wind and mass fields. Results show that, spectrally, the wind field has more of its power in higher wave numbers, and temperature and geopotential height have more power in lower wave numbers than does moisture. Moisture has a shift in its power toward higher wave number with altitude, contrasting with a greater concentration of power in low wave numbers with altitude for geopotential. A baseline aqainst which objective analysis methods for the respective variables may be tested was established, to determine how accurately each method represents the observed field. It is concluded on the basis of the unique characteristics of the moisture spectrum that a mass-motion objective analysis scheme need to be modified to make it useful for moisture analysis or an entirely separate scheme needs to be developed for moisture analysis.
W85-06958

2E. Streamflow and Runoff

FLOOD-RUNOFF FORECASTING WITH HEC1F,
Hydrologic Engineering Center, Davis, CA.
J. C. Peters, and P. B. Ely.
Water Resources Bulletin, Vol. 21, No. 1, p 7-13, February, 1985. 9 Fig, 8 Ref.

Descriptors: *Flood forecasting, *Computers, *Runoff, Hydrographs, Rainfall-runoff relationships, Flood routing, Data processing, Streamflow, Reservoirs, Simulation.

HEC1F is a computer program for making short-to medium-term forecasts of uncontrolled flood runoff. The program employs unit hydrographs and hydrologic routing to simulate runoff from a subdivided basin. Estimates of future rainfall can be accommodated. Runoff parameters for gaged headwater subbasins can be estimated (optimized) in real time. Blending of calculated with observed hydrographs can be performed. HEC1F is a component of an on-line software system that includes capability for data acquisition and processing, precipitation analysis, streamflow forecasting, reservoir system analysis, and graphical display of data and simulation results. The conceptual framework for HEC1F is described, and application of the program is illustrated. (Author's abstract)
W85-06233

PLANNING FOR DROUGHT: THE ROLE OF STATE GOVERNMENT,
Nebraska Univ.-Lincoln. Inst. of Agriculture and Natural Resources.
For primary bibliographic entry see Field 6A.
W85-06236

EVOLUTION OF A DRAINAGE NETWORK: REMOTE SENSING ANALYSIS OF THE NORTH FORK TOUTLE RIVER, MOUNT ST. HELENS, WASHINGTON,
Oregon State Univ., Corvallis. Dept. of Geography.
C. L. Rosenfeld, and G. L. Beach.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 160679/AS, Price codes: A06 in paper copy, A01 in microfiche. Project Completion Report, Oregon Water Resources Research Institute, Corvallis, Publica-

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tion WRRI-88, November 1983, 100 p, 21 Fig, 4 Tab, 10 Ref, 2 Append, Project No. BuRec C-100082-V (1), Contract/Grant No. 14-34-0001-1452.

Descriptors: *Drainage networks, *Drainage patterns, *Erosion, Channel erosion, Gully erosion, *Sedimentation, Sediment transport, Deposition, Mud flows, *Volcanoes, *Remote sensing, Mapping, *Geomorphology, *Mt. St. Helens, *Washington, *Toutle River.

The May 18, 1980 eruption of Mt. St. Helens and subsequent volcanic events caused a large debris avalanche and several smaller pyroclastic flows and mudflows in the upper North Fork Toutle River. Major hydrologic disruptions resulted because of the newly created landscape. Aerial surveillance, mapping and evaluation of hydrologic conditions in upper reaches of the North Fork Toutle River valley were conducted from October 1981 until January 1983. The rate and mode of erosional and depositional landscape development was assessed and the potential for additional castastrophic events was evaluated. Major drainage network development was observed and the geomorphic trends of this evolutionary development were studied. A series of six detailed interpretative hydrologic status maps were produced to study the locations, patterns, and densities of fluvial and geomorphic features as well the temporal and spatial changes. These maps also indicate the rates of channel network evolution. Significant hydrographic changes occurred following each storm event. Development and downward migration of gullies and streams progressed rapidly during winter 1981-1982; numerous outbreaks of ponds and lakes occurred. Channel aggradation and degradation occurred along the North Fork Toutle River during summer 1982. A series of high-intensity, long-duration storm events in February 1982 causes significant changes in drainage network evolution which culminated with the inundation of Jackson Lake, resulting in a flood surge downnriver and the failure of the spillway on the northern sediment retention dam.
W85-06303

PROBLEM ORIENTED EVALUATION OF INSTITUTIONAL DECISION MAKING AND IMPROVEMENT OF MODELS USED IN REGIONAL URBAN RUNOFF MANAGEMENT: APPLICATION TO INDIANA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6A.
W85-06306

STORMWATER MANAGEMENT ALTERNATIVES - A COMPUTER-BASED PROGRAM FOR THE SELECTION OF TECHNIQUES TO MITIGATE THE IMPACT OF URBAN STORMWATER,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
J. T. Tourbier.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157857/AS, Price codes: A07 in paper copy. Project Completion Report, 1984. 141 p, Project No. USGS G-833/23.

Descriptors: *Storm runoff, Management planning, *Computer models, Technology transfer, Planning, Urban runoff.

The purpose of this project was to develop a software program for use with an IBM Personal Computer as a technology transfer tool that aids in the selection of stormwater management techniques. Users are asked to supply information about a development site and define planning objectives. The program then quantifies runoff conditions. The program pre-selects measures applicable to the site. The user is then able to explore measures in various levels of detail and assign to a given measure a value representing its assumed usefulness. The user is then directed to eliminate measures that duplicate functions and reminded to explore applicable concepts and measures that have been overlooked. Finally, the program offers design, operation, and maintenance recommendations for measures selected and gives a printout of the information. The program may be used by planning commissions, engineering and public works departments, consulting firms, and universities.
W85-06328

EVIDENCE OF FLOODS ON THE POTOMAC RIVER FROM ANATOMICAL ABNORMALITIES IN THE WOOD OF FLOOD-PLAIN TREES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2I.
W85-06360

STRUCTURE AND ECOLOGY OF THE MICRO-FAUNA IN THE CENTRAL AMAZONIAN FOREST STREAM 'IGARAPE DA CACHOEIRA',
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
I. Walker.
Hydrobiologia, Vol. 122, No. 2, p 137-152, 1985. 11 Fig, 2 Tab, 37 Ref.

Descriptors: *Microfauna, *Streams, *Brazil, *Forest watersheds, Ecology, Sampling, Litter, Rainfall, Detritus, Fish, Bacteria, Algae, Biomass.

A special method was developed to sample the microfauna in open stream water and to observe its food habits over long periods in the laboratory. The microfauna is primarily associated with submerged leaf litter. Its density in the open water is a function of water current and hence, of rainfall. A considerable quantity of living and detritus biomass is swept downstream with each heavy rain. The foodweb starts essentially with decomposing fungi and detritus, and to a much lesser extent with algae and bacteria. Protozoa and Rhabdocoela are an insignificant input into the foodweb of higher invertebrates, but their role for maintenance of water quality may be important. Prey of fishes and shrimps depends primarily on primary input, i.e. on detritus, fungi and to some extent on algae and bacteria. The role of biomass transport from forest streams into large rivers is discussed in relation to the fauna of the periodically inundated forest. (Baker-IVI)
W85-06387

TIME-SERIES MODELS FOR THE PREDICTION OF STREAM FLOW IN A KARST DRAINAGE SYSTEM,
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
A. J. Jakeman, M. A. Greenaway, and J. N. Jennings.
Journal of Hydrology, Vol. 23, No. 1, p 21-33, 1984. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Time series analysis, *Streamflow, *Karst hydrology, *Drainage systems, *Cave Creek, *Cooleman Plain, *New Zealand, Rainfall, Model studies, Prediction.

Time series methods are used to predict values for numerous missing daily flow records from rainfall in the Cave Creek drainage system, Cooleman Plain, New South Wales. Separate models are developed which are statistically valid for fixed portions of the data. Missing flows within a consistently-behaved hydrological period can be predicted from the statistical model, which is identified from other data within the period. The method circumvents difficulties associated with validating a detailed physical model of a complex hydrological/geomorphological system. By regression with sample chemical analyses the discharge estimates obtained are used to ascertain the temporal distribution of limestone solution, which is the dominant geomorphic process here. (Author's abstract)
W85-06434

INFLUENCE OF WIND ON CURRENTS IN RIVER MOUTHS (O VLIYANII VETRA NA TECHENIYA V UST'YAKH REK),
S. A. Arsenev, and N. K. Shelkovnikov.
Okeanologiya, Vol. 24, No. 2, p 263-269, March/April, 1984. 4 Fig, 21 Ref.

Descriptors: *Wind-driven currents, *River flow, *River mouth, *Volga River, *Hudson River, Water currents, Wind, Wind velocity, Rivers, Bottom currents.

The influence of wind on currents in well-mixed river mouths was investigated. The surge-ebb winds are shown to generate bottom currents directed to and from river mouths. The theory explains the observations made in the Volga and Hudson River mouths. (Author's abstract)
W85-06455

MULTISITE ARMA (1,1) AND DISAGGREGATION MODELS FOR ANNUAL STREAMFLOW GENERATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, D. P. Lettenmaier, and R. M. Vogel.
Water Resources Research, Vol. 21, No. 4, p 497-509, April, 1985. 4 Fig, 9 Tab, 35 Ref, 1 Append.
NSF grants CME 8010889 and CEE 8211730.

Descriptors: *Streamflow, *Autoregressive moving average models, *Disaggregation models, *Time series analysis, Mathematical models, Model studies, Algorithms.

Disaggregation and multisite autoregressive moving average (ARMA)(1,1) time-series models provide simple and efficient frameworks for generation of multisite synthetic streamflow sequences that exhibit long-term persistence. This paper considers multisite ARMA(1,1) models whose Phi and Theta matrices are diagonal; a Monte Carlo study examined the efficiency of three procedures for estimating individual phi-theta values for each site and two estimators of the covariance matrix of the innovations. Also included in the study was a univariate ARMA(1,1) model of the aggregate flows with a simple disaggregation algorithm to generate flows at the individual sites. In the realm of most hydrologic interest, simple diagonal multisite ARMA(1,1) models performed adequately and it is not necessary to fit more cumbersome nondiagonal models. The disaggregation procedure coupled with an ARMA(1,1) aggregate flow model did as well as the multivariate diagonal ARMA(1,1) models. (Author's abstract)
W85-06504

STOCHASTIC STREAMFLOW MODEL BASED ON PHYSICAL PRINCIPLES,
Portland State Univ., OR. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W85-06508

EFFECT OF GLACIERS ON STREAMFLOW VARIATIONS,
Geological Survey, Tacoma, WA.
A. G. Fountain, and W. V. Tangborn.
Water Resources Research, Vol. 21, No. 4, p 579-586, April, 1985. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Glaciers, *Melting, *Streamflow, *Cascade Mountains, *Washington, *Glaciohydrology, Hydrologic cycle, Seasonal variation, Meltwater, Englacial storage, Runoff, Algorithms.

Glaciers are frozen reservoirs of water. The release of water from storage greatly affects the local hydrological cycle by contributing to streamflow in otherwise low flow periods. The effect of temperate glaciers on runoff variations is examined for the North Cascade Mountains of Washington State. The principal influences of glaciers on streamflow are often unexpected contributions to streamflow volume, a delay of the maximum seasonal flow, and a decrease in annual and monthly variation of runoff. The delay of maximum flow is caused by temporary englacial storage of spring meltwater and by peak meltwater production occurring in midsummer. The englacial storage, for one case, is 54% of the potential May runoff. An

algorithm is presented that calculates the coefficient of variation of runoff for any arbitrary glacier cover. A minimum in year-to-year variation may occur for basins about 36% glacierized. The variations then increases with increasing glacerization to 100% glacier cover, at which point the variation is almost equal to that of a nonglacierized basin. The monthly runoff variations show a minimum in April through May for unglacierized basins, and a maximum in March and April for basins 100% glacierized. The minimum is caused by snowmelt compensating for rainfall variations in unglacerized basins, and the maximum, if not an artifact of the analysis, may be caused by irregular water storage in the glacier, resulting in a greater variation in runoff from highly glacierized basins. The minimum coefficient of variation occurs in July, August, and September, when icemelt compensates for deviations in precipitation, and appears for basins with more than about 10% cover. (Moore-IVI)
W85-06512

WATER BALANCE MODELS IN ONE-MONTH-AHEAD STREAMFLOW FORECASTING,
Geological Survey, Reston, VA.
W. M. Alley.
Water Resources Research, Vol. 21, No. 4, p 597-606, April, 1985. 3 Fig, 8 Tab, 25 Ref.

Descriptors: *Hydrologic budget, *Streamflow forecasting, *New Jersey, Seasonal variation, Mathematical models, Time series analysis, Autoregressive models, Forecasting.

Techniques are tested that incorporate information from water balance models in making 1-month-ahead streamflow forecasts in New Jersey. The results are compared to those based on simple autoregressive time series models. The relative performance of the models is dependent on the month of the year in question. The water balance models are most useful for forecasts of April and May flows. For the stations in northern New Jersey, the April and May forecasts were made in order of decreasing reliability using the water-balance-based approaches, using the historical monthly means, and using simple autoregressive models. The water balance models were useful to a lesser extent for forecasts during the fall months. For the rest of the year the improvements in forecasts over those obtained using the simpler autoregressive models were either very small or the simpler models provided better forecasts. When using the water balance models, monthly corrections for bias are found to improve minimum mean-square-error forecasts as well as to improve estimates of the forecasts conditional distributions. (Author's abstract)
W85-06514

RESPONSE OF ALLUVIAL RIVERS TO SLOW ACTIVE TECTONIC MOVEMENT,
Chuo Univ., Tokyo (Japan). Inst. of Geosciences.
For primary bibliographic entry see Field 2J.
W85-06517

DRAINAGE INITIATION BY SUBSURFACE FLOW IN SOUTH TARANAKI, NEW ZEALAND,
Victoria Univ., Wellington (New Zealand). Dept. of Geology.
B. Pillans.
Geology, Vol. 13, No. 4, p 262-265, April, 1985. 3 Fig, 16 Ref.

Descriptors: *Storm seepage, *Drainage initiation, *South Taranaki, *New Zealand, Sapping, Subaerial drainage networks, Bifurcation, Streams, Fluvial processes.

The elevation of new land along an actively rising coastline has been recognized as an initial surface upon which subaerial drainage networks are formed. The South Taranaki coastal plain between Hawera and Wanganui in the North Island of New Zealand represents such an initial surface in the early stages of its evolution. A broad flight of upper Quaternary marine terraces is being progressively dissected by fluvial processes. Small terrace-front valleys as long as 1 km are initiated and lengthened by headward sapping. The process is largely controlled by subsurface flow in permeable terrace cover beds overlying impermeable Tertiary mudstones and siltstones. The gentle, seaward dip of wave-cut surfaces results in dominantly shore-normal (consequent) streams in the early stages of drainage-network evolution. Network growth (bifurcation) is also largely controlled by subsurface flow and may explain why many stream junctions in South Taranaki are roughly orthogonal. A point is eventually reached when a terrace surface becomes completely dissected and drainage networks must evolve by different mechanisms. There are fundamental differences between the mechanisms of drainage-network development in the early and later stages of landscape evolution in South Taranaki; an early stage characterized by headward retreat through sapping and a later stage characterized by its absence or a near absence. (Author's abstract)
W85-06520

EFFECT OF CLUSTERING OF FLOOD PEAKS ON A FLOOD RISK ANALYSIS FOR THE RED RIVER,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
C. Booy, and D. R. Morgan.
Canadian Journal of Civil Engineering, Vol. 12, No. 1, p 150-165, March, 1985. 15 Fig, 5 Tab, 14 Ref.

Descriptors: *Flood forecasting, *Flood peak, *Red River, *Winnipeg, *Manitoba, Risks, Flood frequency, Bayesian probability distribution, Time series, Estimating.

The record of annual flood peaks on the Red River at Redwood Bridge in Winnipeg, Manitoba shows a degree of clustering of high flood years that, statistically speaking, is incompatible with the customary assumption of serial independence in flood frequency analysis. Additional evidence of a circumstantial nature has been adduced to further substantiate the observed clustering. Clustering affects the weight that must be given to the historical floods in the flood risk analysis, in particular the 1826 and 1852 floods, which were considerably in excess of the maximum recorded flood. Bayesian updating of the information obtained from the record with the information supplied by the historical floods shows that clustering leads to a substantially increased flood risk for the City of Winnipeg and the towns and villages in the Red River Valley. (Baker-IVI)
W85-06553

EXTREME VALUE PROCESSES AND THE EVALUATION OF RISK IN FLOOD ANALYSIS,
Universitaet fuer Bodenkultur, Vienna (Austria). Inst. fuer Mathematik and Angewandte Statistik.
F. Konecny, and H. P. Nachtnebel.
Applied Mathematical Modelling, Vol. 9, No. 1, p 11-15, February, 1985. 1 Fig, 12 Ref.

Descriptors: *Flood flow, *Risk analysis, *Predicting, Floods, Stochastic process, Model studies, Flood peak, Seasonal variation, Temporal distribution.

An analysis of hydrological risk is presented associated with decisions based on stochastic flood models. The maxima of a stream-flow are described by a marked Poisson process with a cyclic trend and exponentially distributed marks. Typical design criteria like the expected larger exceedance of a fixed level in a given period are derived from the extreme value process. The proposed model has been applied to a discharge series of 86 years (1893-1978) observed at the gauging station Pegel Federaun which is located at the river Gail in Carinthia, Southern Austria. After selecting a base level such that it was surmounted approximately once a year, 243 flood peaks were observed. Both the intensity function and the distribution of the exceedances are strongly dependent on seasonal influences. The exceedances are not identically distributed, but follow a distribution dependent on the occurrence time. Risk analysis on the basis of a large partial duration series can be performed quite easily using the asymptotic distribution of the design exceedance. (Baker-IVI)
W85-06561

CHARACTERISTICS OF THE HYDROLOGY OF SIBERIAN RIVERS BASED ON EXPERIENCE IN THE DESIGN AND CONSTRUCTION OF HYDROELECTRIC STATIONS,
For primary bibliographic entry see Field 2C.
W85-06595

APPLICATION OF A CELL MODEL TO THE BELLEBEEK WATERSHED,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
M. H. Diskin, G. Wyseure, and J. Feyen.
Nordic Hydrology, Vol. 15, No. 1. p 25-38, 1984. 9 Fig, 2 Tab, 9 Ref.

Descriptors: *Bellebeek watershed, *Belgium, *Cell model, *Runoff, Rainfall-runoff relationships, Model studies, Routing models, Simulation, Storms.

A new version of a semi-distributed routing model has been applied to the Bellebeek watershed in Belgium, where runoff data were available for a number of internal gauging stations in addition to the outlet runoff data. The new version has provisions for separately routing the rainfall excess input and the channel inflow input to each unit of area represented in the model by a cell. The cells are interconnected in a tree-like structure reflecting the main drainage pattern of the watershed. The semi-distributed nature of the model makes it possible to simulate spatially variable rainfalls or moving storms. The cell model was calibrated by adjusting its three parameters to reproduce, as nearly as possible, the outflow at the main gauging station of the watershed. The direct surface runoff hydrographs for internal points of the model were then compared to the measured runoff at the internal gauging stations. (Author's abstract)
W85-06638

HYDROLOGICAL DATA-MODEL WORK IN GREENLAND,
Greenland Technical Organization, Copenhagen (Denmark).
For primary bibliographic entry see Field 2A.
W85-06639

INVESTIGATION OF THE INFLUENCE OF RAINFALL MOVEMENT ON RUNOFF HYDROGRAPH. PART I - SIMULATION ON CONCEPTUAL CATCHMENT,
Lund Univ. (Sweden).
J. Niemczynowicz.
Nordic Hydrology, Vol. 15, No. 2, p 57-70. 1984. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Rainfall, *Hydrographs, *Runoff, *Simulation, *Rainfall-runoff relationships, Catchments, Storms, Directional bias, Velocity, Storm runoff, Discharge.

Studies are described which were performed on a conceptual catchment in efforts to find the general shape of the relation between storm movement parameters like storm duration, intensity, velocity and direction, and its influence on peak discharge. This influence is called a directional bias. Different factors affecting the magnitude of directional bias are described. The relations between rainfall characteristics and the magnitude of the directional bias are shown for a conceptual catchment. The maximal directional bias can be expected for storms moving downstream the catchment with velocity equal to the average flow velocity. The maximal directional bias can reach values of several hundred percent, but this occurs for storms with short duration and has no practical importance. For storms with velocity under the average flow velocity the maximal directional bias decreases with increasing return period. For storms with velocity above the average flow velocity, the maximal directional bias increases with increasing return

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period. Maximal directional bias for reach catchments will probably be lower than simulated for the conceptual catchment. Simple, linear geometry of the conceptual catchment was designed to maximize the directional bias. Relations between storm duration and intensity versus directional bias for the real catchments will probably be more complex since the geometry of real catchments is more complicated than that of the conceptual catchment. Plots of the relative peak discharge versus relative storm velocity for downstream and upstream storm movement are useful tools for approximative calculation of the directional bias for any combination of storm characteristics. (Baker-IVI)
W85-06640

INVESTIGATION OF THE INFLUENCE OF RAINFALL MOVEMENT ON RUNOFF HYDROGRAPH. PART II - SIMULATION ON REAL CATCHMENTS IN THE CITY OF LUND,
Lund Univ. (Sweden).
J. Niemczynowicz.
Nordic Hydrology, Vol. 15, No. 2, p 71-84, 1984. 10 Fig, 2 Tab, 15 Ref.

Descriptors: *Rainfall, *Hydrographs, *Lund, *Sweden, *Rainfall-runoff relationships Catchments, Runoff, Flow velocity, Rainfall intensity, Rainfall distribution, Storms, Storm runoff.

Previously calculated statistical characteristics of rainfall movement in Lund, Sweden, were used for quantitative description of the influence of storm movement on runoff modeled on real catchments in Lund. The maximal directional bias shown for real catchments is much smaller than for the conceptual catchment, but can still reach a significant value. Maximal directional bias simulated for the Lund catchment is 88% in relation to upstream storm movement, or 31% in relation to stationary storms following intensity-duration-frequency curves. For one catchment in Lund the maximal bias was observed for a rainfall duration of 10 minutes and a return period of 1 year. The maximal directional bias occurs for rainfalls with velocities equal to the average full-flow velocity, weighted for all conduits along the catchment. The average full-flow velocity on Lund catchments is much smaller than the average storm velocity. Rainfalls with velocities equal to this velocity have a small probability of occurrence. For rainfalls with intensites following the intensity-duration-frequency relationships, maximal directional bias will occur at durations approximately equal to 1/5 or 1/3 of the concentration time for the catchment. Long catchments with straight conduits oriented parallel to the on axis of the catchment will show higher directional bias than catchments with a more complicated geometry of sewers. The phenomenon of directional bias can be one of the reasons why the frequency of rainfall does not follow the frequency of runoff. (Baker-IVI)
W85-06641

URBAN RUNOFF PEAK FREQUENCY CURVES,
National Water Research Inst., Burlington (Ontario). Hyrdraulics Research Div.
J. Marsalek.
Nordic Hydrology, Vol. 15, No. 2, p 85-102, 1984. 6 Fig, 4 Tab, 10 Ref.

Descriptors: *Runoff, *Urban runoff, *Rainfall-runoff relationships, Rainfall, Frequency, Flow, Simulation, Catchments, Flow routing, Model studies, Storm sewers.

Runoff peak frequency curves were produced for a fully urbanized catchment from five years of observations and from runoff simulations for storms observed in the catchment and at another station 10.6 km west of the catchment. The simulations were performed by means of the calibrated SWMM III model and, whenever sewer surcharging was encountered, the pressurized flow routing was accomplished by means of the EXTRAN model. The most important parameter for the calibration of runoff peaks was the catchment imperviousness which was calibrated by a regression analysis of observed rainfall and runoff volumes. Observed runoff hydrographs indicated that in the Malvern catchment, which can be characterized by an intermediate imperviousness and well-drained soils, the pervious areas barely contributed to the generation of runoff peaks with return periods up to five years. With a calibrated model, runoff frequency curves can be derived from discrete-event runoff simulations with a better accuracy than that typically achieved for individual events. The SWMM model reproduced the observed runoff peaks fairly well. Results confirm the feasibility of using design storms for establishing design runoff flows provided that the normal antecedent conditions are specified. Such findings may be limited to similar catchments. In catchments with low imperviousness and poorly drained soils, the soil infiltration would play a much more significant role. The EXTRAN model performed satisfactorily in pressurized flow routing. For proper simulation of head losses in the sewer network, head losses at sewer junctions were approximated by increasing the adjacent conduit roughness. The scope of the runoff peak frequency curve decreased in the pressurized flow region. For longer return periods, the sewer system becomes severely surcharged and water overflows out of the system at junction manholes. (Baker-IVI)
W85-06642

EVALUATING A MODEL OF SNOW COVER AREA VERSUS RUNOFF AGAINST A CONCURRENT FLOW CORRELATION MODEL IN THE WESTERN HIMALAYAS,
Howard Univ., Washington, DC.
B. Dey, and D. C. Goswami.
Nordic Hydrology, Vol. 15, No. 2, p 103-110, 1984. 4 Fig, 1 Tab, 11 Ref. NASA grant NAG5-224.

Descriptors: *Snow cover, *Runoff, *Concurrent flow model, *Himalayas, Sutlej River, Indus River, Kabul River, Chenab River, Model studies, Snowmelt, Forecasting.

The results obtained from models of snow-cover area versus runoff are evaluated against the estimates derived from correlation of concurrent flows for the same study period. In all basins under study, correlation of concurrent flows explains the variability in flow better than by the snowcover area-runoff model. In view of the inadequate data base, the strength and weaknesses of the models as revealed by the comparison are to be accepted with caution. As the data base improves in size and diversity, more rigorous and elaborate statistical techniques could be used to compare the efficiency of these models. Unlike the snow cover area model, the concurrent flow correlation model cannot be used for operational forecasting procedures. Its potential lies mainly in simulating flows, filling missing data points and extending flow records for infrequently or inadequately gaged watersheds and in being used as a basis for evaluating and upgrading the snow cover area-runoff models. The usefulness of concurrent flow correlation as an additional input parameter in the snow cover area model for the Indus river has been demonstrated. The snow cover area-runoff models that are being increasingly used in water resources studies and management need to be evaluated in regard to their efficiency and adequacy and the concurrent flow correlation model suggested here provides an alternative. (Baker-IVI)
W85-06643

EFFECT OF LOCAL BOTTOM SLOPE AND ROUGHNESS COEFFICIENT VARIATIONS IN OVERLAND FLOWS,
Ecole Polytechnique Federale de Lausanne (Switzerland).
W. H. Hager.
Nordic Hydrology, Vol. 15, No. 3, p 131-144, 1984. 11 Fig, 7 Ref.

Descriptors: *Roughness coefficient, *Overland flow, *Slope, Kinematic wave theory, Topography, Precipitation, Infiltration, Evaporation, Mathematical equations, Flow.

The effects of local bottom slope and roughness coefficient variations in overland flow over a plane were investigated by using the kinematic wave theory. Results are compared with the usual approach. Certain configurations of surface topography and roughness charcteristics are seen to yield results that deviate from the usual predictions. The local effect of roughness coefficient must be accounted for when surfaces are significantly rougher at the upper than at the lower zones of the catchment area. This study allows a simple application of results since all computations are performed with nondimensional quantities. This particular notation allows a thorough comparison between different configurations of bottom and roughness coefficient variations. (Baker-IVI)
W85-06645

TIME LAG SOLUTION OF THE MUSKINGUM FLOOD ROUTING EQUATION,
M. A. Gill.
Nordic Hydrology, Vol. 15, No. 3, p 145-154, 1984. 3 Fig, 6 Ref.

Descriptors: *Flood routing, *Muskingum Flood Routing Equation, *Time lag, Runoff, Hydrographs, Mathematical equations.

Use of time lag in the Muskingum method of flood routing is explained by considering some specific examples. Time lag method removes undesirable predicted results which are obtained by the conventional method. A method is also proposed for calculating the time lag. The examples which have been considered are of floods which can be described in algebraic terms. The method is, however, of general application and can be adapted to numerical computation. From the examples shown it is clear that the use of $Q(0) = I(0)$ always produces negative or appreciably diminished values of outflow and in some cases outflow values higher in magnitude than the highest value of the inflow during a time interval $0<t<k$. These results are unrealistic from a physical point of view. From a purely mathematical view point use of $Q(0) = I(0)$ as an initial condition may appear to be quite right and unobjectionable but it cannot be accepted from a practical viewpoint. This feature has always been regarded as unrealistic and an essential weakness of the Muskingum method. Since there is not an a priori reason for adhering to this initial condition and, in fact, physical consideration suggests the use of time lag between the inflow and outflow reaches, it has been proposed that a suitable time lag should be incorporated in the initial conditions. Time lag can be calculated by equating the volumes of flood under the inflow and outflow hydrographs. (Baker-IVI)
W85-06646

RUNOFF PATTERN AND PEAK FLOWS FROM MOVING BLOCK RAINS BASED ON A LINEAR TIME-AREA CURVE,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
M. Jensen.
Nordic Hydrology, Vol. 15, No. 3, p 155-168, 1984. 7 Fig, 3 Tab, 5 Ref.

Descriptors: *Rainfall-runoff relationships, *Moving block rain, *Time-area model, *Runoff, Storms, Flood peak, Storm Water Management Model, Mathematical models, Prediction.

The time-area model (TAM) is applied corresponding to a linear time-area curve for a moving block rain and functions for the discharge $Q(X,t)$(X = place, T = time) are derived analytically, for both upstream and downstream storm movement. The relative peak flow (storm peak flow relative to the discharge from the same storm of infinite duration) is found as a function of the dimensionless parameters p1 and p2. The dimensionless parameter p1 is the relative storm velocity times relative storm duration, and p2 is the storm velocity relative to the mean kinematic wave celerity. Dimensionless peak flows are found as functions of p1 and p2 and results are compared with computations from the Storm Water Management Model (SWMM) version 2. TAM overestimated the peak flows by approximately 5% of the full flow capacity relative to SWMM on an average of 26 comparisons. The standard deviation is approxi-

mately 10%. The deviations are small enough to conclude that the dimensionless parameters p1 and p2 dominate the peak flow from moving block rains as predicted by TAM. (Moore-IVI)
W85-06647

WATER USE BY ISOLATED TREES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
J. J. Landsberg, and R. McMurtrie.
Agricultural Water Management, Vol. 8, No. 1-3, p 223-242, January, 1984. 3 Fig, 38 Ref.

Descriptors: *Water use, *Trees, *Transpiration, *Mathematical equations, Leaves, Roots, Energy balance, Soil water, Stomatal conductance, Boundary conditions, Potential gradient.

The paper assesses whether water use by isolated trees can be calculated from weather data, and the consequences of water uptake in terms of soil drying patterns. Since foliage area must be known, published relationships between trunk diameter and foliage mass or area are examined. These are consistent enough to be useful. The volume of tree canopies can be estimated using standard geometrical shapes. Root length per tree must be known, so that root length per unit soil volume (Lv) can be calculated. Root:shoot dry mass ratios vary with age and growing conditions. There are data on Lv but estimates for particular cases are likely to be considerably in error. Methods of estimating the soil volume occupied by roots, and the way roots are distributed, are proposed, so that given an estimate of root mass, Lv and its distribution can be calculated. Transpiration (E) can be calculated from the leaf, energy-balance equations. Work on evaluating net radiation per unit leaf area in isolated trees and hedgerow orchards, and on stomatal and boundary layer conductances, is discussed. Transpiration leads to water loss from leaves, which causes potential gradients through the tree to the roots and hence the soil. Uptake from the soil depends on soil-root potential gradients and Lv. The equations to determine this, given E, are presented for the root system of an isolated tree and then extended to include trees subject to mutual interference. (Author's abstract)
W85-06677

SHALLOW FLOW OF WATER THROUGH NON-SUBMERGED VEGETATION,
Melbourne Univ., Parkville (Australia). Agricultural Engineering Section.
A. K. Turner, and N. Chanmeesri.
Agricultural Water Management, Vol. 8, No. 4, p 375-385, February, 1984. 5 Fig, 4 Tab, 6 Ref.

Descriptors: *Vegetation, *Overland flow, *Mathematical equations, Wheat, Slope, Turbulence, Discharge-depth equation.

The shallow movement of water flowing through dense crops of wheat was studied for different crop densities and sowing patterns and ages. The common application of Manning's equation to such flows is shown to be inadequate, particularly since the flows can be described as mixed rather than turbulent. A more flexible discharge-depth equation is proposed as an alternative. The equation is proposed as a generalized form for which the Manning equation with its fixed exponents for the power terms is a specific expression. The variable exponent for the depth term gave consistent values and indicated that complex nature of the flow sheet. Finally the role of slope on the terms in the discharge-depth equation was included as a separate study. The initial results indicate that for these test conditions, if an exponent of 0.35 is used for the slope term rather than the traditional value of 0.5, a more consistent term results for the resistance effect. Overall, the results indicate further support for this method of describing shallow flows, and it is hoped that additional data will become available for a wider range of crops and pastures. (Baker-IVI)
W85-06684

SIMULATING INFILTRATION INTO FROZEN PRAIRIE SOILS IN STREAMFLOW MODELS,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
For primary bibliographic entry see Field 2G.
W85-06702

MISSISSIPPI SOUND WAVE-HINDCAST STUDY: MAIN TEXT AND APPENDICES A AND B,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. E. Jensen.
Technical Report HL-83-8, Final Report, April 1983. 74 p, 24 Fig, 3 Tab, 35 Ref, 7 Append.

Descriptors: *Hydraulics, *Waves, *Coastal engineering, *Hydraulic structures, Dredging, Navigation, Model studies, Wind, Hindcasting, Tides, Mississippi Sound, Shallow water, SWWM model, Mathematical models, Saginaw Bay.

Long-term overwater winds were generated using data from land-based meteorological stations adjacent to Mississippi Sound. A parametric shallow-water wave model was developed and verified employing extensive measured wave data. The shallow-water wave model and the simulated wind fields were utilized to calculate 20 years (1956-1975) of hindcast wave data for 23 sites in Mississippi Sound. Analyses of the hindcast wave data are presented. Verification of the modeling technique was not possible with the limited wave data available in Mississippi Sound. Results from another study, however, showed that the hindcast data compared favorably with the measured wave data. It is assumed that the shallow-water wave model adequately models finite water depth wave growth and transformation processes and that application to Mississippi Sound is valid.
W85-06912

OBSERVATIONS OF CURRENTS AND WATER PROPERTIES IN COMMENCEMENT BAY,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2L.
W85-06959

STOKES AND RAYLEIGH LAYERS IN PRESENCE OF NATURALLY PERMEABLE BOUNDARIES,
Monash Univ., Clayton (Australia). Dept. of Mathematics.
N. C. Sacheti, and B. S. Bhatt.
Journal of Engineering Mechanics, Vol. 110, No. 5, p 713-722, May, 1984. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Unsteady flow, *Stokes layer, *Raleigh layer, Fluid dynamics, Porous media, Permeability, Mathematical equations, Navier-Stokes equations.

Unsteady flow of viscous incompressible fluid caused by oscillations of a naturally permeable wall bounding the fluid is examined in this theoretical paper. Solutions of the governing Navier-Stokes equations, subject to slip condition at a porous interface, have been obtained by considering oscillatory solutions and an initial value problem. The effect of the permeability of the porous medium enters through a slip grouping parameter, whose influence on the structure of the Stokes' layer has been shown graphically. As a particular case of an initial value problem, the Rayleigh layer was obtained over a naturally permeable wall and compared it with the classical Rayleigh layer for a range of nondimensional paramater. (Author's abstract)
W85-07099

CONVERGENT FLOW PATTERN AT AN ABRUPT CONTRACTION,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
C. Chen, and B. Etemadi.
Journal of Engineering Mechanics, Vol. 110, No. 6, p 894-910, June, 1984. 6 Fig, 1 Tab, 4 Ref, 1 Append.

Descriptors: *Convergent flow, *Contractions, Velocity, Flow patterns, Transformation formula, Open channel flow, Opening ratio, Eccentricity.

The Schwarz-Christoffel transformation formula for flow past an eccentric, normal constriction of zero thickness in a straight channel can be proved to have a simple form of arctangent function from the properties of elliptic integrals. Use of this mapping formula with the aid of another mapping formula between the complex potential and the transformed variable enables one to plot the corresponding flow pattern. Using such transformation formulas, flow graphics for convergent flow are thus developed to plot the flow net and the velocity distributions along the streamlines and across the channel width. To minimize the number of flow patterns in the presentation, the transformation formulas are further normalized by using the channel width and the discharge per unit depth. The normalized flow pattern so plotted is shown to vary only with the two physical parameters, the opening ratio and the eccentricity. Typical convergent flow patterns are plotted to show the validity and applicability of the transformation formulas. (Author's abstract)
W85-07101

2F. Groundwater

IRRIGATION AND GROUNDWATER DEPLETION IN CADDO COUNTY, OKLAHOMA,
North Texas State Univ., Denton. Dept. of Geography.
For primary bibliographic entry see Field 4B.
W85-06234

MODELING PHYSICS AND CHEMISTRY OF CONTAMINANT TRANSPORT IN THREE-DIMENSIONAL UNSATURATED GROUNDWATER FLOW,
Simons, Li and Associates, Inc., Fort Collins, CO.
R. M. Li, Y. H. Chen, J. W. Warner, D. W. Zachmann, and D. V. Pryor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 160653/AS, Price codes: A06 in paper copy, A01 in microfiche. Bureau of Reclamation Project Completion Report, 1984. 114 p, 2 Fig, 5 Tab, Contract/Grant No. 4-CR-93-00010 (1).

Descriptors: *Groundwater movement, *Mathematical models, Colorado, Saturated flow, Unsaturated flow, Path of pollutants.

This report describes the utilization of a vector processor for solving the three-dimensional partial differential equations governing groundwater flow and contaminant transport. The solution utilizes a block implicit scheme to formulate the problem in a highly parallel fashion. Tridiagonal systems arising from this formulation are solved using vectors of length corresponding to the horizontal dimensions of the problem. Solution in parallel fashion then proceeds vertically. Research goals were to develop software to model three-dimensional unsaturated/saturated flow, tailor the algorithm to the vector processor, and determine the economic feasiblity of the approach. The model was successfully developed and tested using a two-dimensional dispersion problem that had analytical solutions, and using a flow and solute recharge problem in three-dimensional groundwater basin considered by Freeze (1971). A series of benchmark tests indicated that the explicitly vectorized form of the model is typically over 500 times faster than the equivalent scalar code on a conventional computer, allowing practical application of the equations of saturated/unsaturated flow for the first time. The ability of the model to analyze the movement of hazardous materials through unsaturated media would allow examination of alternative remedial measures, extent of spill migration and numerous other groundwater problems related to hazardous wastes.
W85-06301

FRACTURE TRACE ANALYSIS TO INCREASE THE PROBABILITY OF LOCATING GROUNDWATER FOR MURRAY COUNTY, GEORGIA,

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Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
R. E. Tschirhart, D. W. Kolberg, and N. L. Faust.
Available from the National Technical Information Service, Springfield VA 22161 as PB85 157667/AS, Price codes: A05 in paper copy, A01 in microfiche. Report No. ERC 06-84, September 1984, 54 p, 1 Fig, 24 Ref, Project No. USGS G-836(22).

Descriptors: *Georgia, *Groundwater, *Fracture trace analysis, Lineaments, Geologic fractures, *Hydrogeology, Aerial photography, Remote sensing, Landsat.

Fracture trace analysis was used to determine potential sites to drill for groundwater in the Appalachian Valley and Ridge Province of Murray County, Georgia. Aerial photographs, at a scale of 1:20,000 were analyzed steroscopically to identify the fracture traces. Atlases were made of the seven major 7.5 minute quadrangles in Murray County showing where the fracture traces lie. Developed land and land leveled by flooding in the flood plains tended to obscure fracture traces, whereas undeveloped land, which tended to be in rough terrain, better defined fracture traces. Location of the fracture traces was discussed in terms of the geology of the area. Recharge areas in Murray County were identified using stereoscopic analysis also, but confidence in the reliability of the results was low. Landsat Thematic Mapper data was looked at; however, clouds covered most of the Valley and Ridge Province. The mountainous area, east of the Valley and Ridge Province, showed many lineaments.
W85-06313

HYDRAULIC TECHNIQUE FOR DESIGNING SCAVENGER-PRODUCTION WELL COUPLES TO WITHDRAW FRESHWATER FROM AQUIFERS CONTAINING SALINE WATER,
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 3B.
W85-06316

GEOLOGICAL FACTORS INFLUENCING WELL PRODUCTIVITY ON THE GEORGIA PIEDMONT,
Georgia Univ., Athens. Dept. of Geography.
G. A. Brook, C.-h. Sun, and T. S. Lloyd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB5 157758/AS, Price codes: A05 in paper copy, A01 in microfiche. Environmental Resources Center Report No. ERC 05-84, Georgia Institute of Technology, Atlanta, September 1984, 92 p, 1 Tab, 1 Fig, 18 Ref, Project No. USGS G-836(04).

Descriptors: Fracture traces, Lineaments, Yield, Specific capacity, *Well productivity, Hydrogeology, Crystalline rocks, Piedmont, *Georgia.

Within the crystalline rocks of the Georgia Piedmont and Mountain districts the probability of obtaining a high productivity well is greater in schists, quartzites, mafic and ultramafic rocks, and graywackes than in granites, gneisses, phyllites, cataclastic, and volcanic rocks. In all rock types well specific capacities and productivities are negatively correlated with well depth, which explains 35% of the variation in the productivities of 250 wells. Analysis of a sample of 30 wells indicates that well depth increases and specific capacity and productivity decreases significantly with increasing distance from a fracture trace intersection mapped from aerial photographs. Some 70% of the variation in well productivity is explained by the model: LN (PROD) = 5.98 - 0.002057 (DISTIN) - 1.5036 (LENDEN) + 0.488 (INTDEN) + 0.000234 (LENTH) where PROD is the well productivity in gpm/ft/1000 ft., DISTIN is the distance in ft. from the well to the nearest fracture trace intersection, LENDEN and INTDEN are the length of fracture traces in mi/sq mi and the number of fracture trace intersections per sq mi, and LENTH is the length of the nearest fracture trace in ft. Results indicate that the best sites for high productivity wells are in areas of heavily fractured bedrock, above fracture trace intersections, and near long fracture traces.
W85-06319

NONTRIBUTARY, NONDESIGNATED GROUND WATER: THE HUSTON DECISION,
For primary bibliographic entry see Field 6E.
W85-06367

INTERPRETATION OF PRESSURE-DEPTH FROM CONFINED UNDERPRESSURED AQUIFERS EXEMPLIFIED BY THE DEEP-BASIN BRINE AQUIFER, PALO DURO BASIN, TEXAS,
Texas Univ. at Austin. Bureau of Economic Geology.
E. D. Orr, and C. W. Kreitler.
Water Resources Research, Vol. 21, No. 4, p 533-544, April, 1985. 10 Fig, 17 Ref. DOE contract DE-AC97-84WM46651.

Descriptors: *Confined aquifers, *Pressure-depth plots, *Deep-Basin Brine aquifer, *Palo Duro Basin, *Texas, Underpressured aquifers, Hydrogeology, Topography, Dip, Potentiometric surface.

Investigations of underpressured aquifers can be improved by accounting for factors that impede accurate interpretation of pressure-depth plots. Poor data quality and distribution obscure true pressure-depth trends. Plotted data may also be distorted by the hydrogeologic setting, i.e., the surface topography, the structural dip of the aquifer, and the potentiometric surface. In the Palo Duro Basin in the Texas Panhandle, distortions caused by the hydrogeologic setting are reduced by delineating regions having little variation in surface topography and in structural dip of the aquifer. Pressure-depth plots for these regions vary considerably. The effects of the hydrogeologic setting on these plots were evaluated by computing pressure-depth data for flow parallel to the structural dip of the aquifer in each region. By comparing regression lines through real pressure-depth data with those through computed data, true hydrologic conditions could be distinguished from the misleading effects of the hydrogeologic setting on pressure-depth plots. (Author's abstract)
W85-06507

ANALYSIS OF THE SPATIAL STRUCTURE OF PROPERTIES OF SELECTED AQUIFERS,
Calvin Coll., Grand MI. Dept. of Engineering.
R. J. Hoeksema, and P. K. Kitanidis.
Water Resources Research, Vol. 21, No. 4, p 563-572, April, 1985. 6 Fig, 6 Tab, 36 Ref. Dept. of the Interior and Iowa Water Resources Inst. Project CT381702, NSF grant CME-8106577.

Descriptors: *Aquifer properties, *Model studies, Spatial distribution, Transmissivity, Permeability coefficient, Water storage.

The spatial structural analysis of properties from several aquifers was investigated in order to quantify for each property the range of typical measures of spatial correlation, structured variability, and unstructured variability along with providing evidence for specific probability density functions. With only a few exceptions, the properties of transmissivity, hydraulic conductivity, and storage coefficient can be considered to be log normally distributed. The range of variation of the three estimated parameters: the variance of small scale fluctuations, the variance of structured fluctuations, and the correlation length, are tabulated. Bedrock aquifers typically display smaller structured transmissivity variability and larger unstructured transmissivity variability than aquifers composed of unconsolidated materials. Possibly due to measurement error and scarcity, no significant spatial correlation was detected in a regional scale between measured values of storage coefficient. (Baker-IVI)
W85-06510

NOTE ON HIGHER-ORDER CORRECTIONS OF THE HEAD COVARIANCES IN STEADY AQUIFER FLOW,
Tel-Aviv Univ. (Israel). Faculty of Engineering.
G. Dagan.
Water Resources Research, Vol. 21, No. 4, p 573-578, April, 1985. 2 Fig, 19 Ref, 2 Append.

Descriptors: *Groundwater movement, *Aquifers, *Head, *Steady flow, Permeability coefficient, Mathematical studies, Covariance.

Average uniform flow takes place in a heterogeneous aquifer of infinite extent. The input to the problem is the hydraulic conductivity, which is regarded as a random space function that is lognormal, stationary and statistically isotropic. The output is the water head field, which is a random function satisfying the equation of steady flow. The first-order approximation of the head, in an asymptotic expansion for small log-conductivity variance, is a normal function characterized completely by the head-log-conductivity cross-covariance and the head covariance or variogram. These covariances are proportional to the log-conductivity variance. By using spectral methods, second-order corrections of the head covariances, proportional to the log-conductivity variance squared, are derived explicitly. Detailed calculations are carried out for an exponential log-conductivity covariance. The main finding of the note is that the first-order approximation is very robust and even for a log-conductivity variance equal to unity, the second-order correction of the head variances is smaller than 10% of the first-order approximation. (Author's abstract)
W85-06511

TRANSPORT OF IMMISCIBLE FLUIDS WITHIN AND BELOW THE UNSATURATED ZONE: A NUMERICAL MODEL,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W85-06513

GROUNDWATER CHEMISTRY CHANGE DUE TO TIDAL FLUCTUATIONS IN THE STONEHOUSE BREWERY WELL, PLYMOUTH, ENGLAND,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
I. S. Roxburgh.
Water Resources Research, Vol. 21, No. 4, p 616-618, April, 1985. 8 Fig, 3 Ref.

Descriptors: *Water chemistry, *Groundwater, *Tidal effects, *Saline water intrusion, *Plymouth, *England, Electrical conductivity, Magnesium, Potassium, Sodium, Chloride, Calcium, Nitrates, Hydrogen ion concentration, Wells.

For much of its length, the Plymouth Limestone in England is exposed at the coast and is cut by the Tamar and Plym rivers. The Stonehouse Brewery Well is sunk 24 m into the well-cemented, fissure-dominated Plymouth Limestone. Groundwater within the well is in hydraulic continuity with the marine waters of Plymouth Sound. Groundwater was discharged from the well for 28 hours at approximately 13,500 L/h and samples taken hourly were subsequently analyzed for pH, conductivity, magnesium, potassium, sodium, chloride, calcium, and nitrate. Tidal cyclicity is reflected in the levels of sodium, potassium, chloride, and magnesium observed and to a lesser extent in the levels of calcium. Values for conductivity also altered in sympathy with tidal influences as well as showing an apparent overall rise in average values. The observed values for the pH of samples do not show a readily apparent cyclicity, while nitrate levels clearly show no cyclical pattern. The apparent overall average rise in conductivity and solute concentrations may be linked to the well discharge and its replacement by progressively more saline water from Plymouth Sound. Cyclical changes in the groundwater chemistry are probably linked to the observed rise and fall of tide stage in Plymouth Sound. (Moore-IVI)
W85-06516

INFORMATION FOR STATE GROUNDWATER QUALITY POLICYMAKING,
Oklahoma Univ., Norman. Dept. of Geography.
For primary bibliographic entry see Field 6A.

W85-06535

INTERPRETATION OF LEACHING UNDER MULTIPLE FERTILIZER APPICATIONS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W85-06564

MINERALOGICAL CHANGES ALONG THE FRESHWATER/SALTWATER INTERFACE OF A MODERN AQUIFER,
Florida Univ., Gainesville. Dept. of Geology.
A. F. Randazzo, and J. I. Bloom.
Sedimentary Geology, Vol. 43, No. 1/4, p 291-239, April, 1985. 8 Fig, 42 Ref.

Descriptors: *Aquifer characteristics, *Mineralogy, *Florida, *Saline-freshwater interfaces, Chemical properties, Coastal waters, Dolomite, Wells, Aquifers, Trace elements, Chlorides, Sulfates, Conductivity.

Deposition of carbonate sediments occurred in supratidal, intertidal, and subtidal environments of a carbonate bank along the west coast of peninsular Florida during the Tertiary Period. The position and extent of these environments changed with fluctuations in sea level, and uplift and downwarping of the Florida Platform. During the Miocene, carbonate muds and siliceous clays were deposited in brackish water lagoons. This resulted in the formation of a layer of sediments with low permeability which defines the upper boundary of the Floridan aquifer. During periods of subaerial exposure of the marine sediments, flushing by freshwaters inverted the unstable high-magnesium calcite sediments to low magnesium calcite, accompanied by the inversion of aragonite. Selective dolomitization took place at the freshwater/saltwater interface in the Avonpark, Hawthorn, and upper Tampa Formations. The selectivity of dolomite was related to the fine grain size of the sediments with their high surface area/volume ratio; the occurrence of earlier formed dolomite; the precursor carbonate being aragonite; and the occurrence of clay minerals. Dolomitization proceeded in the freshwater/saltwater mixing zone because mixing freshwater and saltwater can result in a zone where the waters become undersaturated with respect to calcite, yet remain supersaturated with respect to dolomite; the salinity of the mixing zone is lower than it is in seawater, therefore there is less foreign ion competition inhibition dolomite formation; and the magnesium to calcium ion ratio remains well above unity, the level required for dolomitization. Diagenesis of carbonate rocks is a continuous process. Both groundwater and saltwater solutions in contact with the rocks are constantly exchanging ions with the rock to produce the most stable minerals. Carbonate systems tend towards equilibrium with age and time and the expected trend for dolomite is towards a more nearly stoichiometric composition. (Baker-IVI)
W85-06700

USE OF SOLUTE TRACERS RELEASED BY WEATHERING TO ESTIMATE GROUNDWATER INFLOW TO SEEPAGE LAKES,
Maine Univ. at Orono. Dept. of Geological Sciences.
R. E. Stauffer.
Environmental Science and Technology, Vol. 19, No. 5, p 405-411, May, 1985. 1 Fig, 4 Tab, 55 Ref.

Descriptors: *Groundwater movement, *Environmental tracers, *Seepage, *Lakes, *Inflow, *Weathering, Magnesium, Geochemistry, Silicon, Phosphorus, Precipitation.

The steady-state influx to seepage lakes can be estimated by using a solute mass balance, provided the excess of precipitation over evaporation is known for the lake surface. For lakes set in the dolomitic glacial drift of Wisconsin, Mg is an ideal groundwater tracer, both because it has the highest ratio of groundwater concentration to concentration in precipitation and because it behaves nearly conservatively in lakes set in semihumid climates. By use of the Mg mass balance, groundwater inflows were estimated for 10 natural lakes lacking surface inflows and set in pitted glacial outwash in central Wisconsin. The estimated inflows (range = 0.1-2.0 m/year) accord with lakes' different geologic settings and with the lakes' Si and Si/P ratios. The inflow estimates could be improved by better information on the precipitation excess and improved knowledge of the factors regulating Mg concentrations in local vs. regional groundwater flow systems. (Author's abstract)
W85-06705

PLANT COMMUNITIES AND GROUNDWATER LEVELS IN SOUTHERN NASSAU COUNTY, LONG ISLAND, NEW YORK,
City Coll., New York. Dept. of Biology.
J. P. Hanks.
Bulletin of the Torrey Botanical Club, Vol. 112, No. 1, p 79-86, January-March, 1985. 2 Fig, 1 Tab, 22 Ref.

Descriptors: *Vegetation, *Groundwater level, *Nassau County, *Long Island, *New York, *Plant populations, Wetlands, Swamps, Ponds, Streams, Water level, Sewer districts, Succession, Sewer systems.

The vegetation of Nassau County includes 20 different communities; 7 wetland, 3 swamp, 6 upland, 3 stream, and one pond type. The vegetation in the area is largely dependent on the depth to the water table or the depth of surface water. The vegetation in the western section of the study area (Sewage Disposal District 2) has been disturbed by, and responded to, past sewering and other factors and has experienced successional replacement sequences toward drier types of vegetation. Here, the vegetation contains more upland communities and younger communities are more prevalent than in eastern areas (Sewage Disposal District 3). Eastern sections of Nassau County have experienced both more recent and less disturbance and as a result have more extensive aquatic, wetland and swamp vegetation than western areas. (Author's abstract)
W85-06802

COMPARISON OF AQUIFER CHARACTERISTICS DERIVED FROM LOCAL AND REGIONAL AQUIFER TESTS,
Geological Survey, Doraville, GA.
R. B. Randolph, R. E. Krause, and M. L. Maslia.
Ground Water, Vol. 23, No. 3, p 309-316, May-June, 1985. 7 Fig, 3 Tab, 13 Ref.

Descriptors: *Aquifer testing, *Georgia, *Groundwater movement, *Simulation, Model studies, Pumpage, Drawdown, Theis equation, Transmissivity, Anisotropy, Storage.

A comparison of the aquifer parameter values obtained through the analysis of a local and a regional aquifer test involving the same area in southeast Georgia was made in order to evaluate the validity of extrapolating local aquifer-test results for use in large-scale flow simulations. The case study involves an increase in pumpage of 6.3 Mgal/d (million gallons per day) for the local test and a reduction in pumpage of 66 Mgal/d for the regional test, each involving the same well field. The test involved the Floridan aquifer system, a limestone sequence characterized predominantly by secondary permeability in this area. Time-drawdown and time-recovery data were analyzed by using both graphical and least-squares fitting of the data to the Theis curve. Additionally, directional transmissivity, transmissivity tensor, and angle of anisotropy were computed for both tests. The major and minor axes of the transmissivity ellipse determined from the regional test show general agreement with those determined from the local test. A slightly higher ratio of anisotropy was observed on the regional scale: 2.1:1, than on the local scale: 1.5:1. Regional storage coefficients ranged from 0.00034 to 0.00072 as compared with local storage coefficients ranging from 0.00018 to 0.00053. (Author's abstract)
W85-06819

SIMULATION OF GROUND-WATER FLOW IN SOUTHEASTERN OAHU, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
P. R. Eyre.
Ground Water, Vol. 23, No. 3, p 325-330, May-June, 1985. 9 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater movement, *Oahu, *Hawaii, *Aquifers, *Simulation, Model studies, Water table decline, Pumping.

On the leeward side of southeastern Oahu, Hawaii, near-vertical dikes have intruded the gently dipping and highly permeable lava flows of the Koolau mountain. These dikes bound the study area on the north and west and internally divide it into the Waialae and Wailupe-Hawaii Kai aquifers. Recharge to these aquifers, 6 and 9 million gallons per day respectively, has created Ghyben-Herzberg lenses that freely float on sea water and discharge to the sea through coastal sediments. In the Waialae area, where rainfall is high and where thick (poorly permeable) coastal sediments inhibit the discharge of fresh water, heads are 8 to 15 feet above sea level. Lower rainfall and thin coastal sediments that allow easy discharge cause heads to be only 1 to 5 feet in the Wailupe-Hawaii Kai area. The flow of groundwater and the effects of future water development were simulated using AQUIFEM, a two-dimensional finite-element flow model, modified for aquifers containing a sea-water interface. The model provides accurate simulation of observed heads averaged over several years and predicts an additional area-wide head decline of about 1 foot when three recently drilled wells are put into production. (Author's abstract)
W85-06821

EVOLUTION OF REGIONAL HYDROGEOLOGIC SETUP OF A HARD ROCK AQUIFER THROUGH R-C ANALOG MODEL,
National Geophysical Research Inst., Hyderabad (India).
C. P. Gupta, M. Thangarajan, and V. V. S. Gurunadha Rao.
Ground Water, Vol. 23, No. 3, p 331-335, May-June, 1985. 8 Fig, 3 Tab, 4 Ref.

Descriptors: *Aquifers, *India, *Model studies, *Pumping tests, *Andhra Pradesh State, *Hyderabad, *Manaboobnagar, *Geohydrology, Granite, Geologic fractures, Simulation, Porous media, Groundwater level.

Various analytical pumping test methods are, in general, not applicable for estimating hydrogeologic parameters for regional groundwater flow studies in hard rock regions. In such situations, aquifer simulation could be employed as a useful tool to evolve a plausible regional hydrogeological setup provided the groundwater level configuration and its temporal fluctuations are reliably known. An aquifer in granitic terrain was studied in the Hyberadad and Mahaboobnagar districts of Andhra Pradesh State, India. The basin appears to be a closed one with no flow across the boundaries except through a small section of the northern topographic divide. During model calibration, the field estimates of hydrogeological parameters as well as those of recharge and ground-water extraction were appropriately modified. A first-order estimate of the effluent outflow from the aquifer to ephemeral streams was made only from the flow model. The calibrated model satisfactorily reproduced the historical response of the aquifer and could be used for prognosis. Using the available sparse geohydrological data in a hard rock aquifer, one could proceed in a logical manner to gradually modify the field estimates and arrive at a consistent set of these parameters. An essential prerequisite is that the concept of equivalent porous media on a regional scale should be valid and correct water level data and their spatio-temporal variation should be known. Such an approach can additionally provide useful clues in designing a data collection network at minimal cost. (Collier-IVI)
W85-06822

AUTOMATIC GENERATION OF FLOW NETS WITH CONVENTIONAL GROUND-WATER MODELING ALGORITHMS,
Texas Univ. at Austin. Bureau of Economic Geol-

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ogy.
G. E. Fogg, and R. K. Senger.
Ground Water, Vol. 23, No. 3, p 336-344, May-June, 1985. 9 Fig, 2 Tab, 15 Ref. U.S. Department of Energy, Office of Nuclear Waste Isolation contract DE-AC-97-83WM46615.

Descriptors: *Flow nets, *Groundwater movement, *Model studies, *Algorithms, *Palo Duro Basin, *Texas, *New Mexico, Permeability coefficient, Boundary conditions, Hydraulic head, Geohydrology.

Though flow nets offer one of the best means of visualizing ground-water flow fields, accurate construction of flow nets can be very difficult in heterogeneous, anisotropic media or in regional cross sections where vertical exaggeration of scale is great. A method was developed for automatically generating the streamlines of a flow net using conventional ground-water flow modeling algorithms. The method can be implemented using most any of the existing computer programs for flow modeling, and no modification of the programs is necessary. One need only replace the hydraulic head and conductivity terms in the steady-state ground-water flow equation with the stream function and an inverse form of hydraulic conductivity, respectively. Possible boundary conditions include prescribed stream function (Dirichler type) and prescribed stream function gradient (Neumann type). The former can be determined from prior knowledge of recharge or discharge rates or from boundary fluxes computed in previous simulations of hydraulic head distribution. The latter can be determined from data on hydraulic head along the boundaries, raising the possibility of solving for the streamlines directly without first solving for the head distribution. The method is generally not appropriate when sources or sinks occur inside the flow region, and it will not handle transient conditions. Accuracy of the method was demonstrated in three hypothetical test problems and a vertical-plane model through the Palo Duro Basin of Texas and New Mexico. (Author's abstract)
W85-06823

REJECTION OF RECHARGE WATER FROM MADISON AQUIFER ALONG EASTERN PERIMETER OF BIGHORN ARTESIAN BASIN, WYOMING,
Wyoming Univ., Laramie. Dept. of Geology and Geophysics.
P. W. Huntoon.
Ground Water, Vol. 23, No. 3, p 345-353, May-June, 1985. 6 Fig, 3 Tab, 22 Ref.

Descriptors: *Wyoming, *Bighorn, *Artesian basins, *Aquifers, *Recharge, *Paleozoic aquifers, Permeability, Artesian springs, Transmissivity, Karst hydrology.

Approximately half of the perimeters of Wyoming foreland artesian basins are characterized by structural continuity of the Paleozoic aquifers between the recharge areas and the interior parts of the artesian basins. A significant percentage of the ground water which circulates through such recharge areas is rejected through springs because there is a marked decrease in transmissivity basinward from the recharge areas. The transmissivity contrasts have developed since the recharge areas became morphologically differentiated from the basin interiors during post-Laramide time. Secondary enhancement of permeabilities is occurring in the recharge areas through dissolution of the rock matrix and cement, and in some locations the rocks were tectonically fractured. In contrast, the rate of dissolution within the basin interiors are substantially decreased, or processes of recrystallization, cementation, or compaction are operating to destroy permeability. The result is that in the case treated here, net recharge to the basin interior is a small fraction of measured stream losses in the headwaters of the recharge area. (Author's abstract)
W85-06824

DISTRIBUTION OF VOLATILE ORGANIC COMPOUNDS IN A NEW JERSEY COASTAL PLAIN AQUIFER SYSTEM,
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 5B.
W85-06825

INTERFERENCE DUE TO NEIGHBORING WELLS DURING PUMPING TESTS,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton.
Ground Water, Vol. 23, No. 3, p 361-366, May-June, 1985. 4 Fig, 5 Tab, 3 Ref.

Descriptors: *Groundwater potential, *Pumping tests, *Wells, *Aquifers, Drawdown, Theis equation, Algorithms, Transmissivity, Storage.

Pumping test analysis is usually based on the assumption that the aquifer is in a state of equilibrium before the test starts. Corrections can be made for seasonal changes, but the effects of other pumping wells are often ignored because the wells are considered to be too distant to have a significant influence. Even if an interfering well is relatively close, it is usually assumed that its effect can be ignored provided that its pumping rate is maintained at a steady value during the period under consideration. If the interfering wells are several kilometers away, they can still have a significant effect on test results. The interference is usually apparent as a deviation from the conventional aquifer response and may be misinterpreted as a boundary effect. By combining the series expansions for the Theis expression for the pumped and interfering wells, the magnitude of the interference depends primarily on the length of time for which the interfering well pumps before the start of the test. The distance between the test and interfering wells has a small effect. An equation was developed which allows an estimate to be made of magnitude of the interference effect; this equation also can be used to correct the observed drawdowns. (Collier-IVI)
W85-06826

LUMPED PARAMETER MODEL: FURTHER APPLICATION IN CHALK AQUIFERS, U.K.,
Binnie and Partners, London (England).
D. M. Walsh, and S. Puri.
Ground Water, Vol. 23, No. 3, p 377-380, May-June, 1985. 6 Fig, 1 Tab, 4 Ref.

Descriptors: *Lumped parameter models, *Chalk Aquifer, *England, *Aquifers, *Model studies, Transmissivity, Stream discharge, Pumping, Groundwater level, Water level, Water table.

A lumped parameter groundwater model was developed which permitted inexpensive and rapid investigations if the principal constraints to be considered when investigating a proposed river augmentation scheme in a relatively complicated Chalk catchment in southern England. A previously published lumped parameter model explained an unusual chalk aquifer consisting of a thin zone of high storage and transmissivity whose response of small annual fluctuations and high stream flows were considered to be anomalous. A similar model has been further developed and used in a preliminary desk study of possible river augmentation schemes. The model developments incorporate stream bed leakage to the aquifer and saturated depth varying transmissivity. When water levels are very high, and maximum fissure density is fully saturated, the transmissivities can reach very high values but the drop-off of transmissivity with water level decline is fairly rapid. Two hydraulic conductivity values separated by a thin transition zone mathematically represent the aquifer. Although it is necessary to invoke a transition zoned because of numerical instability, such a zone is now thought to be present in most chalk aquifers of the United Kingdom. The model is versatile in its ability to test a variety of control rules for groundwater abstraction. The newly incorporated factors are significant for assessment of the degree of success of augmentation proposals. This lumped model gave valuable guidance for future field investigations. (Collier-IVI)
W85-06827

POWER OF THE ELECTRONIC WORKSHEET: MODELING WITHOUT SPECIAL PROGRAMS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
T. N. Olsthoorn.
Ground Water, Vol. 23, No. 3, p 381-390, May-June, 1985. 11 Fig, 2 Ref.

Descriptors: *Computer models, *Spreadsheets, *Software, *Microcomputers, *Groundwater movement, Model studies, Finite difference methods, Data processing.

So-called spreadsheet programs are forerunners of new general software from which the groundwater engineer is likely to benefit - no more special programs each capable of fulfilling just the single task it was explicitly designed for, but programs suitable to do almost any job, where only the imagination of the user limits the possibilities. Moreover, this new software is very user friendly, proving that it is unneccessary to be a computer specialist to use it. With a spreadsheet you can build a simple finite-difference model from scratch within one or two minutes. With some extra time a wide variety of problems can be solved as the multiaquifer, three-dimensional, phreatic and transient groundwater flow examples prove. Using this software, any hydrologist should be able to solve diverging groundwater models without depending on special numerical models. A good knowledge of the water balance is all that is needed beyond a microcomputer and a spreadsheet program. (Author's abstract)
W85-06828

COMPARISON OF SAMPLING MECHANISMS AVAILABLE FOR SMALL-DIAMETER GROUND WATER MONITORING WELLS,
IEP, Inc., Worthington, OH.
D. M. Nielsen, and G. L. Yeates.
Ground Water Monitoring Review, Vol. 5, No. 2, p 83-99, Spring, 1985. 8 Fig, 13 Tab, 18 Ref.

Descripors: *Monitoring, *Groundwater, *Wells, *Sampling, Water quality control, Aquifers, Physical properties.

Several well-designed devices are available for retrieving ground water samples from small diameter monitoring wells. Obtaining the most representative samples with one of these devices is largely dependent on choosing the appropriate sampling device for a particular sampling situation. The selection of a sampling device for a monitoring well or series of wells must include the consideration of a number of details. These considerations are tabulated for each of the types of sampling devices described. Based on these and other considerations, each of these devices has characteristics that makes it suitable for sampling under specific sets of conditions. No one method is applicable to all situations, however, for nearly all situations there is at least one appropriate sampling device available. Sampling equipment available today ranges from simple to highly sophisticated, and includes bailers, syringe devices, suction-lift pumps, gas-drive devices, bladder (Middelburg-type) pumps, gear-drive and helical rotor electric submersible pumps and gas driven piston pumps. (Baker-IVI)
W85-06834

CHEMICAL EQUILIBRIUM MODEL FOR THE ILLINOIS BASIN FORMATION WATERS,
University of Western Ontario, London. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W85-06872

DATA FOR SELECTED WELLS IN NORTHERN WISCONSIN DROUGHT AND GROUND LEVELS IN NORTHERN WISCONSIN: APPENDIX B,
Wisconsin Geological and Natural History Survey, Madison.
A. Zaporozec.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-130997,

Report No. NSF/RA-800659, 1980. National Science Foundation, Washington, DC. 135 p, 30 Fig, 52 Ref. Contract/Grant No. OSS7723964.

Descriptors: *Groundwater levels, *Groundwater, *Wells, Precipitation, Geohydrology, *Wisconsin, Shallow wells, Hydrographs, Water level, Water table, Drought.

Precipitation records and long-term, ground-level measurements are presented for shallow wells in a glaciated area of northern Wisconsin. The wells are arranged alphabetically by county. A complete data set for each well contains a location map and tables showing the following: summary of groundwater levels; average monthly groundwater levels; hydrographs of monthly high water levels; relation of annual groundwater levels to precipitation; longest duration of extreme groundwater levels; probability of exceedance of groundwater levels; frequency of weekly groundwater levels; exceedance of weekly groundwater levels; total precipitation at nearest station; and monthly mean discharge. (Author)
W85-06894

HELIUM ACCUMULATION IN GROUNDWATER, I: AN EVALUATION OF SOURCES AND THE CONTINENTAL FLUX OF CRUSTAL 4HE IN THE GREAT ARTESIAN BASIN, AUSTRALIA,
Australian National Univ., Canberra. Research School of Earth Sciences.
T. Torgersen, and W. B. Clarke.
Geochimica et Cosmochimica Acta, Vol. 49, No. 5, p 1211-1218, May, 1985. 2 Fig, 2 Tab, 44 Ref.

Descriptors: *Great Artesian Basin, *Australia, *Helium isotopes, *Groundwater, Geochemistry, Water chemistry, Weathering, Uranium, Thorium, Chemical analysis, Confined aquifers.

The rate of accumulation of He-4 in the groundwaters of the J-aquifer of the Great Artesian Basin, Australia has been determined using C-14 and hydrologic ages. The rate of accumulation of He-4 in the Basin is the result of two processes. In young water (aged $<50,000$ years) the rate of accumulation of He-4 can be accounted for by the in situ production of He-4 by the alpha-decay of U and Th series elements with the release factor for helium near 100%. In the main part of the basin ($>100,000$ years), the rate of accumulation of He-4 is about 74 times the rate of in situ production and cannot be accounted for by in situ weathering and the subsequent release of He-4 trapped in mineral grains over geologic time. The rate of accumulation of He-4 in the older waters of the Basin can be accounted for by the flux of He-4 from the whole crust. The Auob Sandstone of Namibia would also appear to reflect such a whole crust He-4 flux and the data of numerous other authors strongly suggest large He-4 sources outside the confines of individual groundwater bodies. The observation of a whole crust He-4 flux and crustal degassing of He-4 probably requires the release of He-4 by rock fracturing and may require facilitated transport of He-4 through the crust. (Baker-IVI)
W85-07035

NONLINEAR RESPONSE OF COUPLED FLOW-STRESS PROBLEMS,
San Diego State Univ., CA.
For primary bibliographic entry see Field 8D.
W85-07103

2G. Water In Soils

SOIL STRUCTURE EFFECTS AND LEACHING OF SODIUM FOLLOWING SODIUM CHLORIDE FERTILISER APPLICATIONS,
Lincoln Coll. (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 2K.
W85-06184

REGIONAL-SCALE ESTIMATES OF SURFACE MOISTURE AVAILABILITY FROM GOES INFRARED SATELLITE MEASUREMENTS,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 7B.
W85-06188

SOME SENSITIVITY RESULTS FOR CORN CANOPY TEMPERATURE AND ITS SPATIAL VARIATION INDUCED BY SOIL HYDRAULIC HETEROGENEITY,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2I.
W85-06193

CONSTANT HEAD WELL PERMEAMETER: EFFECT OF UNSATURATED FLOW,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
W. D. Reynolds, D. E. Elrick, and B. E. Clothier.
Soil Science, Vol. 139, No. 2, p 172-180, 17 Ref.

Descriptors: *Unsaturated flow, *Constant head well permeameter, Permeability coefficient, Flow rates, Soil water, Water tables.

The constant head well permeameter (CHWP) theory is extended analytically to account for the effects of unsaturated flow. This results in a more accurate estimate of the field-saturated hydraulic conductivity and in new methods for in situ estimation of the soil sorptivity and the alpha parameter of the exponential hydraulic conductivity-presssure head function. The original CHWP theory is found to be a special case of the extended theory where there is no capillarity. The extended theory successfully predicts many of the conclusions drawn from previous numerical investigations of the CHWP method. In so doing it also established the approximate functional relationships between the major factors influencing the method. (Baker-IVI)
W85-06208

LEACHING FROM A TROPICAL ANDEPT DURING BIG STORMS: A COMPARISON OF THREE METHODS,
Florida Univ., Gainesville. Dept. of Botany.
A. E. Russell, and J. J. Ewel.
Soil Science, Vol. 139, No. 2, p 181-189, February, 1985. 2 Fig, 2 Tab, 41 Ref.

Descriptors: *Leaching, *Storm seepage, *Soil water, Lysimeters, Darcy flow equation, Water balance, Nutrients, Flow, Saturated flow.

Water and nutrient leaching in the field was measured using three methods: estimates of flux using the Darcy flow equation, a water balance, and zero-tension lysimeters. The measurements were taken in an Andept near Turrialba, Costa Rica, during two large storms 33 and 22 cm/wk at two soil depths 25 and 110 cm. Mean water flows calculated by the flux and water balance methods were significantly different. The flux method overestimated water flow during the 22 cm storm. Mean water flow determined from zero-tension lysimeter data during both storms was substantially lower than that estimated by the other two methods. Nutrient leaching was determined two ways. First, nutrient concentrations measured using porous cup samplers were multiplied by water flows derived from water balance data. Second, nutrient concentrations of leachate collected by zero-tension lysimeters were multiplied by water flows from the lysimeters. In general, nutrient losses determined by the first method were greater than those measured by zero-tension lysimeters. In soil where lateral flow is relatively unimportant and impeding layers do not occur, the lysimeters provide a measure of the occurrence and quality of rapid channelized flow. (Baker-IVI)
W85-06209

EFFECT OF VEGETATION ON SOIL MOISTURE SENSING OBSERVED FROM ORBITING MICROWAVE RADIOMETERS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
J. R. Wang.
Remote Sensing of Environment, Vol. 17, No. 2, p 141-151, April, 1985. 6 Fig, 30 Ref.

Descriptors: *Vegetation effects, *Soil water, *Satellite technology, *Microwave radiometry, Remote sensing, Measuring instruments, Radiometry, Soil properties.

Remote sensing of soil moisture by microwave radiometers at satellite altitudes has been examined. The effect of vegetation cover observed by ground level radiometric measurements was also present in large area observations by the Skylab 1.4 GHz radiometer and the 6.6 and 10.7 GHz channels of Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR). The high altitude observations of vegetation effect showed strong frequency dependence. The effect of vegetation introduces ambiguity in moisture sensing by a microwave radiometer. An independent means of estimating biomass of vegetation cover is needed to determine soil moisture uniquely by remote microwave radiometric measurements. The polarization factor defined from the SMMR dual-polarized radiometric measurements at 6.6 and 107 GHz frequencies is sensitive to soil moisture variation when vegetation cover is not dense. Correlation of this factor with horizontally polarized brightness temperature could be useful in isolating the effects of vegetation cover and surface roughness from soil moisture variation. (Baker-IVI)
W85-06215

RELATIONS BETWEEN AVAILABLE AND EXTRACTABLE SOIL WATER AND EVAPOTRANSPIRATION FROM A BEAN CROP,
Lincoln Coll. (New Zealand). Dept. of Soil Science.
J. B. Reid, O. Hashim, and J. N. Gallagher.
Agricultural Water Management, Vol. 9, No 3, p 193-209, November, 1984. 7 Fig, 4 Tab, 34 Ref.

Descriptors: *Evapotranspiration, *Soil water, *Estimating, Model studies, Crop yield, Irrigation, Available water, Extractable water.

The accuracy of available and extractable soil water estimates was investigated using irrigated and unirrigated beans grown in an alluvial silt loam in Canterbury, New Zealand. Available water capacity was defined as the difference between soil water contents in the root zone at the drained upper limit (DUL) and at the lower limit (LL) as estimated by laboratory procedures. Extractable water capacity was specified as the difference between field estimates of DUL and LL for the whole profile affected by roots. DUL was estimated in the laboratory by equilibrating soil cores at matric potentials at -10, -20, or -30 kPa, and in the field by neutron moderation. In the field LL was measured by neutron moderation on plots where evaporation had apparently ceased due to drought stress. Estimates of the DUL, LL and available water capacity may be useful for irrigation management, are misleading indicators of the distribution of water available for uptake by crops. Lab estimates of these variables seem especially prone to inaccuracy in the latter respect, and field estimates are preferable. Even estimates of extractable water can be inaccurate because of upward fluxes of water into the root zone. Apparent and effective rooting depths need not necessarily be the same. In some situations the time required for a thoroughly wetted soil to drain to the DUL can lead to significant inaccuracies in water balance calculations. These inaccuracies can largely be avoided by the use of a simple equation which relates drainage rate to soil water content in excess of the DUL. It is important that irrigation/water use experiments on alluvial soils should make appropriate observations of soil variability. Insufficient attention to this aspect may result in errors when results from experimental plots are used to predict soil water behavior over larger areas. (Baker-IVI)
W85-06279

CALIBRATION OF NEUTRON MOISTURE METERS ON STONY SOILS (NOTE),
Ministry of Agriculture and Fisheries, Ashburton (New Zealand). Winchmore Irrigation Research Station.
For primary bibliographic entry see Field 7B.

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W85-06435

STOCHASTIC ANALYSIS OF UNSATURATED FLOW IN HETEROGENEOUS SOILS; 1. STATISTICALLY ISOTROPIC MEDIA,
New Mexico Inst. of Mining and Technology, Socorro.
T.-C. J. Yeh, L. W. Gelhar, and A. L. Gutjahr.
Water Resources Research, Vol. 21, No. 4, p 447-456, April, 1985. 8 Fig, 30 Ref. NSF grants ENG 75-14184 and CEE-8311786, EPA grant R-806092.

Descriptors: *Unsaturated flow, *Steady flow, *Stochastic hydrology, Model studies, Soil water, Soil properties, Permeability coefficient, Infiltration, Porosity, Porous media.

Steady unsaturated flow with vertical mean infiltration through unbounded heterogeneous porous media is analyzed using a perturbation approximation of the stochastic flow equation which is solved by spectral representation techniques. The general formulation of the problem is emphasized along with solution techniques. Specific results are developed for the case of vertical mean infiltration when alpha is a deterministic constant, with a three-dimensional statistically isotropic and a one-dimensional representation of the hydraulic conductivity variation. The mean behavior of the flow is determined in terms of an effective hydraulic conductivity relationship expressed as a function of mean capillary pressure. Conditions under which the flow becomes one-dimensional are established from comparisons of the variance of capillary pressure head. (Baker-IVI)
W85-06499

STOCHASTIC ANALYSIS OF UNSATURATED FLOW IN HETEROGENEOUS SOILS; 2. STATISTICALLY ANISOTROPIC MEDIA WITH VARIABLE ALPHA,
New Mexico Inst. of Mining and Technology, Socorro.
T.-C. J. Yeh, L. W. Gelhar, and A. L. Gutjahr.
Water Resources Research, Vol. 21, No. 4, p 457-464, April, 1985. 5 Fig, 1 Tab, 13 Ref, 1 Append.

Descriptors: *Unsaturated fow, *Steady flow, *Stochastic hydrology, Model studies, Soil water, Soil properties, Permeability coefficient, Infiltration, Porosity, Anisotropy.

Natural soils or geological formations, in general, exhibit bedding or stratification. Because of this geological structure, hydrologic properties of the porous media should be considered to be statistically anisotropic. Steady unsaturated flow in heterogeneous soil with an arbitrarily oriented mean hydraulic gradient is analyzed using spectral solutions of the stochastic perturbation equation which describes the capillary pressure head. Several general cases with variable alpha and statistical anisotropy are developed. These analyses explore the anisotropy of effective hydraulic conductivity for unsaturated flow and the effect of the variability of alpha on the variance of capillary pressure head. The effective hydraulic conductivity for arbitrary orientation of the mean hydraulic gradient is shown to have tensorial properties, but its components depend on the magnitude and direction of the hydraulic gradient and the orientation of the stratification in the soil. When alpha is random, the degree of anisotropy of the effective conductivity depends strongly on mean capillary pressure. The variance of the capillary pressure head increases with increasing mean capillary pressure. The anisotropy of effective unsaturated hydraulic is strongly dependent on the mean capillary pressure. (Baker-IVI)
W85-06500

STOCHASTIC ANALYSIS OF UNSATURATED FLOW IN HETEROGENEOUS SOILS; 3. OBSERVATIONS AND APPLICATIONS,
New Mexico Inst. of Mining and Technology, Socorro.
T.-C. J. Yeh, L. W. Gelhar, and A. L. Gutjahr.
Water Resources Research, Vol. 21, No. 4, p 465-471, April, 1985. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Stochastic process, *Unsaturated flow, *Soil water, Capillary flow, Anisotropy, Permeability coefficient, Groundwater recharge, Path of pollutants, Runoff, Vadose zone.

The results of the stochastic theory developed for flow in heterogeneous soils predict the general behavior of the variability of capillary pressure or moisture content in a field situation. The variability of capillary pressure or moisture content increases when mean capillary pressure increases. The anisotropy ratio (horizontal/vertical) of effective (mean) unsaturated hydraulic conductivity increases when mean capillary pressure increases or mean moisture content decreases. The importance of the correlation scale in effective hydraulic conductivity is demonstrated through a direct comparison of the anisotropy ratios derived from both the stochastic result and a direct average method. Through examples of recharge, pollutant migration, and rainfall-runoff problems in large-scale vadose zones, the importance of the new unsaturated hydraulic conductivity anisotropy concept in hydrologic applications is stressed. The theoretical results are applied to study practical problems associated with liquid waste isolation, pollutant migration, and design of capillary barriers for shallow underground waste storage. Applications of the theoretical results to field situations require information on the statistical properties of the processes. (Baker-IVI)
W85-06501

TWO-PHASE NUMERICAL MODEL FOR PREDICTION OF INFILTRATION: APPLICATIONS TO A SEMI-INFINITE SOIL COLUMN,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, and J. A. Billica.
Water Resources Research, Vol. 21, No. 4, p 607-615, April, 1985. 12 Fig, 11 Ref. NSF grant CEE-8212668.

Descriptors: *Mathematical models, *Infiltration, *Soil water, Algorithms, Simulation, Computers, Costs, Boundary conditions, Two-phase models, Air phase, Water content profile.

A numerical algorithm for prediction of infiltration and water content profiles evolution in a soil column is derived from the two-phase flow theory for water and air. The approach provides a more physical description of the process of infiltration and of water content profiles evolution in a soil column. When water contents are high, that is as ponding is approached and after ponding has occurred, the two-phase approach not only may provide the proper answer but does so at lower cost than by the one-phase approach. The governing equations reduce to the usual one-phase flow equations by setting a parameter to a zero value. The model can shift back and forth from the one-phase to the two-phase mode within the course of a simulation as demanded by the situation. The need for the two-phase approach is demonstrated for several situations with a semi-infinite lower boundary condition, when the two-phase approach might appear a priori least needed. It is needed even for a semi-infinite soil column when mobile air cannot be confined. Naturally, for other lower boundary conditions such as an impervious bottom at a finite depth or the presence of a fluctuating water table, the two-phase approach, including air compression efects, becomes the only feasible one on multiple counts of realism, accuracy, stability, and cost. The two-phase computer runs actually cost less than the corresponding one-phase runs. The two-phase algorithm is naturally more stable than the one-phase algorithm when the water contents are high in a portion of the column. Thus the two-phase approach is not only more realistic, but it is even less expensive whenever it is needed. (Moore-IVI)
W85-06515

FLUX AND WATER CONTENT RELATION AT THE SOIL SURFACE,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J.-Y. Parlange, W. L. Hogarth, J. F. Boulier, J. Touma, and R. Haverkamp.
Soil Science Society of American Journal, Vol. 49, No. 2, p 285-288, March-April, 1985. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Soil water movement, *Soil physics, *Soil surface, *Erosion, *Infiltration, Ponding, Runoff, Sand, Erosion control, Mathematical equations, Soil properties.

The prediction of the increase of the water content at a soil surface for a surface flux measured as a function of time, represents an important problem of soil physics. Of particular importance is the determination of the time when incipient ponding first occurs, which determines the onset of surface runoff and possible surface erosion. A general analytical equation is presented which relates the surface water content and surface flux. There is no limit given to any particular soil behavior, and the time dependence of the surface flux is arbitrary. While the equation is approximate, it is optimal at least in the short time limit. Comparisons with numerical and experimental results from Grenoble sand and when the surface flux is constant are used to assess the accuracy of the equation. If the analytical results were used to predict the time at which a certain water content is to be reached at the surface, the difference in the analytical and numerical results, though small, would be significant. The numerical solution has an intrinsic error in the short time limit, suggesting that the analytical result may be more accurate than the numerical solution. The good agreement between the numerical results and an earlier approximate analytical solution reinforces this suggestion. (Baker-IVI)
W85-06538

TIME DOMAIN REFLECTOMETRY FIELD MEASUREMENTS OF SOIL WATER CONTENT AND ELECTRICAL CONDUCTIVITY,
Agricultural Research Service, Riverside, CA. Salinity Lab.
S. Dasberg, and F. N. Dalton.
Soil Science Society of American Journal, Vol. 49, No. 2, p 293-297, March/April, 1985. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Soil water, *Electrical conductivity, *Saline soils, *Time domain reflectometry, Gravimetry, Neutron scattering, Soil properties.

The conventional method for measuring soil salinity is by taking soil samples and determining the electrical conductivity of the extract of a saturated soil paste. These measurements can be converted into soil solution salt concentration by correcting for the soil water content at the time of sampling. Simultaneous measurements of volumetric water content and bulk electrical conductivity were made using time domain reflectometry (TDR) with a single parallel transmission line (PTL) imbedded in the soil. Sixty PTL's were installed at five depths in 12 existing lysimeter plots, irrigated with different amounts of water at two salt concentrations (1.3 and 3.1 dS/m). The correlation between TDR and gravimetric determination is similar to that between neutron and gravimetric determination, but it is somewhat closer to a 1:1 relationship. Another test of the validity of the TDR determined water content measurements was carried out during irrigation of the experimental plots. The water balance for all plots was calculated using TDR, neutron measurements and applied water. The discrepancy between the water actually applied and that measured by TDR and neutron probe seem to reflect soil variability. In many cases the differences between the two neutron sites per plot are as great or greater than the differences between TDR and neutron measurements. Both measurements seem to give a true estimate of water content for their sampling volume, and no conclusion can be drawn which method gives a better estimate of water content. More rigorous testing is needed to reach such a conclusion. (Baker-IVI)
W85-06539

LEACHING AND WATER REQUIREMENT STUDIES IN A GYPSIFEROUS DESERT SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
For primary bibliographic entry see Field 3F.
W85-06540

STATE MODEL FOR INFILTRATION,
Helsinki Univ. of Technology, Espoo (Finland). Systems Theory Lab.
K. Pingoud, and P. J. Orava.
Nordic Hydrology, Vol. 15, No. 3, p 113-130, 1984. 5 Fig, 7 Ref.

Descriptors: *Infiltration, *Model studies, *Soil water, Philips equation, Runoff, Mathematical equations, Unsaturated flow, Ponding, Rainfall-runoff models, Ponding, Rainfall-runoff relationships.

A state model for infiltration is presented which is based on a spatial discretization of partial differential equations of vertical water-movement in unsaturated homogeneous soil. A transformation of the spatial coordinate is made in the basic equations, thus allowing the representation of a semi-infinite soil in the state form. The aim of the model is to describe the dynamical relationship between ponding conditions in the catchment and infiltration during highly variable rainfall rates so that the model can be used flexibly as part of larger rainfall-runoff models. The model is intended to be combined with short-term surface runoff models applied to storm water modelling. The infiltration process is assumed to take place in semi-infinite unsaturated soil. This idealization can be motivated if the water table is rather far from the surface and the model is intended to describe only the infiltration rate at the surface. In classical infiltration equations such as Philip's equation the soil is also assumed to be semi-infinite so that a direct comparison of the model with these equations is possible. The combination of the infiltration model with a surface runoff model containing several state variables seemed to give satisfactory results assuming that the rainfall and initial saturation of the soil are horizontally relatively uniformly distibuted along the catchment. In spite of the relative simplicity of the method for estimating infiltration in surface runoff models, it is far more realistic than the use of explicit infiltration equations such as Philip's equation, because the varying ponding conditions in the catchment are considered in the model. (Baker-IVI)
W85-06644

EVAPOTRANSPIRATION AND SOIL HETEROGENEITY,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2D.
W85-06679

WATER BALANCE UNDER WHEAT MODELLED WITH LIMITED SOIL DATA,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils.
E. S. Greacen, and C. L. Hignett.
Agricultural Water Management, Vol. 8, No. 1-3, p 291-304, January, 1984. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Water balance, *Wheat, *Soil water, *Mathematical models, *New South Wales, Permeability coefficient, Roots, Evapotranspiration, Clay, Soil water capacity, Hydrologic properties.

The dominant role of water in determining yield, and the possibility of describing water storage and movement in the soil with reasonable accuracy have led to the hope of establishing patterns of hydrologic behavior of relevance to agronomy for the major wheatland soils of Australia. CEREAL is a single layer water balance model which utilizes the moisture characteristic and the hydraulic conductivity function of the soil. The model was run on wheat crops at 23 sites in the winter rainfall region of south-east Australia. For red soils in New South Wales the best result was a root mean square deviation (RMSD) of 11 mm (between predicted and measured stored water) for 18 sites using a deep drainage option with field-determined available water capacity (AWC); a laboratory measurement of AWC gave an RMSD of 15 mm. The model CEREAL assumes a general relationshop between root length and evapotranspiration, and error due to this assumption is included in RMSD. The model performed poorly on cracking clays, giving a RMSD of 35 mm; this improved to 25 mm when the simulated rate of root growth was reduced by 30%. The model overall performed reasonably for red soils with the set root function, but there were some aberrations that have not been explained. The possibility exists of predicting the hydrological properties of wheatland soils from texture and field structure. (Moore-IVI)
W85-06680

IN SITU WATER TRANSMISSION CHARACTERISTICS OF A TROPICAL SOIL UNDER RICE-BASED CROPPING SYSTEMS,
Central Soil Salinity Research Inst., Karnal (India). Div. of Soils and Agronomy.
S. S. Hundal, and S. K. De Datta.
Agricultural Water Management, Vol. 8, No. 4, p 387-396, February, 1984. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Rice, *Soil water, *Water transmission, Permeability coefficient, Percolation, Hydraulic conductivity, Soil saturation, Soil matric potential, Diffusivity.

In soils under rice-based cropping systems in Asia water movement and distribution in the root zone of rice and dryland crops are important for efficient water management. Saturated hydraulic conductivities in the wetland soil profile were evaluated from measurements of hydraulic gradients and percolation rates in the field. The subsoil layer (15-60 cm) restricted percolation rate to a greater degree than the puddled top soil. Unsaturated hydraulic conductivities and soil water diffusivities in the soil profile under dryland conditions were obtained from simultaneous measurements of soil water content using the neutron moderation technique and the soil matric potential by tensiometers over time and soil depth. Soil matric potential versus hydraulic conductivity and soil water content versus soil water diffusivity relations of various soil depths were established. At equivalent soil matric potentials, the hydraulic conductivity of surface soil was greater than that of the subsoil layers. Soil water diffusivity at different depths responded similarly. The study describes a simple in situ technique to measure percolation rates in wetland rice fields and evaluation of water transmission properties of field soil profiles. (Author's abstract)
W85-06685

SALT AND WATER TRANSPORT IN UNSATURATED SOIL FOR NON-CONSERVATIVE SYSTEMS,
Arizona Univ., Tucson. Dept. of Mathematics.
D. O. Lomen, P. J. Tonellato, and A. W. Warrick.
Agricultural Water Management, Vol 8, No. 4, p 397-409, February, 1984. 6 Fig, 15 Ref. OWRT project B-097-ARIZ.

Descriptors: *Solute transport, *Soil water, Aeration zone, Roots, Mathematical equations, Dispersion, Unsaturated flow.

Materials are commonly removed from soil water by adsorption to the soil particles, dissolution, plant uptake and volatilization. An analytical solution is developed for one-dimensional salt and water transport in soil systems with a steady intake velocity. Both water and solutes are non-conservative in the sense that they are removed by plant roots. The solute (or any water-transported entity) may be lost through a first order reaction. In this analytical solution, the unsaturated flow is coupled to solute uptake by the use of a 'reflection coefficient' describing selective uptake by the roots. Hydrodynamic dispersion is included in the initial formulation, but is assumed negligible in actual calculations. Four numerical examples illustrate the utility of the solution. Possible extensions include effects of solute dispersion or multidimensional flow systems. (Moore-IVI)
W85-06686

SIMULATING INFILTRATION INTO FROZEN PRAIRIE SOILS IN STREAMFLOW MODELS,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
D. M. Gray, P. G. Landine, and R.J. Granger.
Canadian Journal of Earth Sciences, Vol. 22, No. 3, p 464-472, March, 1985. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Infiltration, *Prairies, *Model studies, *Snowmelt, Soil water, Soil properties, Streamflow, Permeability, Frozen ground, Rainfall-runoff relationships, Snowmelt.

A first generation model is presented describing snow melt infiltration into frozen Prairie soils which may be interfaced with operational systems used in streamflow synthesis and forecasting. The concept on which the model is based assumes that frozen soils of a watershed can be grouped into three classes according to their infiltration potential, namely, restricted (impervious, or most of the snow-cover water equivalent goes to runoff), limited (the amount of infiltration is governed by snow-cover water equivalent and the water or ice content of the frozen soil at the time of melt), and unlimited (a soil has the ability to absorb most of the snow water). An empirical expression describing the interrelationship between snowmelt infiltration, soil moisture content, and snow-cover water equivalent for the limited case is given. The main advantages of the model are its simplicity and ease of programming; the fact that is has a physical base; it makes use of parameters that can be readily measured or observed; and it does not require an extensive data base. Water balance calculations of runoff volumes, where the model was applied to snowmelt events on a small watershed, showed the calculated volumes agreed within 17% of the measured flows. The infiltration algorithms significantly improved the performance of the National Weather Service river forecasting system-Sacramento model in synthesizing streamflow from snowmelt over that obtained with the system when its land phase subroutine was unchanged. An infiltration index approach, similar to that employed in rainfall-runoff studies, therefore may be used to describe the process in soils of limited potential in operational systems. These findings suggest an initial value of the snowmelt infiltration index equal to the infiltration potential divided by 6 or 7 days. (Baker-IVI)
W85-06702

PERCOLATION TESTS, SOIL TEXTURE, AND SATURATED HYDRAULIC CONDUCTIVITY IN LACUSTRINE SOILS IN NORTH DAKOTA,
Virginia State Dept. of Health, Richmond.
J. F. Conta, J. L. Richardson, and L. Prunty.
Journal of Environmental Quality, Vol. 14, No. 2, p 191-194, April/June, 1985. 3 Fig, 4 Tab, 25 Ref.

Descriptors: *Percolation tests, *Soil texture, *Soil properties, *Permeability coefficient, *North Dakota, Wastewater disposal, Clay.

Percolation tests were shown to be unreliable estimators of in situ saturated hydraulic conductivity (K sub sat) if the data were to be used to predict soil permeability for on-site septic disposal systems in soils with > 0.35 kg/kg clay ($r = -0.38$(nonsignificant), $p = 0.01$). The wide variations in percolation rates (10.5-135.9 min/cm) measured on similar pedons with silty clay or clay textures were attributed to the pedal nature and vertic properties that exist in high clay content soils of the area. Percolation rates yielded good estimates of K sub sat in soils with < 0.35 kg/kg clay ($r = -0.79^{**}$, $p = 0.01$)(**indicates significance at the 1% level). The soil clay content and K sub sat rate correlated with sufficient precision over a wide range of soil textures for clay content to be used in predicting permeability and to permit using permeability to interpret the soil suitability for septic absorption fields. This research showed that clay content could reliably form the basis of a sanitary code. A comparison of in situ K sub sat rates and estimated permeability ranges used by the Soil Conservation revealed that many fine-textured soils have permeabilities greater than the Soil Conservation Service ranges indicate. The ranges of permeability should be expanded for these fine-textured soils to include more rapid permeabilities. (Author's abstract)
W85-06717

NOTE ON LEWIS-KOSTIAKOV'S INFILTRATION EQUATION,

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Bidhan Chandra Krishi Viswa Vidyalaya, Mohanpur (India). Dept. of Agricultural Engineering.
R. K. Ghosh.
Soil Science, Vol. 139, No. 3, p 193-196, March, 1985. 2 Fig, 16 Ref.

Descriptors: *Soil water, *Infiltration, *Lewis-Kostiakov's Equation, Mathematical equations, Rainfall, Permeability, Soil properties.

Equations were evaluated for use in predicting and controlling rainwater infiltration and rainfall excess in crop and range lands. Experimental data was obtained from investigations using infiltrometers on two soil sites in situ. In analyzing the experimental data the conclusion appeared to be valid that the time exponent of Lewis-Kostiakov's infiltration equation may at some time assume a value greater than 1. The traditional notion that this exponent will always be less than or equal to 1 is shown to be unfounded. (Baker-IVI)
W85-06746

AGGREGATE BREAKDOWN IN RELATION TO RAINDROP ENERGY,
Jember Univ. (Indonesia). Faculty of Agriculture.
Wustamidin, and L. A. Douglas.
Soil Science, Vol. 139, No. 3, p 239-242, March, 1985. 2 Tab, 23 Ref.

Descriptors: *Rain, *Soil properties, *Soil aggregates, Aggregates, Infiltration, Permeability, Chemical composition, Montmorillonite, Energy.

A model was developed to relate a number of soil properties to the drop energy required to cause aggregate breakdown (D). Aggregates from 17 soils were used in the study. Aggregate breakdown was studied by allowing drops to fall 1 m through a 12 cm diameter plexiglas tube onto an air-dry aggregate placed on fiberglass gauze attached to the mouth of a glass funnel. The weight of the soil that passed through the fiberglass gauze due to the action of a recorded number of drops was used to calculate D, the amount of raindrop energy required to pass 1 g of soil through the fiberglass gauze. The model as presented enabled D to be predicted from soil properties for five out of six test soils. In the one case where the model failed, the soil differed from all others used in this study in that it contained an exceptionally high amount of montmorillonite. A positive correlation was found between soil Al hydrous oxide content and D. Organic matter content also yielded a positive correlation. The high negative charge on soil organic matter has significantly influenced the correlation result associated with cation exchange capacity. (Baker-IVI)
W85-06747

SALT REMOVAL FROM SOILS OF THE LOW SYRT PLAIN,
Volga Inst. of Hydraulic Engineering and Melioration, Engel's (USSR).
T. K. Platanova, and L. N. Shmyglya.
Soviet Soil Science, Vol. 16, No. 5, p 93-98, September/October, 1984. 3 Fig, 1 Tab, 7 Ref. Translated from Pochvovedeniye, No. 7, p 144-149, 1984.

Descriptors: *Leaching, *Salt removal, *Soil water, *Low Syrt Plain, Irrigation, Salinization, Seepage, Gypsum, Sodium hydrocarbonate.

The results of field and lab experiments on the leaching of Dark Chestnut, deeply secondarily Solonchakic soils on syrt deposits are given. The stages of salt removal are distinguished and the ways of secondary salt formation shown. Two main stages could be distinguished. The first stage is characterized by rapid, almost piston-like removal of salts from the original pore solution. The second is characterized by the secondary formation of significant quantities of salts, predominantly sodium sulfate, due to exchange reactions between the adsorbing complex and poorly dissolving, salts (gypsum and calcium carbonate). If the gypsum content in the soils is not great, the secondary formation of sodium hydrocarbonate begins. The rate of salt removal sharply decreases in the second stage. The leaching of soils to some degree imitates the conditions of long-term irrigation and therefore the physicochemical phenomena that occur in the process apparently will also appear in analogous forms in irrigated lands. In order to substantiate theoretical schemes for forecasting the salt regime of soils the potential salt supply in groundwater must be estimated. (Baker-IVI)
W85-06749

CHANGES IN SOUTHERN CHERNOZEMS AFTER DRIP IRRIGATION,
Leningrad State Univ. (USSR).
For primary bibliographic entry see Field 3F.
W85-06750

EFFECT OF DIFFERENTIAL POROSITY ON THE NATURE OF MOISTURE MIGRATION AND SALT ACCUMULATION IN SOIL (AS EXEMPLIFIED BY NEWLY DEVELOPED SOILS OF TADZHIKISTAN),
Tadzhik Scientific Research Inst. of Soil Science, Dushanbe (USSR).
T. M. Drozhzhina, and S. I. Vasil'chikova.
Soviet Soil Science, Vol. 16, No. 5, p 109-115, September/October, 1984. 4 Tab, 5 Ref. Translated from Pochvovedeniye, Vol. 4, p 71-77, 1984.

Descriptors: *Soil water, *Leaching, *Irrigation, *Soil properties, *Tadzhikistan, *USSR, Infiltration, Permeability, Clay, Chemical composition, Saline soils.

Movement of moisture in the soil profile and salt accumulation depend not only on natural and climatic factors, but also on the simultaneous presence of pores with readily mobile and difficulty mobile moisture held in pores 4-50 micro-m in diameter. The effect of differential porosity on soil moiture and salt accumulation was studied using soils in newly developed areas: the Yavan and Beshkent valleys and the Karadum region in southern Tadzhikistan. Drawing of moisture into subsoil waters, the groundwater and the downward migration of salts are largely dependent on the combination of pores with mobile moisture and passive moisture. The predominance of pores with mobile moisture ensures a leaching regime even in the presence of mineralized soil groundwaters close to the surface. Aeration porosity does not take part in raising soil moisture. In all cases the predominance of pores 4-50 micro-m in diameter in the presence of mineralized groundwater and absence of poorly permeable screens leads to salinization of the aeration zone of the Solonchak stage. (Baker-IVI)
W85-06751

INFLUENCE OF SOIL DROUGHT AND PARTIAL WATERLOGGING ON WATER RELATIONS OF GMELINA ARBOREA SEEDLINGS,
Department of Botany, University of Ibadan, Nigeria, Africa.
For primary bibliographic entry see Field 2I.
W85-06858

2H. Lakes

PREDICTION OF CHLOROPHYLL A CONCENTRATIONS IN IMPOUNDMENTS OF SHORT HYDRAULIC RETENTION TIME,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. D. Pridmore, and G. B. McBribe.
Journal of Environmental Management, Vol. 19, No. 4, p 343-350, December, 1984. 2 Fig, 1 Tab, 35 Ref.

Descriptors: *Chlorophyll a, *Reservoirs, *Hydraulic retention time, Mathematical models, Phytoplankton, Biomass, Phosphorus, Nutrients, Growing season.

A mathematical model is developed to predict growing season chlorophyll a concentrations in impoundments of short hydraulic retention time (i.e. < 2 weeks). This model is preferred for environmental management over other models, because it predicts limited rates of growth as phytoplankton biomass increases, admits simple analytical solution, includes measurements which are relatively easy and inexpensive to obtain and requires no field calibration. Growth rate is limited in the model by the inclusion of an inhibition factor, (K-B)/K, which increases in importance as the chlorophyll a concentration in the impoundment (B) approaches its theoretical maximum (K), based on an empirical relation between the maximum observed chlorophyll a concentration and growing season mean total phosphorus concentration in the euphotic waters of 82 lakes. When tested on two New Zealand hydro-electric impoundments, the model was found to describe reliably both the observed chlorophyll a build-up curve and the observed steady state concentration. Further attempts to corroborate the model are encouraged. (Author's abstract)
W85-06177

LAKE ALGAL POPULATIONS AND PHYSICO-CHEMICAL CHANGES AFTER 14 YEARS INPUT OF METALLIC MINING WASTES,
Victoria Univ. (British Columbia). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W85-06221

MATHEMATICAL ANALYSIS OF OXYGEN AND NITRATE CONSUMPTION IN DEEP MICROBIAL FILMS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
S. E. Strand, and A. J. McDonnell.
Water Research, Vol. 19, No. 3, p 345-352, 1985. 3 Fig, 1 Tab, 42 Ref. NSF grant ENG7820221.

Descriptors: *Oxygen, *Nitrates, *Microbial films, *Mathematical models, Aerobic conditions, Anaerobic conditions, Diffusion, Microorganisms, Films.

The simultaneous diffusion and consumption of oxygen and nitrate into microbial films with aerobic and anaerobic layers was modeled by a system of differential equations and solved by numerical methods. Fickian diffusion was assumed. Models used Monod kinetics and zero-order kinetics, for growth limitation by oxygen and nitrate. Denitrification was assumed to be repressed by oxygen concentrations greater than a finite critical value. Both models indicate that oxygen concentration in the overlying water would have little effect on the nitrate uptake of thick films. (Author's abstract)
W85-06227

INTERACTION BETWEEN RIPARIAN VEGETATION, WATER TEMPERATURE, AND SALMONID HABITAT IN THE TUCANNON RIVER,
Agricultural Research Service, Fort Collins, CO. Hydro-Ecosystem Research Unit.
F. D. Theurer, I. Lines, and T. Nelson.
Water Resources Bulletin, Vol. 21, No. 1, p 53-64, February, 1985. 2 Fig, 7 Tab, 14 Ref.

Descriptors: *Salmon, *Steelhead, *Riparian vegetation, *Water temperature, *Tucannon River, *Washington, River restoration, Habitats, Economic aspects, Fish populations, Model studies.

The Tucannon River watershed is located in southeastern Washington. The upper third of the watershed is on public land and has enough riparian vegetation and clean substrate to serve as satisfactory salmonid spawning and rearing habitat. The lower two-thirds is on privately owned land; here the river has lost most of its vegetation and is not satisfactory for either rearing or spawning habitat. Physical-process, ecological, and economic models are used to: analyze the instream water temperatures with respect to existing and proposed riparian vegetation under natural conditions; use these water temperatures to determine salmon and steelhead fish populations that were based upon actual field count and known temperature preference data; and determine the economic worth based upon the estimated carrying capacity of the river, the estimated number of return spawners, and the economic value of commercially caught and sport-caught salmon and steelhead. The analysis demonstrates the efficacy of multidisciplinary

modeling efforts to relate riparian vegetation, water temperature, and salmonid habitat. The economic results clearly indicate the value and feasibility of restoring riparian vegetation on the Tucannon River. The total cost for restoring the entire thermal regime would be less than 1.5 million dollars, as contrasted to the present worth of 6.9 million dollars. (Moore-IVI)
W85-06239

CHARACTERIZATION OF SEDIMENT REFERENCE MATERIALS BY X-RAY PHOTOELECTRON SPECTROSCOPY,
National Inst. for Environmental Studies, Tsukuba (Japan).
M. Soma, H. Seyama, and K. Okamoto.
Talanta, Vol. 32, No. 3, p 177-181, March, 1985. 3 Fig, 3 Tab, 24 Ref.

Descriptors: *Sediment-water interfaces, *Chemical composition, Estuarine sediments, Pond sediments, River sediments, Silicon, Chromium, Organic matter, Binding energy.

The chemical composition of surface layers of three sediment reference materials, Pond Sediment (Japan NIES CRM No. 2), River Sediment (US NBS SRM 1645) and Estuarine Sediment (US NBS SRM 1646), has been studied comparatively by X-ray photoelectron spectroscopy (XPS). The composition of River Sediment as determined by XPS is peculiar in that the concentration of Cr is much higher but that of Si is much lower than that expected from the bulk composition of the sample. This can be attributed to the structure of the sediment particles, which consist of silica-rich cores covered by surface layers rich in Cr(III). Organic substances are predominant in the surface layers of all three materials, as indicated by the C 1s and N 1s lines. The elemental composition of the surface layers can be reasonably related to the origin of the sediments. The bonding states of some elements in the sediment samples, deduced from the photoelectron binding energies, are briefly discussed. (Author's abstract)
W85-06250

OXYGEN BUDGET OF THE WATERS OF THE FELDBERGER LAKEPLAIN BASED ON SUMMER DEPTH PROFILES FOR 1924 AND 1962, PART 3: SCHARTEISEN, WASCH-SEE, DOLGENER SEE (ZUM SAUERSTOFFHAUSHALT DER GEWASSER DER FELDBERGER SEENPLATTE AN HAND AUSGEWAHLTER SOMMERLICHER TIEFENPROFILE SEIT 1924 UND 1962, TEIL 3: SCHARTEISEN, WASCH-SEE, DOLGENER SEE),
For primary bibliographic entry see Field 5C.
W85-06274

STABILITY OF THE STATIONARY STATE OF A EUTROPHIC WATER POOL,
Bulgarian Academy of Sciences, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika.
For primary bibliographic entry see Field 5C.
W85-06277

MATHEMATICAL REPRESENTATION OF SHORT TERM PHOSPHORUS VARIATIONS IN A NON-STRATIFIED SOUTHERN LAKE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
C. E. Mericas, and R. F. Malone.
Environmental Monitoring and Assessment, Vol. 4, No. 1, p 85-98, March, 1984. 10 Fig, 1 Tab, 12 Ref.

Descriptors: *Eutrophic lakes, *Mathematical models, *Phosphorus, *Crest Lake, *Louisiana, Lake restoration, Siumlation, Seasonal variation, Rainfall, Wind.

Total phosphorus concentrations in a small urban hypereutrophic lake undergoing restoration were continually modeled by a modified version of a Vollenweider model for the latter part of the three and one-quarter year restoration period. Results of the modeling effort on Crest Lake (Louisiana) were analyzed to determine the compatibility of the basic Vollenweider model with short term applications to highly eutrophic southern lakes. Input parameters such as rainfall and wind speed were considered on a daily basis to see if the model could represent the short term variations observed in the lake. Model simulations were compared to total phosphorus observations collected on the lake at intervals as short as one day. Results indicated that the model can be used as a tool for analysis of system responses on a seasonal basis, but short term variations on the weekly or daily timeframe were poorly represented by the model. Intensive temporal and spatial sampling within the lake verified the validity of the completely mixed assumption for short term applications. Nine sampling locations within the lake, distributed with area and depth, displayed a mean coefficient of variation of only 10.9% when averaged daily for the 54 day intense sampling period. Short term variations were poorly correlated with meterological inputs, suggesting that variability be best represented by a stochastic approach if a practical management tool is desired for situations where variabilty is critical. The seasonal trends were well represented by the model, reflecting the rapid response by hypereutrophic systems to alterations in phosphorus loadings. (Author's abstract)
W85-06285

CHANGES IN IONIC DISTRIBUTIONS IN FINNISH LAKE WATER DURING THE PERIOD 1968-1983,
For primary bibliographic entry see Field 5C.
W85-06296

APPLICATION OF THE FINNECO MODEL TO LAKE PYHAJARVI,
J. Niemi, and J. Eloranta.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 77-96, 1984. 14 Fig, 4 Tab, 17 Ref.

Descriptors: *Model studies, *Water quality, *Lake Pyhajarvi, *Finland, Eutrophic lakes, Phytoplankton, Wind, Simulation, Computer models.

The FINNECO lake model is a one-dimensional water quality simulation model developed in a joint project between the National Board of Waters, Finland and International Business Machines, Finland during the years 1978-1981. The model has eighteen state variables, includes the effect of wind in mixing water and simulates the freeze-up and break-up of ice on the basis of energy balance. The model was applied to the eutrophic Lake Pyhajarvi situated in southern Finland. Calibration was carried out by a trial and error method using the data of the open water season of 1980. Using the same parameter combination and the corresponding data of 1981, the agreement between the model output and observations was poor and the model could not be considered as verified. However, reasonably good agreement was obtained with this set of data by changing the values of only five parameters. It can be concluded that the model is unable to simulate water quality accurately in the lake as eutrophic as Lake Pyhajarvi. The sensitivity of the model to the input data was also tested. When the input data was given to the model as weekly or monthly averages instead of once every eight hours the values of most state variables, except those of phytoplankton, did not change markedly. This shows that the interval between individual input data can be longer than eight hours, which simplifies the application of the model and decreases computer costs. (Author's abstract)
W85-06298

EFFECT OF ASH FALLOUT ON WATER QUALITY IN WESTERN MONTANA,
Montana Univ., Missoula. Dept. of Chemistry.
For primary bibliographic entry see Field 5C.
W85-06325

AERATION-DESTRATIFICATION OF LAKE EUREKA: SECOND YEAR OPERATION,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5G.
W85-06344

MICROSYSTEM SEDIMENT-WATER SIMULATION: A PRACTICAL TECHNIQUE FOR PREDICTING RESERVOIR WATER QUALITY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5B.
W85-06358

STUDIES ON DESTRUCTION OF ORGANIC SUBSTANCE OF HIGHER AQUATIC PLANTS BY LABORATORY WATER COURSE MODELS (IZUCHENIE DESTRUKTSII ORGANICHESKOGO VESHCHESTVA VYSSHIKH VODNYKH RACTENII NA LABOPATORNYKH MODELYAKH VODOTOKOV),
For primary bibliographic entry see Field 2K.
W85-06376

ELODEA IN LAKE BAIKAL (ELODEYA KANADSKAYA V OZ.BAIKAL),
O. M. Kozhova, V. N. Pautova, and S. S. Timofeeva.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 82-84, 1985. 11 Ref.

Descriptors: *Elodea, *Lake Baikal, *Angara River, *USSR, Aquatic plants, Phenols, Aliphatic amines, Cyanide, Hydrocarbons, Enzymes, Biofilters, Distribution.

The Elodea distribution in Lake Baikal (USSR) and in Angara River is reported. The results of the authors' observations and data available in literature are presented. Elodea is found to be stable to the effects of phenol, aliphatic amines, cyanide and petroleum hydrocarbons. The oxidoreductase activity is determined, and a conclusion is presented on the advisability of its use as a biofilter as well as on the value of Elodea distribution for the natural state of Lake Baikal. (Author's abstract)
W85-06380

ORTHOPHOSPHATE UPTAKE OF PLANKTONIC MICROORGANISMS IN LAKE BALATON,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
V. Istvanovics, and S. Herodek.
Hydrobiologia, Vol. 122, No. 2, p 159-166, 1985. 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Plankton, *Lakes, *Phosphates, *Orthophosphates, *Lake Balaton, Absorption, Eutrophication, Model studies, Microorganisms, Seasonal variation.

Seasonal orthophosphate uptake of natural plankton has been studied in hypertrophic and mesotrophic basins of Lake Balaton. Radioactivity of labelled phosphorus first decreased rapidly in filtrates of unenriched samples over time, and became constant afterwards. Uptake can be described by a simple two-compartment model between plankton and media. The model predicts isotope equilibrium between particulate and dissolved phases and first order kinetics for initial decrease of activity in filtrate. Turnover times in water of Lake Balaton were short and seasonally different. The shortest values were obtained in summer. Turnover times were longest in winter, under ice-cover and at the end of April. Rapid turnover of orthophosphate in water does not mean a similarly rapid turnover of planktonic phosphorus. Turnover time of phosphorus in microorganisms has been estimated on the basis of equilibrium isotope distribution between water and particular phases and turnover time in water. It ranged from 28 to over 1,000 min. Turnover time of orthophosphate in water increased in relation to phosphate additions according to Michaelis-Menten kinetics. The values of Michaelis-constant plus the ambient orthophosphate concentration suggested an overestimation of real phosphate concentration by chemical measurements, being much lower than soluble reactive phosphorus content in most cases, as it is well known in many other lakes. (Baker-IVI)
W85-06389

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CARBON FLOW IN THE PELAGIC ZONE OF A SHALLOW TURBID IMPOUNDMENT, WURAS DAM,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
J. U. Grobbelaar.
Archiv fur Hydrobiologie, Vol. 103, No. 1, p 1-24, March, 1985. 12 Fig, 7 Tab, 29 Ref.

Descriptors: *Reservoirs, *Turbidity, *Carbon cycle, *Wuras Dam, *South Africa, Dams, Turbidity, Pelagic zone, Phytoplankton, Flooding, Primary productivity.

Carbon flow within the pelagic zone of a shallow turbid man-made impoundment, Wuras Dam (South Africa) was measured during intensive 24 or 48 hour studies over a two year period. The Wuras Dam system was seen as a close-knit system in which the various components are heavily dependent on each other. Primary production by the phytoplankton provides the major source of organics to the system and any factor which influences this would influence the entire system. The underwater light climate and the thermal regime were identified as the two most important factors influencing phytoplankton productivity. The underwater light climate is directly influenced by the suspensoids which therefore, has an influence on the entire system. Flooding and the consequent throughflow of water has a marked influence in a shallow system such as Wuras Dam, where the components of the pelagic zone are washed out. The system appears to stabilize relatively quickly after such major disturbances. (Baker-IVI)
W85-06391

POSTGLACIAL CHANGES IN ALGAL AND CLADOCERAN ASSEMBLAGES IN LITTLE ROUND LAKE, ONTARIO,
Queen's Univ., Kingston (Ontario). Dept. of Biology.
J. P. Smol, and M. M. Boucherle.
Archiv fur Hydrobiologie, Vo. 103, No. 1, p 25-49, March, 1985. 11 Fig, 34 Ref. Natural Sciences and Engineering Research Council of Canada grant A-0808.

Descriptors: *Algae, *Cladocerans, *Little Round Lake, *Ontario, Stratigraphy, Species composition, Water temperature, Erosion, Nutrients, Hemlock trees, Trophic level.

Stratigraphic changes in algal and cladoceran assemblages were described from the postglacial sediments of Little Round Lake, a small, meromictic, alkaline lake in southeastern Ontario, Canada. The shifts recorded in species composition and abundance were attributed to a variety of factors, including low temperatures during the lake's early history, watershed processes regulating erosion and nutrient release, and variations in the lake's meromixis. In contrast to other lakes that have been studied in the region, the return of hemlock (Tsuga canadenis) about 3,000 years ago to the lake's catchment did not result in a return to more oligotrophic conditions. Instead, the changes in algal and cladoceran microfossils indicate fluctuations in trophic status that are attributed to episodes of increased entrainment of nutrient-rich water from the monimolimnion. (Author's abstract)
W85-06392

IMPLICATIONS OF SLOW DEEP WATER RENEWAL OF LAKE KOENIGSSEE DERIVED FROM COMBINED TRITIUM-3HELIUM MEASUREMENTS,
Heidelberg Univ. (Germany, F.R.). Inst. fuer Umweltphysik.
K. H. Fischer, W. Weiss, O. Siebeck, and R. Muller.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 409-414, February, 1985. 1 Fig, 9 Ref.

Descriptors: *Lake Konigssee, *Turnover time, *Tritium, *Helium isotopes, Mixing, Diffusion, Gas exchange, Thermoclines, Temperature effects.

Two vertical tritium and helium-3 profiles fom December 1980 and September 1981 taken at a station near the deepest point of Lake Konigssee are presented. The tritium profiles indicate that water inflow by rivers is concentrated at shallow depth. The deep water renewal rate by inflowing rivers during winter 1980/81 deduced from tritium data is 10%, which corresponds to a water turnover time of 10 years. The deep water net oxygen consumption rate, that is based on the tritium - helium-3 age, amounts to 0.07 mg/l/month. Helium-3 gas exchange rates of 0.2 m/d during winter 1980/81 and 0.02 m/d during summer 1981 are calculated from the data. From the September 1981 profile a vertical eddy diffusion coefficient for tritium, helium-3 and temperature of 0.03 cm sq/sec is derived from the depth range between 6 m and 21 m, i.e. directly below the thermocline. These findings show that tritium - helium-3 measurements are a powerful tool for the study of the mixing behavior of lakes. The exceptionally small gas exchange rates found in Lake Konigssee may be caused by its particular geographical situation surrounded by high mountains, which protect the lake surface from strong winds. The tritium - helium-3 measurements in Lake Konigssee demonstrate only a weak regeneration capability of the deep water of the lake. Consequently Lake Konigssee represents an extremely sensitive ecosystem, which even with relatively small loads of nutrients is in danger of collapsing. (Baker-IVI)
W85-06395

TRANSFORMATIONS OF NITROGEN FOLLOWING AN EPILIMNETIC NITROGEN FERTILIZATION IN CASTLE LAKE, CA: 1. EPILITHIC PERIPHYTON RESPONSES,
California Univ., Davis. Div. of Environmental Studies.
J. E. Reuter, S. L. Loeb, R. P. Axler, R. G. Carlton, and C. R. Goldman.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 425-433, February, 1985. 2 Fig, 1 Tab, 20 Ref. NSF grant DEB 80-19918.

Descriptors: *Castle Lake, *California, *Nitrogen fixation, *Periphyton, Ammonia, Nitrates, Epilimnion, Algae, Dissolved solids.

Changes in inorganic nitrogen metabolism of a nitrogen fixing periphyton community were measured following an epilimnetic addition of NH4NO3 to N-deficient Castle lake, California in August of 1980 and 1981. Ambient concentrations of both ammonium and nitrate were reduced to pre-addition levels in 30 days in 1980 while these substrates were depleted in 16 and 26 days in 1981, respectively. The elevated dissolved inorganic-N (DIN) concentrations did not suppress nitrogenase activity and rates of nitrogen fixation were statistically similar during the pre- and post-addition periods. DIN levels > 700 micro-g NO3(-)-N and 70-700 micro-g NH4(+)-N/liter were needed to totally inhibit nitrogen fixation. Under normal growing season conditions of low DIN nitrogen fixation is the major pathway for inorganic N incorporation. At ammonia-N and nitrate-N levels < 45 micro-g/liter, these substrates were assimilated simultaneously with no apparent preferential utilization. The ratios of ammonia to nitrate ions uptake ranged from 0.66 to 2.46. Since nitrogenase activity was not suppressed by a 20-fold DIN enrichment and since ammonia and nitrate were simultaneously assimilated, epilithic periphyton in Castle Lake are N-deficient and dependent upon N2-fixation during the summer when ambient DIN levels are extremely low. (Baker-IVI)
W85-06397

OBSERVATIONS ON THE PHYTOBENTHOS OF THE FRESHWATER THAMES; I. THE ENVIRONMENT, FLORISTIC COMPOSITION AND DISTRIBUTION OF THE MACROPHYTES (PRINCIPALLY MACROALGAE),
British Museum of Natural History, London (England). Dept. of Botany.
D. M. John, and J. A. Moore.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 435-459, February, 1985. 3 Fig, 5 Tab, 34 Ref.

Descriptors: *Aquatic plants, *Benthic flora, *Thames, *England, Ecological distribution, Algae, Bryophytes, Seasonal variation, Macrophytes, Locks, Sluices, Weirs, Boats, Navigation.

The Thames is one of the most important lowland rivers in the British Isles, which much of its main watercourse engineered for navigation. This is the first general account of the composition, seasonality, and distribution of the benthic algae forming evident macroscopic growths in this lowland, hard-water river in southern England; some consideration is also given to other aquatic macrophytes. The headwater is fed by springs and flows for about nine months each year; a diverse and luxuriant aquatic vegetation develops rapidly on the river bed as the water level drops each spring in the seasonally-flowing headwater. Various assemblages of aquatic macrophytes develop further downriver in the permanently-flowing section that is too shallow for motor cruisers. Few plants occur on the bed of the very long and deep navigable section, except in the marginal shallow and on the floor of sluice channels and weir steps. In this section of the river, algae and bryophytes commonly form a band along the bank when the water level stabilizes for several weeks in summer. Such bands also develop in the sides of lock pounds, and on walls wetted by splash and spray. Local factors which influence the height and pattern of zonation include wash from boats, the nature of the substratum, and frequency of opening the sluices. (Moore-IVI)
W85-06398

UPTAKE OF CARBON AND INORGANIC NITROGEN IN A EUTROPHIC LAKE, LAKE NAKANUMA, JAPAN, FROM SPRING THROUGH SUMMER,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
T. Miyazaki, Y. Honjo, and S. Ichimura.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 473-485, February, 1985. 6 Fig, 1 Tab. 32 Ref.

Descriptors: *Carbon, *Nitrogen, *Eutrophic lakes, *Lake Nakanuma, *Japan, Seasonal variation, Ammonium, Nitrites, Nitrates, Carbon isotopes, Nitrogen isotopes, Particulate matter.

Sampling was done in a freshwater, eutrophic lake, Lake Nakanuma, Japan. The surface area and maximum depth of this lake are 1.3 ha and 13 m, respectively. Carbon and inorganic nitrogen uptake were measured simultaneously by the C-13 and N-15 method. Carbon uptake activity in the 1 m layer was 3.8 micro-g C/l/h in spring and 34 micro-g C/l/h in the summer stagnation period. Ammonium was most effectively incorporated into particulate matter fraction, followed by nitrate and nitrite. The activity of ammonium uptake in the layer ranged from 43 ng at N/l/h in spring to 216 ng at N/l/h in the summer stagnation period. Dark uptake of ammonium was 22-66% of light uptake in the 1 m layer. This percentage was higher than that of dark uptake of carbon. The difference between carbon and nitrogen uptake suggests that the uptake mechanism of carbon was different from that of nitrogen. (Moore-IVI)
W85-06400

SPECIES COMPOSITION, TEMPORAL ABUNDANCE AND COMMUNITY STRUCTURE OF ZOOPLANKTON IN LAKE SATTAL (U.P.), INDIA,
D.S.B. Constituent Coll., Naini Tal (India). Dept. of Zoology.
M. C. Pant, A. Joshi, and P. C. Sharma.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 519-535, February, 1985. 6 Fig, 6 Tab, 28 Ref.

Descriptors: *Species composition, *Zooplankton, *Lake SatTal, *India, Copepods, Rotifers, Cladocerans, Species diversity, Phytoplankton, Biomass, Trophic level.

Out of 22 species of zooplankton, only four species viz., Mesocyclops leuckarti, Daphnia similis, Anuraeopsis fissa and Keratella tropica were dominant in terms of number. The species composition and number reflected the characteristics of both temperate and tropical areas in Lake SatTal (India). Copepod and rotifers showed their peak abundance from August through October and remain segregated in 3-5 m water column; whereas cladocerans which peaked during winter tended to be

concentrated in the deeper strata (10-15 m) of the lake. The diversity was low due to dominance of only few species. The mean annual phytoplankton ratio to zooplankton biomass (P/Z) was 1.00 and 3.89 in western and eastern basins respectively. However, the resource partitioning between second and first trophic levels was not inefficient but energy transfer was more efficient between herbivores and primary carnivore. (Author's abstract)
W85-06401

STRIPED BASS MANAGEMENT IN LAKES WITH EMPHASIS ON MANAGEMENT PROBLEMS,
Kentucky Dept. of Fish and Wildlife Resources, Frankfort.
J. R. Axon, and D. K. Whitehurst.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 8-11, January, 1985. 3 Ref.

Descriptors: *Striped bass, *Fish management, *Water pollution effects, *Reservoir fisheries, Reservoirs, Dissolved oxygen, Thermal stress, Thermal pollution, Habitats.

The number of fisheries for striped bass Morone saxatilis in freshwater impoundments in the United States has increased dramatically over the last decade. A survey of fisheries agencies throughout the country was conducted to evaluate accomplishments and problems associated with management of striped bass and hybrid striped bass (male white bass Morone chrysops x female striped bass). Through 1981, fisheries for striped bass, hybrid striped bass, or both had been established in at least 279 lakes in 34 states. Mean annual harvest rates from striped bass, hybrid striped bass, and mixed (both fish in same lake) fisheries were 1.1, 0.7, and 3.0 kg/hectare, respectively. In reservoirs where they are established, these fisheries contribute an average of 13.6% to the total harvest by weight; their maximum contribution is 66.2%. Improvements in management have been limited by the lack of good objectives and of quantitative evaluations of stocking success. The most frequently cited management problem was mortality of adult striped bass due to thermal stress and to low dissolved oxygen concentrations. Other major problems included inadequate prey availability, emigration, predation on salmonids, and variable survival of introduced fish. Management potential can be greatly enhanced by additional information on the habitat requirements and predator-prey relations of these fish in impoundments. (Author's abstract)
W85-06402

SUMMER SELECTION OF THERMAL REFUGES BY STRIPED BASS IN ALABAMA RESERVOIRS AND TAILWATERS,
Alabama Dept. of Conservation and Natural Resources, Montgomery. Game and Fish Div.
J. L. Moss.
Transactions of the American Fisheries Society, Vol. 114, p 77-83, 1985. 2 Fig, 1 Tab, 13 Ref. Federal Aid in Fish Restoration project F-38.

Descriptors: *Striped bass, *Water temperature, *Fish behavior, *Reservoirs, *Alabama River, *Alabama, Ecological distribution, Habitats, Thermal refuges, Reservoir fisheries, Seasonal variation.

Routine sampling for striped bass in Alabama reservoirs during summer months was unsuccessful until June 1979 when adult striped bass were discovered concentrating in two spring-fed tributaries along the Alabama River. One area was 0.6 km below Millers Ferry Dam and the other was 0.6 km below Jones Bluff dam. Adult and subadult striped bass began concentrating in the spring-fed tributaries of the Alabama River in early June as ambient river temperatures approached 27 C. Fish collected from summer refuges had lower condition factors than those collected during April through May. Six striped bass (2.7-5.9 kg) equipped with ultrasonic and radiotelemetry transmitters tended to seek cool-water refuges (22-26 C) in reservoirs during summer, but they tolerated temperatures 5-6 C higher during excursions of several hours from or between refuges. If thermal refuges are important to the success of striped bass in southern reservoirs, they may control the carrying capacity of the system. (Moore-IVI)
W85-06407

DEPTH DISTRIBUTION OF STRIPED BASS AND OTHER FISH IN LAKE TEXOMA (OKLAHOMA-TEXAS) DURING SUMMER STRATIFICATION,
Oklahoma Univ., Kingston. Biological Station.
W. J. Matthews, L. G. Hill, and S. M. Schellhaass.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 84-91, January, 1985. 3 Fig, 18 Ref. DOE contract 14-16-009-82-018.

Descriptors: *Stratification, *Population density, *Seasonal variation, *Fish, *Lake Texoma, *Oklahoma, *Texas, Lakes, Water depth, Oxygen depletion.

In May and June 1982, before stratification, echolocator charts indicated that fish in the main basin of Lake Texoma (Oklahoma-Texas) were distributed from the surface to the bottom. With the onset of stratification and oxygen depletion in the hypolimnion in July, fish moved upward in the waters column, avoiding anoxic conditions near the bottom. Stratification (defined more conspicuously by dissolved oxygen and conductivity than by temperature) became progressively more distinct in late summer, and by August temperatures in the epilimnion were greater than 28 C and dissolved oxygen in the hypolimnion was less than 2 mg/liter. Echolocator charts indicated that fish were concentrated immediately above the chemocline (8-12 m deep) where water temperature was 28.5 C and dissolved oxygen was 7.2 mg/liter. This concentration of fish included subadult and adult striped bass Morone saxatilis, which are known to congregate in the main basin of Lake Texoma during the summer. Despite the high temperatures in the epilimnion, and low oxygen conditions in the hypolimnion, no mortality of adult striped bass was observed. Although the available data indicate that the temperature-oxygen 'squeeze' is typical in Lake Texoma in numerous summers, the reservoir has a large population of striped bass with many individuals larger than 5 kg. (Author's abstract)
W85-06408

UPTAKE OF PHOSPHATE AND INORGANIC NITROGEN BY A SEDIMENT-ALGAL SYSTEM IN A SUBARCTIC LAKE,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
S. Bjork-Ramberg.
Freshwater Biology, Vol. 15, No. 2, p 175-183, April, 1985. 5 Fig, 2 Tab, 35 Ref.

Descriptors: *Lake Gunillajaure, *Sweden, *Phosphates, *Nitrogen, *Phytoplankton, Absorption, Nutrients, Limnology, Stratification, Lake sediments, Algae.

Phosphate and inorganic nitrogen uptake by sediment and phytoplankton was studied under natural conditions in 1977 and during lake fertilization with phosphorus and nitrogen (1978-79) in Lake Gunillajaure, a small, stratified, subarctic lake in northern Sweden. The experiments were performed in situ in plexiglass cylinders, to which additions of nutrients were made, and the uptake followed by consecutive sampling and analysis of the water phase. Addition of HgCl2 to the experimental vessel inhibited phosphate uptake to the sediment very effectively, suggesting that the uptake by the sediment of Lake Gunillajaure was biological for the most part and that physical-chemical sorption was of minor importance. Phosphate uptake in the dark by the sediment was 30-40% of that in tubes exposed to light. Since light clearly stimulated the uptake it was probably the epipelic algae that dominated this procedure. A comparison of half-saturation constants for phosphate uptake by phytoplankton, both cultured and natural, and the epipelic algae of Lake Gunillagaure was performed. The epipelic algae and not the bacteria dominated the phosphate uptake. The uptake of ammonia-N and nitrate-N by the sediment was very slow indicating that the epipelic algae were not nitrogen-starved and perhaps that the nitrogen pool in the sediment was available to the algae. Even though the algae on the sediment apparently took up phosphate extensively and efficiently, phytoplankton took between 92% and 96% of the phosphate added on each fertilization. This was mainly an effect of the morphometry of Lake Gunillajaure which makes the water volume:sediment surface area in the epilimnion layer high and gives the phytoplankton competitive advantage over the epipelic algae. Even though the epipelic algae had a potential for efficient uptake of phosphorus, the phytoplankton took up 92-96% of the phosphate added to the lake on each fertilization occasion due to the relatively large water volume in the epilimnion in relation to the bottom area available for the epipelic algae. (Baker-IVI)
W85-06415

STABLE CARBON ISOTOPE RATIOS OF FISH AND THEIR INVERTEBRATE PREY IN FOUR NEW ZEALAND RIVERS,
Institute of Nuclear Sciences, Lower Hutt (New Zealand).
J. S. Rounick, and B. J. Hicks.
Freshwater Biology, Vol. 15, No. 2, p 207-214, April, 1985. 5 Tab, 17 Ref.

Descriptors: *Fish, *New Zealand, *Rivers, *Invertebrates, *Carbon isotopes, Carbon cycle, Food chain, Nutrients, Trout.

Sources of carbon utilized by invertebrates and fish in four New Zealand streams were investigated using stable carbon isotope analysis. A prerequisite for the use of stable isotope techniques in food-chain studies is an understanding of the amount of C13-fractionation (either enrichment or depletion) which normally occurs between food source and consumer. A second prerequisite for studies of this kind is that a measurable isotopic distinction exists between potential food sources. Utilization of carbon inputs by invertebrates showed some variation. The delta-C-13 values of invertebrates from the shaded HRB site were unusually enriched in C-13 relative to those from other studied forest streams in New Zealand. The cause of this additional C-13 enrichment relative to local C3 vegetation is unclear, but it is likely that an additional unknown C-13 enriched carbon source is contributing to the diet of the resident invertebrates. The delta-C-13 values for fish were not closely linked to aquatic invertebrate ratios. Instead, at all sites their carbon was isotopically similar to terrestrial organic carbon. (Baker-IVI)
W85-06416

ALKALINE PHOSPHATASE ACTIVITY AND CELLULAR PHOSPHORUS AS AN INDEX OF THE PHOSPHORUS STATUS OF PHYTOPLANKTON IN MINNESOTA LAKES,
Minnesota Univ., Minneapolis. Dept. of Botany.
M. A. Gage, and E. Gorham.
Freshwater Biology, Vol. 15, No. 2, p 227-233, April, 1985. 2 Fig, 1 Tab, 31 Ref.

Descriptors: *Alkaline phosphatase, *Phosphorus, *Phytoplankton, *Minnesota, *Lakes, *Lake Josephine, Nutrients, Seasonal variation, Organic matter, Stratification.

Nine lakes were investigated during 1975 in Clearwater and Hubbard Counties, Minnesota, one of them (Lake Josephine) throughout the year and the others during straification in late summer and early autumn. Total alkaline phosphatase activity is inversely related to cellular phosphorus in the particulate organic matter on waters above and below the thermocline in the nine lakes. Diagnostic criteria for assessing surplus and limiting levels of phosphorus, when applied to seasonal changes in phosphorus status in Lake Josephine, demonstrate severe phosphorus starvation in late summer and autumn. (Baker-IVI)
W85-06418

ECOLOGY OF THE SULDALSLAGEN RIVER IN WESTERN NORWAY BEFORE ITS REGULATION,
Oslo Univ. (Norway). Zoological Museum.

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A. Lillehammer.
Fauna Norvegica, Vol. 5, p 22-30, 1984. 7 Fig, 3 Tab, 19 Ref.

Descriptors: *River Suldalslagen, *Rogaland, *Norway, Macroinvertebrates, Seasonal variation, Biomass, Ecology.

The River Suldalslagen, 22 km in length, situated in Rogaland province in western Norway, has been studied over a period of four years. The macro-invertebrate benthos was low in abundance especially in August and September. The main biomass was contributed by large case-bearing caddis-fly larvae, such as Potamophylax latipenis, which are shredders. The fauna composition of the upper and lower reaches of the river differed widely. Filter feeders, such as the caddis fly Polycentropus flavomaculatus, occurred in large numbers below the lake outlet, while shredders were predominant in the lower reaches. Large quantities of planktonic Crustacea, washed out to the Suldalsvatn Lake, were present in the river during the summer months. The Suldalslagen river is primarily a recruitment area for salmon and sea trout. Interestingly, the diet of the young salmonids did not show a close relationship to the available invertebrate biomass. For example, young salmon almost completely neglected the large caddis-fly larvae, while planktonic Crustacea washed out from Suldalsvatn and adult insects were taken in large numbers. A large proportion of the food supplies of both the salmon fry and parr were thus produced outside the river system. In 1962, for example, 34% of the food of the parr and 43% of that of the fry was produced in other ecosystems than the river one. (Author's abstract)
W85-06442

QUANTITATIVE ESTIMATES AND COMMUNITY STRUCTURE OF INVERTEBRATES IN A MACROPHYTE RICH STREAM,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
T. M. Iversen, J. Thorup, T. Hansen, J. Lodal, and J. Olsen.
Archiv fur Hydrobiologie, Vol. 102, No. 3, p 291-301, Januray, 1985. 4 Tab, 18 Ref.

Descriptors: *Invertebrates, *Susa River, *Denmark, Fauna, Macrophytes, Vegetation.

The invertebrate fauna of the Danish river Susa was split up into two components: the vegetation fauna and the benthic fauna. These were sampled separately. Numbers of invertebrates/g macrophyte differed in some invertebrate taxa significantly between the three species of macrophyte studied. In July 1979 a total population of 450,000 ind./sq m was estimated, most of which were found in the vegetation (95%). Chironomidae made up 79% of the fauna. Filter feeders and epiphytic grazers were the dominant functional groups in the invertebrate community. (Author's abstract)
W85-06443

CHEMICAL STATE OF FOREST SPRINGS IN THE KAUFUNGER WALD (CHEMISCHER ZUSTAND VON QUELLEN IM KAUFUNGER WALD),
Goettingen Univ. (Germany, F.R.). Abt. Bodenkunde und Waldernahrung.
J. Puhe, and B. Ulrich.
Archiv fur Hydrobiologie, Vol. 102, No. 3, p 331-342, January, 1985. 9 Fig, 1 Tab, 21 Ref.

Descriptors: *Kaufunger Wald, *Saxony, *Chemical analysis, Springs, Forests, Water analysis, Organic carbon, Acidity, Metals, Nitrates, Sulfates, Phosphates, Water quality.

In the Kaufunger Wald in southern Lower Saxony the cation and anion composition of springs emerging in forests has been investigated. The chemical analysis covered pH, organic carbon Na, NH4, K, Mg, Ca, Al, Mn, Fe, Zn, Cu, Pb, Cd, and the anions Cl, NO3, SO4 and PO4. The springs on the exposed west side of this hill area emerge from acidified soil layers; with pH values around 3.7 they are strongly acidic and contain Al and heavy metals. Aquatic life seems to have no chance in these waters. The east side springs which pass through deeper layers have a good quality. (Author's abstract)
W85-06444

APPLICABILITY OF THE STABLE ISOTOPE METHOD USING 13C AND 15N SIMULTANEOUSLY TO THE ESTIMATION OF CARBON AND NITROGEN ASSIMILATION IN A EUTROPHIC, FRESHWATER LAKE, LAKE NAKANUMA, JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
T. Miyazaki, Y. Honjo, and S. E. Ichimura.
Archiv fur Hydrobiologie, Vol. 102, No. 3, p 355-365, January, 1985. 6 Fig, 2 Tab, 22 Ref.

Descriptors: *Lake Nakanuma, *Japan, *Phytoplankton, Carbon, Nitrogen, Lakes, Eutrophic lakes.

Simultaneous measurements of carbon and nitrogen uptake were applied to a eutrophic, freshwater lake, Lake Nakanuma, Japan. Stable isotopes 13C and 15N, were used to measure the amounts and isotope ratios of carbon and nitrogen simultaneously with a quadrupole mass spectrometer equipped with a combustion furnace. Addition of inorganic nitrogen (ammonium, nitrite, nitrate) did not affect the uptake activity of acrbon. Similarly, the addition of sodium bicarbonate did not influence the nitrogen uptake activity. One possible explanation for the results is that in situ concentrations of total carbon dioxide and inorganic nitrogen were in the range of saturation uptake. Comparison of C:N assimilation ratios and C:N ratios of particulate matter suggests that carbon and nitrogen metabolisms were not necessarily closely linked to each other. The results indicate that the application of the stable isotope method is useful to studies on phytoplankton in freshwater systems. (Baker-IVI)
W85-06445

SPECIES COMPOSITION OF ZOOPLANKTON IN TWO KUMAUN HIMALAYAN LAKES (U.P., INDIA),
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
P. C. Sharma, and M. C. Pant.
Archiv fur Hydrobiologie, Vol. 102, No. 3, p 387-403, January, 1985. 4 Fig, 6 Tab, 43 Ref.

Descriptors: *Zooplankton, *Lakes, *Himalayan lakes, Species composition, Rotifers, Copepods, Seasonal variation, Population diversity, Littoral zone.

The species composition of zooplankton in two Kumaun Himalayan lakes has been determined on the basis of year round samples. A total of 88 species comprising 66 Rotifera, 7 Copepoda and 15 Cladocera were collected and identified during the course of the present investigation. Zooplankton assemblage exhibited a type of seasonality closer to a temperate situation yet the species diversity and limnetic species composition reflected the characteristics of tropical or subtropical water bodies. The littoral zone harbored a greater variety of organisms compared to limnetic ones in both the lakes. The Qualitative Similarity Index (QSI) reflected a higher degree of similarity between the two lakes. QSI worked out between different zones displayed a higher degree of similarity (0.96) between the limnetic zones, as compared to littoral ones (0.82) of the two lakes. A succession of rotifer species with the march of the season was also discussed. A well defined correlation of two parameters, namely temperature and food with the total zooplankton species was found in the two lakes. The differences in the organic enrichment of the two lakes seemed to influence their species composition. (Author's abstract)
W85-06446

VERTICAL DISTRIBUTION OF ZOOPLANKTON AND PHYSICO-CHEMICAL CONDITIONS DURING A 24-HOUR PERIOD IN AN AMAZON FLOODPLAIN LAKE - LAGO CALADO, BRAZIL,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
T. R. Fisher, J. M. Melack, B. Roberston, E. R. Hardy, and L. F. Alves.
Acta Amazonica, Vol. 13, No. 3-4, p 475-487, July, 1983. 6 Fig, 1 Tab, 29 Ref.

Descriptors: *Lake Lago Calado, *Brazil, *Vertical distribution, *Zooplankton, Physicochemical properties, Crustaceans, Water level, Anoxic conditions, Oxygen, Thermocline.

In May 1980 Lago Calado was 9 meters deep, the water level was rising slowly, and below 4 meters the water was anoxic. Virtually all of the zooplankton was in the oxygenated layer. Adult and juvenile Daphnia gessneri, the most abundant crustacean species, occurred between 0.5 and 4.5 meters. Copepod nauplii tended to occur nearer to the surface, in the 0-2 meter stratum. No clear vertical migration was observed. The epilimnion was undersaturated (< 40% oxygen) and contained < 0.1 microM phosphate, ammonium and nitrate. The hypolimnion contained substantial phosphate (> 2 microM) and ammonium (> 5 microM), but little nitrate (< 0.1 microM). A peak in particulate carbon and nitrogen occurred between 4-5 meters, just below the thermocline, and was associated with a pigment maximum. (Author's abstract)
W85-06449

FINE STRUCTURE OF THE VERTICAL DISTRIBUTION OF ORGANIC AND INORGANIC PHOSPHORUS (TONKAYA STRUKTURA VERTIKAL'NOGO RASPREDELENIYA ORGANICHESKOGO I MINERAL'NOGO FOSFORA),
V. V. Sapozhnikov, and V. L. Zubarevich.
Okeanologiya, Vol. 24, No. 5, p 772-776, November/December, 1984. 2 Fig, 7 Ref.

Descriptors: *Phosphorus, *Vertical distribution, *Lakes, Euphotic zone, Photosynthesis, Nitrates, Silicates, Minerals, Intermittent lakes, Intermittent streams.

Fine vertical structure of organic and inorganic phosphorus has been studied in the euphotic layer and in the intermittent waters. It is suggested that the maxima of organic phosphorus and oxygen at the depth of 20 meters result from the intensive development of the photosynthesis processes during the day-time which are accompanied by the assimilation of inorganic phosphorus, nitrates and silicate. In the night-time metabolic matter is accumulated in the same layer, which results in an increase of mineral and organic forms of phosphorus, nitrogen and silicate, accompanied by oxygen consumption. (Author's abstract)
W85-06457

AGGREGATES OF ORGANIC SUBSTANCES IN FRESH WATERS AND THEIR ROLE IN NUTRITION OF FILTER FEEDING CLADOCERS (AGREGATY ORGANICHESKIKH VESHCHESTV V PRESNYKH VODAKH I IKH ROL'V PITANII RACHKOV-FIL'TRATOROV),
M. A. Kuznetsova, O. V. Orlova, and A. B. Savinov.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 3-8, 1984. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Dissolved solids, *Aquatic animals, Films, Organic matter.

Dissolved organic substances (DOS) of a protein nature in fresh water can change to an aggregate state, forming films on the surfaces of air bubbles or mineral particles. After the bubble failure, the films, ranging from 3 to 48 microm thick, remain in the water strata. In the cases where the films form on the mineral particle surface, they are 35-60 microm thick. These formations occur in experiments with the initial DOS concentration of 3 mg/l amounting to 1 to 50,000 particle/l depending on the size. DOS in such a form are consumed by filter animals. Experiments with cladocers show that addition of different DOS aggregates enhances the growth rate and fecundity of cladocers. The accumulation of labelled carbon 14C in the cla-

docer body is indicative of the OS aggregate incorporation in the animal metabolism. (Author's abstract)
W85-06458

RELATION BETWEEN CERTAIN COMPONENTS OF PLANKTONIC COMMUNITY AND THE CONTENT OF PHOSPHATES AND OXYGEN IN WATER (VZAIMOSVYAZI MEZHDV NEKOTORYMI KOMPONENTAMI PLANKTONNOGO SOOBSHCHESTVA I SODERZHANIEM FOSFATOV I KISLOROBA V VODE),
Y. S. Chuikov, and A. A. Strogonov.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 9-17, 1984. 1 Fig, 3 Tab, 26 Ref.

Descriptors: *Zooplankton, *Phosphates, *Dissolved oxygen, *Volga delta, Eutrophic lakes, Population dynamics, Water pollution effects.

Correlation dependences were studied between indices of zooplankton development and the contents of phosphates and oxygen dissolved in water bodies subjected to an eutrophic effect from birds settling in the Volga delta. Estimates are given for the value and direction of relations between phosphate and oxygen concentrations in water, between these indices and zooplankton numbers and biomass as a whole, and between numbers and biomass of Rotatoria, Copepoda and Cladocera. All the studied systematic groups of planktonic invertebrates respond as a single system to environmental variations. At the same time the relation of various systematic groups of invertebrates to the investigated factors is different. Variations in the amounts of Cladocera are most closely related to changes in phosphate concentrations in water, those of Copepoda are less close. Rotatoria reveal no significant relations of concern. As to the content of oxygen dissolved in water, the systematic groups of the invertebrates are arranged in an inverse order. (Author's abstract)
W85-06459

MICROFLORA OF BOTTOM SEDIMENTS IN THE NAROCH LAKE (MIKROFLORA DONYKH OTLOZHENII OZ. NAROCH'),
G. A. Inkina, O. N. Savelieva, and O. M. Itkina.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 49-52, 1984. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Bottom sediments, *Microflora, *Naroch Lake, *Lakes, Bacteria.

Data on the quantity, biomass, and number duplication times are given for bacteriobenthos of various types in Naroch Lake. From these results the role of microorganisms in biological water self-purification and quality control may be assessed more completely. (Author's abstract)
W85-06460

PRIMARY PLANKTON PRODUCTION OF LAKE SHARTASH (PERVICHNAYA PRODUKTSIYA PLANKTONA V OZ. SHARTASH),
G. V. Bardysheva, and A. P. Vasilchikova.
Gidrobiologischeski Zhurnal, Vol. 21, No. 2, p 9-12, 1984. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Primary productivity, *Phytoplankton, *Lakes, *Lake Shartash, Productivity, Aquatic produtivity.

Information on the primary phytoplankton production is given for Lake Shartash. The findings characterize the lake as a water body of high productivity. (Author's abstract)
W85-06465

TYPOLOGICAL CHARACTERISTICS OF LATVIAN LAKES FOR INFUSORIA SPECIES COMPOSITION (TIPOLOGICHESKAYA KHARAKTERISTIKA OZER LATVII PO VIDOVOMV SOSTAVU INFUZORII),
R. A. Liepa.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 13-17, 1984. 1 Tab, 17 Ref.

Descriptors: *Zooplankton, *Species composition, *Lakes, Benthos, Oligotrophic lakes, Eutrophic lakes, Eutrophication, Trophic levels.

Studies were made of protozooplankton and benthos in two lakes which represent two different types of oligotrophic-eutrophic succession, the oligotrophic Vaidavas and the polytrophic Kiruma lakes of the Latvian SSR. The study shows that infusoria species diversity of the oligotrophic lake is higher than that of the polytrophic lake, and the quantitative development of infusoria is lower. Both lakes reveal a littoral-to-pelagial increase in trophy, with distinctions between littoral communities of protozooplankton and protozoobenthos being slightly pronounced after the polytrophic state is reached. (Author's abstract)
W85-06466

TROPHIC STRUCTURE OF BIOCENOSES IN THE TSIMLYANSKOE RESERVOIR BENTHOS (TROFICHESKAYA STRUKTURA BIOTSENOZOV BENTOSA TSIMYLANSKOGO BODKHRANILISHCHA),
M. P. Miroshnichenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 28-35, 1984. 5 Fig, 6 Tab, 22 Ref.

Descriptors: *Tsimlyanskoe Reservoir, *Trophic levels, *Fish, Benthic fauna, Aquatic animals, Reservoirs.

Pecularities in the trophic structure of biocenoses of benthos living in the Tsimlyanskoe Reservoir are reported. The findings were revealed during an analysis of the food relationships of various benthic animals. From the findings it was possible to estimate the food basis of benthophage fishes living in the reservoir. (Author's abstract)
W85-06467

METHODOLOGICAL PRINCIPLES FOR ECOLOGICAL CLASSIFICATION OF SURFACE WATER QUALITY (O METODOLOGICHESKIKH OSNOVAKH EKOLOGICHESKOI KLASSIFIKATSII KACHESTVA POVERKHNOSTNYKH VOD SUSHI),
For primary bibliographic entry see Field 5A.
W85-06473

NECESSITY OF CREATION OF UNIVERSAL WATER QUALITY CLASSIFICATION (O NEOBKHODIMOSTI SOZDANIYA UNIVERSAL'NOI KLASSIFIKATSII KACHESTVA VOD),
For primary bibliographic entry see Field 5A.
W85-06474

EVALUATION OF SAPROBIC CHARACTER OF CERTAIN SMALL RESERVOIRS OF THE UKRAINE FOR PHYTOPLANKTON (OTSENKA SAPROBNOSTI NEKOTORYKH MALYKH VOVOKHRANILISHCH UKRAINY PO RITOPLANKTONU),
For primary bibliographic entry see Field 5C.
W85-06475

ABIOTIC ENVIRONMENTAL FACTORS AND PRIMARY PRODUCTION OF WATER BODIES OF THE KOVDA RIVER BASIN (ABIOTICHESKIE FAKTORY STEDY I PERVICHNAYA PRODUKTSIYA VODOEMOV BASSEINA R. KOVDY),
N. S. Kharkevich, A. V. Sabylina, M. I. Basov, I. G. Vislyanskaya, and E. A. Klyukina.
Gidrobiologischeski Zhurnal, Vol. 20, No. 5, p 16-24, 5 Fig, 5 Tab, 9 Ref.

Descriptors: *Water chemistry, *Primary productivity, *Kovda River Basin, Phytoplankton, Biomass, Organic matter, Decomposition, Chlorophyll, Macrophytes, Aquatic plants.

The paper presents a hydrochemical characteristic of Top Lake, Pija Lake, and Kovd Lake, including data on phytoplankton biomass (its mean and maximum values for all seasons), organic matter production and destruction. A quantitative characteristic of the chlorophyll content in the lacustrine phytoplankton is given. An attempt is made to calculate the diurnal assimilation number. Phytomass of macrophytes is determined on the whole for each water body. (Author's abstract)
W85-06480

INTENSITY OF DENITRIFICATION IN THE RYBINSK RESERVOIR GROUNDS (INTENSIVNOST' DEMITRIFIKATSII V GRUNTAKH RYBINSKOGO VODOKHRANILISHCHA),
For primary bibliographic entry see Field 2J.
W85-06481

CHLOROPHYLL A IN WATER OF LAKE BAIKAL (KHLOROFILL A V VODE OZ.BAIKAL),
For primary bibliographic entry see Field 5B.
W85-06483

STUDY OF A SHALLOW CARP (CYPRINUS CARPIO L.) POND AND ITS RELEVANCE TO INLAND FISH FARMING IN LIBYAN JAMAHIRIYA,
Garyounis Univ., Benghazi (Libya). Dept. of Zoology.
For primary bibliographic entry see Field 8I.
W85-06486

CHECKLIST OF THE SPECIES OF FISHES IN LAKE MAUREPAS, LOUISIANA,
Southeastern Louisiana Univ., Hammond. Dept. of Biological Sciences.
T. Millican, D. Turner, and G. Thomas.
Louisiana Academy of Sciences, Vol. 47, p 30-33, December, 1984. 3 Ref. NOAA grant NA-83-AAA-D-CZ025.

Descriptors: *Population dynamics, *Fish, *Lake Maurepas, *Louisiana, Estuarine environment, Lakes, Data collection.

Lake Maurepas, a large Louisiana estuarine lake located west of Lake Pontchartrain, encompasses a surface area of 5800 acres with a mean depth of 2.53 m. Preliminary sampling in the fall through spring of 1983 to 1984 of Lake Maurepas yielded a catch of 22 families, 29 genera, and 39 species of fish. Gillnets and trawls were used as the main types of collecting gear. The majority of fishes collected, 24 species, are considered freshwater residents, and 15 species are euryhaline or marine transients. Comparison of these results with prior investigations are inconclusive due to variations in gear type, seasons, length of study, and because they combined samples obtained from Lake Pontchartrain and Maurepas. (Baker-IVI)
W85-06488

LATERAL SOLUTE CONCENTRATION GRADIENTS IN STRATIFIED EUTROPHIC LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Water Resources Research, Vol. 21, No. 4, p 554-562, April, 1985. 6 Fig, 5 Tab, 29 Ref. EPA Research grant R805-281.

Descriptors: *Eutrophic lakes, *Dissolved oxygen, *Phosphorus, *Lake Mendota, *Green Lake, *Wisconsin, Lake sediments, Eddy diffusion, Metalimnion, Hypolimnion, Shelf sediments, Solute transport.

Lateral concentration gradients in dissolved oxygen and phosphorus were studied in the metalimnion of Lake Mendota and the hypolimnion of Green Lake, Wisconsin. Oxygen concentrations were invariably lower (by up to 4.5 mg/L) in the 3-m interval overlying shelf sediments as compared to adjacent stations in deeper water. Conversely, phosphorus concentrations were up to 65 mg/cu m higher overlying the shelves. In Mendota, the 'shelf shift' - Delta O/Delta P, was low as compared to expectations based on Redfield's equation for the aerobic oxidation of sedimenting phytoplankton; this difference indicates a net sediment release of P under aerobic conditions, corroborating laboratory studies. For Lake Mendota a phos-

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phorus profile at the deep hole station underestimates total lake phosphorus by cira 3% in midsummer. Because of its elongated asymmetric basin and related factors, the deep hole sampling bias is larger (cira 15%) for Green Lake. Based on lateral oxygen gradients and flux-gradient computations, the lateral eddy diffusivity is 200,000 sq m/day in the metalimnion of Mendota and the hypolimnion of Green Lake. (Author's abstract)
W85-06509

WAVE DISTURBANCE ON LAKESHORES AND THE WITHIN-LAKE DISTRIBUTION OF ONTARIO'S ATLANTIC COASTAL PLAIN FLORA,
Ottawa Univ. (Ontario). Dept. of Biology.
P. A. Keddy.
Canadian Journal of Botany, Vol. 63, No. 3, p 656-660, March, 1985. 3 Fig, 1 Tab, 29 Ref.

Descriptors: *Wave action, *Lake shores, *Plants, *Ecological distribution, *Axe Lake, *Ontario, Substrates, Water level fluctuations, Shores, Nutrients, Particle size.

Although water level fluctuations may explain the persistence of Atlantic coastal plain species in certain Georgian Bay lakes, they cannot explain the within-lake distribution of this flora. To test whether the within-lake distribution of these species was correlated with disturbance from waves, 25 transects were quantitatively sampled along an exposure gradient in Axe Lake, Ontario. The proportion of Atlantic coastal plain species in a transect increased significantly with exposure ($p < 0.01$). Total frequency of Atlantic coastal plain species reached a maximum at an intermediate level of exposure. Analysis of substrate samples showed that the exposure gradient is a multivariate gradient including not only biomass removal by waves, but sorting of the shoreline substrate. The coarse, nutrient poor sites on exposed shore may allow the persistence of Atlantic coastal plain species in at least two different ways. Their physiological tolerance limits may be narrowly specialized on exposed shorelines. Alternatively, their physiological tolerances may include a broad range of shoreline types, but competition restricts them to those sites least suitable for other species. (Author's abstract)
W85-06518

ELEMENT ACCUMULATION AND RELEASE BY MACROPHYTES IN A WETLAND STREAM,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
J. H. Peverly.
Journal of Environmental Quality, Vol. 14. No. 1, p 137-143, January/March, 1985. 2 Fig, 4 Tab, 32 Ref. OWRT grant A-079-NY.

Descriptors: *Macrophytes, *Streams, *Wetlands, Oak Orchard Creek, New York, Plant growth, Nitrogen, Phosphorus, Potassium, Aquatic plants, Nutrients, Stream sediments.

Aquatic macrophyte growth and element accumulation was measured seasonally for 1 yr in Oak Orchard Creek, NY, and compared with stream element loads. The stream flows from drained and cultivated wetland soils upstream into undisturbed wetlands downstream. The stream was calcareous and near saturation with CO2 most of the time. It was enriched with dissolved N, P, and K in both water and sediments, especially just below the cultivated area. Plant biomass was greatest at the lower end of the wetlands in July, ranging up to about 600 g dry wt/sq m and consisting mostly of elodea (Elodea canadensis Michx.) and curlyleaf pondweed (Potamogeton crispus L.). Maximum net biomass accumulation rate was about 0.06 mg C/sq m/s for sago pondweed (Potamogeton pectinatis L.). Element concentrations in plant tissues were above limiting levels and showed no definite relationship to season or species, although instream emergent plants showed a fall decrease in major nutrients (N, P, and K). Tissue nutrient concentrations were related to position in stream, increasing as the nutrient concentrations increased in the water. Maximum nutrient load contained by the plants occurred in July, which corresponded to the maximum standing crop. Potential contributions of major nutrients to the creek from plant senescence that occurred instream ranged from 10 to 100% in summer and fall. However, this contribution is 1 to 2% of total annual stream nutrient load. (Author's abstract)
W85-06625

CHEMICAL COMPOSITION OF AQUATIC VEGETATION IN SOME TYPICAL WETLANDS OF KASHMIR,
Himachal Pradesh Univ., Simla (India). Dept. of Biosciences.
S. Kaul.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 47-57, 1983. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Aquatic plants, *Wetlands, *Chemical composition, *Kashmir, *India, Calcium, Magnesium, Sodium, Potassium, Phosphorus, Nitrogen, Macrophytes, Litter.

The mineral content in macrophyte below-ground biomass, above-ground biomass and litter was investigated in five wetlands in the valley of the river Jehlum, in Kashmir, India. The concentrations of calcium, magnesium, sodium, potassium, phosphorus and nitrogen in the dry matter were determined in March, May, July, September, November, and January. Na, P, K and Ca showed decreasing concentrations from spring to autumn. Na and Mg concentrations showed an irregular trend. On the whole, the incorporated mass of substances per unit of area increases in the course of the period of vegetation for the below-ground biomass as well as the above-ground biomass. In general, significant variations were observed with regard to both time and site differences in mineral constituents; P and K of litter were the only exceptions, where significant variations with respect to time were not observed. Ca and N did not show any significant variation with regard to site. The mineral content in litter is comparatively lower than in the fresh biomass. This can be attributed to the invasion of the dead tissues by bacteria and fungi, and the leaching out of the nutrients from withering tissues. (Moore-IVI)
W85-06651

OXYGEN CONCENTRATION OF WATERS OF THE FELDBERGER LAKE DISTRICT ON THE BASIS OF SELECTED SUMMER DEPTH PROFILES FROM 1924 THROUGH 1962. PART 2: ZANSEN, WOOTZEN, CARWITZER LAKE, DREETZ AND KRUSELIN (ZUM SAUERSTOFFHAUSHALT DER GEWASSER DER FELDBERGER SEENPLATTE AN HAND AUSGEWAHLTER SOMMERLICHER TIEFENPROFILE SEI 1924 BZW. 1962, TEIL 2: ZANSEN, WOOTZEN, CARWITZER SEE, DREETZ UND KRUSELIN),
Bonito A.G., Osterburg (German D.R.).
W. M. Richter.
Acta Hydrochimica et Hydrobiologies, Vol. 11, No. 1, p 59-73, 1983. 5 Fig, 2 Tab, 35 Ref.

Descriptors: *Dissolved oxygen, *Depth profiles, *Zansen, *Wootzen, *Carwitzer, *Dreetz, *Kruselin, *Germany (Federal Republic), Metalimnion, Transparency, Water temperature, Hydrogen sulfide, Eutrophication, Water quality, Hydrography.

For the four lakes of the lower Feldberg lake district as well as for the Kruselin, situated on the periphery of the lake district, summer depth profiles of the oxygen concentration together with the metalimnion, transparency, water temperature and the depth limit of the occurrence of hydrogen sulfide are represented for the period from 1924 or 1962 to 1980. The profiles very clearly demonstrate the progressive eutrophication of these lakes, but also the beginning of improvement of the quality of their water. Important data on hydrography as well as the possibilities of restoration are discussed. (Author's abstract)
W85-06652

SEDIMENTATION AND SEDIMENT ANALYSIS IN MUGGEL LAKE (SEDIMENTATION UND SEDIMENTANALYTIK IM MUGGELSEE),
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
G. Mothes.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 75-99, 1983. 14 Fig, 1 Tab, 25 Ref.

Descriptors: *Sedimentation, *Sediments, *Muggel Lake, *German Democratic Republic, Carbon, Nitrogen, Phosphorus, Primary productivity, History, Lake restoration.

Organically bonded carbon which sediments during the period of vegetation growth in Muggel lake amounts to 10% of the carbon quantity which is bonded by primary production during that time period. The lake is one of the water supply sources for the capital of the German Democratic Republic. The sedimentation behavior is discussed, as is the composition of sediments with regard to their content of combined carbon, nitrogen and phosphorus and other substances. Conclusions are presented concerning the history of Muggel Lake for past centuries and the possibility of restoring it. (Author's abstract)
W85-06653

ROLE OF THE LITTORAL (SHALLOW) ZONE IN RESERVOIR PRODUCTIVITY,
Central Inland Fisheries Research Inst., Mirzapur (India). Sub-Center Rihand Dam.
P. K. Smith.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 101-107, 1983. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Reservoirs, *Rihand Reservoir, *India, *Littoral environment, *Productivity, Transparency, Calcium, Magnesium, Physicochemical properties, Seasonal variation, Dissolved oxygen, Silicates, Bicarbonates, Carbon dioxide.

The Rihand reservoir (India) which is used for hydroelectricity generation has a surface area of 46,588 ha, a capacity of 10.6 cu km, and a shore line length of 561 km. Most of the elements dissolved in water were found at higher levels in the littoral zone than in the profundal zone. The higher concentration of dissolved oxygen in the littoral zone was mostly due to a high rate of photosynthesis and mixing. The low values of free carbon dioxide in the littoral zone are mainly due to its high consumption during photosynthesis as this zone was richer in phytoplankton. The high values of bicarbonate and the low values of carbon dioxide in the littoral zone indicated the conversion of carbon dioxide into bicarbonate with the association of hydroxyl ion. The consumption of nitrate and phosphorus by densely growing plankton crop was higher in the littoral zone than in the profundal zone. High values of calcium and magnesium ions and hardness in the littoral zone showed the greater release or calcium and magnesium ions from soil due to cation exchange and organic matter decomposition. Dissolved organic matter, silicate and iron followed the same trend as the other nutrients. The net and gross productions, mainly controlled by the plankton population, penetration of light and transparency were high in the littoral zone and low in the profundal zone, due to the variable conditions in the littoral zone. (Baker-IVI)
W85-06654

DO-PROCESS MODELS FOR SHALLOW SYSTEMS. PART 1: PONDS AND LAKES,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 2K.
W85-06655

PRODELTA ENVIRONMENT OF A FJORD: SUSPENDED PARTICLE DYNAMICS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Centre.
J. P. M. Syvitski, K. W. Asprey, D. A. Clattenburg, and G. D. Hodge.
Sedimentology, Vol. 32, No. 1, p 83-107, February, 1985. 27 Fig, 4 Tab, 48 Ref.

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Descriptors: *Fjords, *Butte Inlet, *British Columbia, *Prodelta environment, *Suspended solids, Deltas, Sedimentation.

Sediment-flux calculations for the prodelta environment are imprecise because of the sampling problem in relating sediment dynamics to variable flow conditions. This problem is less severe in fjords since the flow is confined by the walls. The dynamics of suspended particle within Butte Inlet, British Columbia, were investigated and the results compared with larger non-enclosed prodelta environments. In the upper prodelta, the seaward-flowing river plume flows over the ambient marine water depositing much of the initial riverine suspended load. Particles less than 10 micro m have similar settling velocities regardless of size because they settle in flocs: the settling velocity at a water depth of 5 m is 30 m/day and increases with depth so that at 30 m the particles settle at 100 m/day. For larger particles, the downward settling velocity enhancement due to flocculation decreases with increasing grain size. Particle dynamics in the lower prodelta are dependent on the character of the freshwater wedge that thins seaward of the upper prodelta. The vertical flux of particles is controlled by biogeochemical interactions such as pelletization of fine particles and flocculation which occurs within the surface layer. The pellets are produced by indiscriminate filter feeding zooplankton. Across the lower prodelta the suspensate character, recognized in the composition of both flocs and pellets, changes from a dominance of mineral grains to that of autochthonous organic matter. The interaction of bacteria with the suspended particles increases with depth and seaward distance. At depth, the mucoid filaments form stable interconnecting webs. Particle concentration in the surface layer decreases at rates proportional to the distance seaward but differently for the upper and lower prodelta. (Collier-IVI)
W85-06698

SEASONAL SUCCESSION AND MICROLAMINA FORMATION IN A MEROMICTIC LAKE DISPLAYING VARVED SEDIMENTS,
Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2J.
W85-06699

DISSOLVED SILICON IN A NORTH WALES CATCHMENT OF HIGH RELIEF,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
For primary bibliographic entry see Field 2K.
W85-06728

EFFECT OF STORMS ON NITRIFICATION RATES IN A SMALL STREAM,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 2K.
W85-06730

VEGETATION OF THREE MOUNTAIN MIRES, WEST TAUPO, NEW ZEALAND,
New Zealand Forest Service, Rotorua. Forest Research Inst.
B. R. Clarkson.
New Zealand Journal of Botany, Vol. 22, No. 3, p 361-375, 1984. 9 Fig, 2 Tab, 18 Ref, 3 Append.

Descriptors: *Vegetation, *Mires, *Taupo, *New Zealand, Wetlands, Drainage, Ferns, Sedges, Shrubs, Mosses, Trophic level, Pumice.

Vegetation is described at three mountain mires (informally named Ongarue A, B, and C) in the proposed Pureora Mountain Ecological Area, west Taupo, on the North Island of New Zealand. Data were collected from systematically-located plots, using a modified Braun-Blaunquet cover scale. Ordination techniques arranged the plots and species in a sequence from sedge-fernland through shrubland to forest, following a gradient of increasingly better drainage. Plot classification identified four mappable floristic groups which reflect drainage conditions and mire nutrient status. The central part of the mires comprises a mosaic of low vegetation types in which the dominant plant is the fern Gleichenia dicarpa. Sedges (Lepidosperma australe, Carpha alphina, Baumea rubiginosa), mosses (spagnum, Dicranoloma robustum), and a few low shrubs (monoao, manuka) vary in prominence with different drainage conditions. Ongarue A mire is predominantly oligotrophic according to Dobson's diagram of the relationship between mean temperature and overall fertility; local mesotrophic conditions, as a result of increased waterflow, are reflected by the presence of B. rubiginosa and, to a lesser extent, sphagnum. The smaller Ongarue B and C mires are mainly mesotrophic, with minor oligotrophic patches. Deposition of Taupo pumice may have caused a deterioration of drainage in Ongarue A mire, which may account for an apparent change in vegetation from a shrub mire to the present predominantly herbaceous mire. If no future disturbance(s) occurs, the Ongarue mires, particularly Ongarue A mire, can be expected to become increasingly oligotrophic. (Rochester-IVI)
W85-06785

FRESHWATER WETLAND VEGETATION OF VITI LEVU, FIJI,
University of the South Pacific, Suva (Fiji). School of Natural Resources.
J. Ash, and W. Ash.
New Zealand Journal of Botany, Vol. 22, No. 3, p 377-391, 1984. 9 Fig, 1 Tab, 16 Ref.

Descriptors: *Wetlands, *Vegetation establishment, *Viti Levu, *Fiji, *Pacific Islands, Bogs, Soil properties, Soil types, Drainage, Peat bogs, Land use.

Viti Levu is the largest island of the archipelago of the Fiji Islands. The island's wetlands are a prominent feature of the densely populated coastal areas of the high rainfall regions of the island and occur on Recent alluvium. Most of the wetlands formed after the sea reached its present level, and they have probably been affected by man through most of this time. The peat bogs developed as a result of forest clearance in areas of impeded drainage. The wetlands are classified into peat, colluvium-peat, gley soils, and brackish soils, and the vegetation is described for each of the major wetlands and substrate types. Most of the native wetland plant species also occur in dryland habitats. The majority of the plant species are recent introductions. The coastal wetlands are all formed in association with, and overlie, coastal landforms which have formed since the sea reached its present level 6000-3000 years ago. It is probable that man has been in Viti Levu for most if not the entire history of the present lowland freshwater wetlands; most of the lowland wet gley soils were cultivated up to the margins of the peat swamps. The natural vegetation of the freshwater gley soils is forest. The present vegetation represents the outcome of human disturbance. Areas which are cleared of trees are rapidly colonized by sedges, grasses, and herbs; if these herbaceous assemblages are not burned or grazed then shrubs and trees are soon established, and a tree assemblage eventually results. The combination of forest clearance, occasional cultivation and burning is probably sufficient to create peat bogs in areas of naturally impeded drainage. The dispersal of Sphagnum cuspidatum, Metroxylon vitiense, and Eleocharis dulcis is discussed. (Collier-IVI)
W85-06786

PREDICTING CONCENTRATION OF TOTAL PHOSPHORUS AND CHLOROPHYLL A IN A LAKE WITH SHORT HYDRAULIC RESIDENCE TIME,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
B. J. Premo, C. D. McNabb, F. C. Payne, T. R. Batterson, and J. R. Craig.
Hydrobiologia, Vol. 122, No. 3, p 231-241, March, 1985. 1 Fig, 6 Tab, 33 Ref.

Descriptors: *Phosphorus, *Chlorophyll a, *Residence time, *Skinner Lake, *Indiana, *Lakes, Nutrients, Nitrogen, Seasonal variation, Algae, Hydrology.

The relationship between total phosphorus and chlorophyll a concentration was determined for Skinner Lake, Indiana over an annual cycle in 1978-79. Total nitrogen:total phosphorus ratios in the epilimnion ranged from 19 to 220 suggesting a phosphorus-dependent algal yield in the epilimnion. Approximately 90% of annual TP loading reached the lake via streamflow, and 93% of this entered during snowmelt and spring-overturn periods. At that time incoming water flushed the lake 2.4 times. Atmospheric loading accounted for 1.4% of annual TP load. Internal hypolimnetic TP loading occurred during summer stratification. Mean concentration of chl a for the ice-free period was 15.15 mg/cu m, within the range expected for eutrophic lakes. The 1978-79 data were used in conjunction with the Vollenweider and Kerekes model to produce a model specific for the Skinner Lake system. The model predicted mean epilimnetic total phosphorus and chlorophyll a concentrations from mean total phosphorus concentration in inlet streams and from lake water residence time during the period of spring overturn and summer stratification. The Skinner-specific model was tested in 1982 and it closely predicted observed mean epilimnetic TP and chl a concentrations during the ice-free period. Variability in lake models which average data over an annual period can be reduced by considering lake-specific seasonal variation in hydrology and external TP loading. (Author's abstract)
W85-06789

QUANTITY AND QUALITY OF SESTON IN AN IMPOUNDED AND A FREE-FLOWING RIVER IN VIRGINIA, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Entomology.
J. R. Voshell, Jr., and C. R. Parker.
Hydrobiologia, Vol. 122, No. 3, p 271-280, March, 1985. 3 Fig, 5 Tab, 42 Ref.

Descriptors: *Seston, *Reservoirs, *Virginia, *North Anna River, *South Anna River, *Ecological effects, Particle size, Rivers, Resources development, Zooplankton, Diatoms, Algae.

Seston in the impounded North Anna River (NAR) was analyzed and compared to that in the free-flowing South Anna River (SAR) in Virginia, U.S.A. A wet filtration technique was used to separate seston into five size classes. The overall quantity of organic seston was much lower in the NAR than in the SAR. The seston in the NAR was composed of more living organisms, in particular zooplankters in the medium large (234-864 micro m) and small (105-234 micro m) size classes and diatoms and other algae in the fine (43-105 micro m) and very fine (25-43 micro m) size classes. The percentage of zooplankton declined sharply before reaching the downstream study site (32 km). The seston in the NAR tended to consist of slightly larger particles, but 80-85% of the seston in both rivers was in the ultrafine (0.45-25 micro m) size classes, which was almost entirely composed of detritus. One indication of seston food quality, the organic/inorganic ratio, was considerably higher for the medium large and small size classes in the NAR immediately below the dam and for the fine and very fine size classes farther downstream. Another indication of food quality, the usable caloric content, showed that the seston in the NAR contained considerably less total assimilable energy as far as 32 km downstream from the dam, but that the medium large and small size classes were rich in assimilable energy immediately below the dam because of zooplankton released from the reservoir. Thus, the overall quantity and quality of seston was lower in the NAR, but the quality of the seston, for at least a short distance below the dam, was higher in a well-defined size range that can be effectively utilized by certain filter feeders. (Author's abstract)
W85-06791

BENTHIC COMMUNITY METABOLISM IN FOUR TEMPERATE STREAM SYSTEMS: AN INTER-BIOME COMPARISON AND EVALUATION OF THE RIVER CONTINUUM CONCEPT,
Academy of Natural Sciences of Philadelphia,

Avondale, PA. Stroud Water Research Center.
T. L. Bott, J. T. Brock, C. S. Dunn, R. J. Naiman, and R. W. Ovink.
Hydrobiologia, Vol. 123, No. 1, p 3-45, April, 1985. 13 Fig, 16 Ref, 95 Ref. NSF grants BMS-7507333 and DEB-78-11671.

Descriptors: *Metabolism, *Benthos, *River continuum concept, *Pennsylvania, *Michigan, *Idaho, *Oregon, *Biomes, Ecology, Photosynthesis, Primary productivity, Respiration, Photosynthetically active radiation, Water temperature, Chlorophyll a, Productivity.

Benthic community metabolism was studied on four stream systems located in different biomes in the United States: the eastern deciduous forest (Pennsylvania, PA, and Michigan, MI), the high desert (Idaho, ID), and the coniferous forest (Oregon, OR). Studies were designed to test the hypothesis advanced within the River Continuum Concept that a transition in community metabolism will occur from a predominance of heterotrophy in headwaters to a predominance of autotrophy in mid-sized reaches, with a return to heterotrophy further downstream. Both gross primary productivity (GPP) and community respiration (CR sub 24) increased with downstream direction on all systems. Net daily metabolism (NDM, or GPP CR sub 24) shifted from heterotrophy (NDM, GPP < CR sub 24) to (+NDM, GPP > CR sub 24) with downstream direction at all sites, supported the hypothesis. Annual metabolism in the most upstream reach all sites was dominated by respiration; however, the farthest downstream reach was not necessarily the most autotrophic. Site-specific factors affected manifestation of the trend. Photosynthesis predominated annual metabolism in reaches (designated 1-4 in order of increasing size) 2-4 in ID, 3 and 4 in OR, and 4 in MI. In PA annual photosynthesis was slightly greater than respiration only at Station 3. Photosynthesis was predominant most consistently in ID and respiration most often in PA. About half the reaches that were heterotrophic annually were autotrophic at one or more seasons. Annual means of benthic GPP, CR sub 24 and NDM ranged from 0.16 to 3.37, 0.36 to 2.88 and 0.73 to 0.50 g O2/sq m/d, respectively. Metabolic rates were usually high in PA and MI (and sometimes ID) and almost always lowest in OR. Parameters accounting for most variance in multiple linear regression analyses of the combined metabolism data from all sites were indicators of stream size, photosynthetically active radiation, temperature, and chlorophyll a concentration. (Author's abstract)
W85-06792

PRIMARY PRODUCTIVITY AND SPATIAL STRUCTURE OF PHYTOLITHIC GROWTH IN STREAMS IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK, TENNESSEE,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
E. D. Keithan, and R. L. Lowe.
Hydrobiologia, Vol. 123, No. 1, p 59-67, April, 1985. 4 Fig, 3 Tab, 31 Ref.

Descriptors: *Primary productivity, *Benthos, *Algae, *Great Smoky Mountains National Park, *Tennessee, *Rocks, Logging, Ecological effects, Diatoms, Chlorophyll a, Species composition, Diversity, Productivity.

The primary production rates of phytolithic communities found in the major different habitats of streams were studied and the effects of physical and chemical parameters associated with each habitat on periphyton community spatial structure were determined. The project was designed to study natural, intact communities within stream systems. A comparative analysis was made of phytolithic communities found in Camel Hump and Husky Branch streams in the Great Smoky Mountains National Park. Camel Hump flows through virgin forest area and Husky Branch flows through an area logged approximately 60 y ago. The effects of logging on Husky Branch stream and the surrounding watershed are discussed. Seasonal data were collected from July, 1981 through May, 1982 from fast flow, slow flow and pool areas within each stream. An incubation chamber designed for use in lotic systems was used for in situ measurements of 14 C uptake. Rock samples collected at each site were used as substrates for community structure observations utilizing a scanning electron microscope. The algal communities of Camel Hump and Husky Branch streams were found to be predominantly composed of diatoms. The dominant genera in the fast, slow and pool areas included Achnanthes, Eunotia, Meridion, Navicula and Gomphonema. Fast flow areas were dominated by diatom species growing in a prostrate position. Slow flow areas were more densely populated by diatoms than the fast flow areas. Diatoms in the slow flow areas appeared mainly in prostrate position with a few stalked forms present. Pool area communities were less densely packed than slow flow areas and contained stalked and chain formations of diatoms. Results indicate that the physical and chemical parameters associated with each habitat affect the primary production rates and community structure found at the experimental sites. Measurements of carbon assimilation and chlorophyll a concentration were significantly greater in habitats of higher current velocity and light availability. Cell densities tend to increase with a decrease in current velocity. Habitats of high density showed a decrease in diversity and evenness. Correlations between productivity in the various habitats of each stream and other parameters measured in the study are discussed. (Author's abstract)
W85-06793

ACCELERATED EUTROPHICATION IN A NEW ZEALAND LAKE: LAKE ROTOITI, CENTRAL NORTH ISLAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
W. F. Vincent, M. M. Gibbs, and S. J. Dryden.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 4, p 431-440, 1984. 5 Fig, 6 Tab, 24 Ref.

Descriptors: *Eutrophication, *New Zealand, *Lake Rotoiti, *Algae, Eutrophic lakes, Cyanophyta, Phytoplankton, Hypolimnion, Oxygen demand, Trophic status.

Lake Rotoiti, North Island, New Zealand, is a deep (maximum depth, 126 m) lake surrounded by a mostly forested and farmland catchment. However, it currently demonstrates several attributes characteristic of enriched waters. Algal production is high relative to other deep basin lakes of the central North Island. The hypolimnion deoxygenates completely each year, and a bloomforming species of blue-green algae is numerically important in the summer phytoplankton. These features appear to be recent rather than longstanding properties of the Lake Rotoiti ecosystem. A detailed comparison of limnological measurements from 1955 onwards reveals a consistent decline in water clarity, a large and possibly exponential increase in hypolimnetic oxygen demand, and a conspicuous shift in the summer phytoplankton community towards blue-green algal dominance. This recently accelerated change in the trophic status of Lake Rotoiti is probably a response to the Ohau Channel inflow from Lake Rotorua. (Author's abstract)
W85-06794

NITRATE LOSS AND TRANSFORMATION IN 2 VEGETATED HEADWATER STREAMS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
A. B. Cooper, and J. G. Cooke.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 4, p 441-450, 1984. 2 Fig, 6 Tab, 31 Ref.

Descriptors: *Nitrates, *Cycling nutrients, *Eutrophication, *New Zealand, *Streams, Nutrients, Aquatic plants, Grass, Aquatic life, Nitrogen, Denitrification, Nitrogen removal.

The processes of nitrate removal from the stream waters of 2 headwater catchments were studied. In study stretches where the stream channels were vegetated with thick mats of grass (Glyceria fluitans), nitrate removal processes were particularly active. In such grassed stream channels, c. 75% of the nitrate removal was attributable to plant uptake and the remainder to denitrification. Both of these nitrate removal processes were linearly dependent on nitrate concentration, resulting in an exponential decline of nitrate level from the springs along the stream's length. Regeneration of nitrogen, by plant decay within the stream channel, results in export of dissolved organic nitrogen and particulate nitrogen from the catchments. The overall impact of vegetated stream channels in modifying nitrogen exports from catchment is discussed. (Author's abstract)
W85-06795

OPTICAL CHARACTERISATION OF NATURAL WATERS BY PAR MEASUREMENT UNDER CHANGEABLE LIGHT CONDITIONS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. J. Davies-Colley, W. N. Vant, and G. J. Latimer.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 4, p 455-460, 1984. 4 Fig, 9 Ref.

Descriptors: *Photosynthetically active radiation, *Solar radiation, *Euphotic zone, *Optical properties, Transparency, Physical properties, Light intensity, Measuring instruments.

Water bodies can be characterized optically by the euphotic depth, Z sub eu (1% of surface light), the diffuse attenuation coefficients, K sub d for downwelling light and K sub u for upwelling light, and the reflectance coefficient, R (ratio of upwelling to downwelling light), all in terms of photosynthetically active radiation (PAR). The estimation of all of these quantities from underwater PAR measurements is simple in principle but very difficult in practice under changing ambient light conditions caused by drifting cloud patches. A method of PAR measurement using a two-channel instrument which records the ratio of the response of 2 PAR sensors and thus overcomes the problems of changeable ambient light is described. Relative PAR Q(z)/Q sub r, where Q(z) is PAR (either upwelling or downwelling) at depth z, and Q sub r is reference (downwelling) PAR, is much less dependent on ambient light when the reference sensor is located in water than when located in air (deck sensor). The profiles of relative PAR can be used to calculate Z sub eu, K sub d, and K sub u. R can be measured directly as the ratio of upwelling to downwelling PAR. (Author's abstract)
W85-06797

BENTHIC MACROINVERTEBRATES OF CANE CREEK, NORTH CAROLINA, AND COMPARISONS WITH OTHER SOUTHEASTERN STREAMS,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
D. R. Lenat.
Brimleyana, No. 9, p 53-68, June, 1983. 1 Fig, 5 Tab, 20 Ref.

Descriptors: *Invertebrates, *Benthic fauna, *Cane Creek, *North Carolina, Streams, Aquatic insects, Monitoring, Ecosystems, Distribution, Environmental quality.

Data on benthic macroinvertebrates collected by several investigators working in Cane Creek, in the Piedmont Plateau of North Carolina, were combined to generate a species list of 272 taxa. This data set may define the characteristics of the 'normal' stream community in this area, and thus represent a source of control information for biological monitoring studies. Cane Creek is a third-order stream located in Orange County; it has a total drainage area of 90 sq km and average discharge of roughly 0.7 cu m/sec. Taxa from first-order tributaries differed markedly from those collected at stations farther downstream. Groups with many taxa were Ephemeroptera (30), Odonata (22), Trichoptera (31), and Diptera (80). Comparison of average taxa richness at Cane Creek (55.1 in 3 collections) with that of other North Carolina Piedmont streams (range: 43.33-55.8 in 3 or 4 col-

lections) showed considerable constancy among streams. There was often constancy within groups (eg, 8.0-9.4 for Ephemeroptera in six streams). Average taxa richness for 7 coastal Plain streams (48.4), 6 Piedmont streams (48.9), and 9 mountain streams (44.5) also appeared relatively constant. In contrast, density by organism group (as a percent of total density) for Cane Creek and five other Piedmont streams exhibited much more between-stream variability than did average taxa richness. The patterns observed suggest a constant number of niches in stream ecosystems, and indicate that average taxa richness appears to be the best tool for environmental assessment work. (Rochester-IVI)
W85-06799

SUBMERSED MACROPHYTE COMMUNITIES OF ADIRONDACK LAKES (NEW YORK, U.S.A.) OF VARYING DEGREES OF ACIDITY,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
D. A. Roberts, R. Singer, and C. W. Boylen.
Aquatic Botany, Vol. 21, No. 3, p 219-235, March, 1985. 4 Fig, 4 Tab, 34 Ref.

Descriptors: *Macrophytes, *Aquatic plants, *Adirondacks, *New York, *Lakes, *Acid lakes, Hydrogen ion concentration, Mountain lakes, Oligotrophic lakes, Water pollution effects, Species composition, Acidic water, Acidity, Sphagnum, Bulrushes, Utricularia, Pondweed.

The submersed macrophyte communities of nine high-altitude oligotrophic lakes in Adirondack Mountain region of upstate New York were characterized in detail in terms of percent cover of each species. The pH of these clear-water lakes ranges from 6.9 to 4.4 and the acid neutralizing capacity ranged from 91 micro eq/l to -38 micro eq/l. The degree of acidity covaried with lower total ion content and nutrient status. The dominant species in the circumneutral lakes and in the acidic lakes were the same, with several Utricularia species being the major component of the bottom cover. Species richness and diversity were lower in the acidic lakes (pH $<$ 5.5). The plants found in the acidic lakes were typical of oligotrophic systems in general, regardless of pH, and similar to those found in lake surveys in Scandinavia and Eastern Canada. Potamogeton confervoides Reichenb., Scirpus subterminalis Torr., Sphagnum spp. and Utricularia geminiscapa Benj. were the only species that were primarily exclusive to the acidic lakes surveyed. In contrast to the results of Scandinavian studies, Sphagnum was found to be a major component of the plant cover in only two of the five acidic lakes. (Author's abstract)
W85-06804

APPLICATION OF LANDSAT SATELLITE DATA FOR MAPPING AQUATIC AREAS IN NORTH-EASTERN FINLAND,
Oulu Univ. (Finland). Dept. of Astronomy.
For primary bibliographic entry see Field 7B.
W85-06805

STATUS OF COLONIAL WATERBIRDS NESTING IN SOUTHERN MANITOBA,
Manitoba Dept. of Natural Resources, Winnipeg.
W. H. Koonz, and P. W. Rakowski.
Canadian Field-Naturalist, Vol. 99, No. 1, p 19-29, January-March, 1985. 38 Ref, 2 Append.

Descriptors: *Water birds, *Manitoba, *Birds, *Animal populations, Species distribution, Population density, Environmental protection, Resource management, Pelicans, Cormorants, Gulls, Grebes, Terns, Environmental impact.

The southern Manitoba nesting abundance, colony location, historic and present regional and provincial status of 12 colonial nesting waterbird species have been assembled, with major field data collected in 1979. American White Pelican (Pelecanus erythrorhynchos), Double-crested Cormorant (Phalacrorax auritus), and Ring-billed Gull (Larus delawarensis) breeding populations were at or near historic peaks with cormorant and pelican numbers larger than recent estimates for all of Canada. Eared Grebe (Podiceps nigricollis), and Western Grebe (Aechmophorus occidentalis) populations were considered in decline as were Common Tern (Sterna hirundo) and Caspian Tern (Sterna caspia) numbers. Management should include stronger protective measures, public education, colony habitat management, and monitoring of known and suspected colony locations. Human encroachment, pesticides, marsh draining, water-level manipulation, and disturbance are major threats to all Manitoba waterbird species. (Author's abstract)
W85-06844

ECOLOGY OF FRESHWATER GASTROPODS ON THE SOUTHWESTERN EDGE OF THE PRECAMBRIAN SHIELD,
Winnipeg Univ. (Manitoba). Dept. of Biology.
E. Pip.
Canadian Field Naturalist, Vol. 99, No. 1, p 76-85, January/March, 1985. 2 Fig, 3 Tab, 25 Ref.

Descriptors: *Gastropods, *Mollusks, *Precambrian Shield, *Ecological effects, Lakes, Ponds, Streams, Rivers, Oligotrophic lakes, Species diversity, Water chemistry, Hydrogen ion concentration, Alkalinity, Dissolved solids, Nitrates, Nitrites, Phosphates, Chlorides, Sulfates, Organic matter, Oligotrophy, Dystrophy, Dystrophic lakes.

The Canadian Shield region provides an abundance of oligotrophic and dystrophic habitats. A study was made of the apparent tolerance ranges of gastropods with respect to pH, total alkalinity, total dissolved solids, total nitrate and nitrite, molybdenum reactive phosphorus, chloride, sulfate, and dissolved organic matter at 100 stations on the southwestern edge of the Precambrian Shield. Snail and aquatic plant community diversity, and interspecific associations among gastropods as well as among plants and gastropods were also examined. A total of 40% of the sites were lakes ($>$10 ha), 24% were ponds ($<$10 ha), 24% rivers ($>$2 m deep) and 12% creeks ($<$2 m deep). Of the 31 gastropod species found in the area, 15 were recorded at 5 or more sites, and of these, Gyraulus deflectus occurred in the most diverse snail and aquatic plant communities; Stagnicola elodes frequented communities with low diversity. Helisoma campanulatum showed the greatest tendency to occur in waters with low total dissolved solids, while S. elodes appeared to be poorly adapted to the soft waters of the region. Chi-square analysis of interspecific gastropod associations adjusted for apparent tolerance ranges yielded a single planar cluster composed of 13 species interrelated by 18 positive associations. Chi-square tests also identified 49 positive snail-plant associations, 11 of which involved H. campanulatum. Ponds showed the lowest snail and plant diversity; these sites also often showed the most extreme water chemistry values. The ecology of freshwater gastropods may show regional variation, since some species appear to undergo a certain amount of adaptation to the environmental characteristics prevailing in the Shield sites. The gastropods typical of Shield waters form a tightly-knit association cluster which reflects to some degree the qualities of the habitats where the species tend to occur. The gastropods also form numerous associations with Shield macrophytes; in some cases these appear to be the result of similar ecological affinities. (Collier-IVI)
W85-06846

TWENTY-FIVE YEARS OF PHYTOPLANKTON ON THE WEST FORK AND MAIN STEM OF THE WHITE RIVER: 1958-1982,
Indiana State Board of Health, Indianapolis.
T. E. Lauer, J. L. Winters, and H. L. BonHomme.
Proceedings of the Indiana Academy of Sciences, Vol. 93, p 181-186, 1983. 5 Fig, 13 Ref.

Descriptors: *Phytoplankton, *White River, *Indiana, Population dynamics, Water pollution effects, Nutrients, River flow, Algae.

The phytoplankton of the White River were monitored beginning in 1958. Sampling stations were concentrated above and below major population centers. Sampling locations have been moved upstream, downstream, added or deleted, based on the needs and resources of the study personnel. The original bench sheets from 1958 to 1974 were lost and all that remains for this period are the major grouping values. From 1975 to 1982 a more detailed evaluation of the phytoplankton community exists. Low mean phytoplankton densities correspond to high flow years 1959, 1961, 1968, 1969, 1972, 1974, and 1975. High phytoplankton densities were only found in 1960, 1962, 1963, 1971, and 1977 when flows were reduced. Phytoplankton densities as high as 200,000 cells/ml were found in some portions of the river. Nutrient point source loading comes from many places along the river. The cities of Muncie, Anderson and Indianapolis contribute the largest amounts. The phytoplankton populations appear to react to this nutrient loading. (Baker-IVI)
W85-06849

CHANGES OF PHYTOPLANKTON BIOMASS AND PRODUCTION IN A FIELD LAKE AND DRAINING CHANNEL,
Polish Academy of Sciences, Turew. Dept. of Agrobiology.
J. Jurkowska.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 4, p 341-352, 1984. 6 Fig, 4 Tab, 19 Ref.

Descriptors: *Phytoplankton, *Turew, *Poland, *Primary productivity, Lakes, Drainage channels, Nutrients, Biomass, Algae, Organic matter, Cyanophyta, Nanoplankton, Photosynthesis.

For the years 1980-1981 the biomass, structure and primary productivity of phytoplankton, as well as the destruction of organic matter were studied in two water bodies of different types, both situated in an area of intensive farming in the vicinity of Turew, Poland. One was a field lake, Lake Zbechy, and the other was an outflowing drainage channel. The biomass of the phytoplankton decreased and its composition changed. In the lake, a drop in the proportion of diatoms and blue algae in the phytoplankton biomass was paralleled by an increase in the proportion of nanoplankton. In the drainage channel, the participation of blue algae in the total biomass markedly dropped and that of nanoplankton rose. In the lake and channel both, the production and destruction of organic matter diminished. In both water bodies, the relative photosynthetic activity rose, owing to an increase in participation of intensely producing small forms. (Baker-IVI)
W85-06856

DENSITY AND BIOMASS OF BENTHIC CHIRONOMIDAE (DIPTERA) IN A LAKE AND MELIORATION CHANNEL, SITUATED IN AGRICULTURAL LANDSCAPE,
Polish Academy of Sciences, Poznan. Dept. of Agrobiology and Forestry.
J. Banaszak.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 4, p 353-363, 1984. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Population density, *Biomass, *Benthos, *Midges, *Lake Zbechy, *Poland, *Channels, Species composition, Species diversity, Lake sediments, Littoral zone, Profundal zone, Eutrophic lakes.

Studies were made of the occurrence and density of Chironomidae larvae in bottom sediments of the eutrophic and polymictic Lake Zbechy in western Poland and of the lake's outflowing melioration channel. The lake has a surface area of 108.9 ha, mean depth of 4.2 m and maximum depth of 7.5 m. Its banks are flat and without forest cover, being almost completely overgrown by Phragmitetum. Lake waters are drained off by the melioration channel through the peatbog bottom of a small glacial gully covered by meadows and cultivated soils. Mean breadth of the channel is 4.5 m and mean depth is 0.5 m. Marked faunistic differences between the littoral and profundal as well as between the lake and channel were found. The density of Chironomidae larvae in lake littoral and profundal zones was 1981.4 and 210.5 indiv./sq m, respectively. Chironomidae larvae biomass in lake littoral and profundal zones amounted to 2.0 and 0.5 g dry wt./sq m, respectively. In the lake, the

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mean density of larvae was highest in the spring-summer period (May-June) and autumn-winter perid; it markedly dropped in the summer. The density of Chironomidae larvae was almost 4 times higher in the melioration channel as compared with the lake littoral zone; the channel had 7378.3 indiv./sq m and the biomass equaled 1.8 g dry wt./sq m. The dominance of larvae of genus Chironomus s. str. (Ch. f.l. plumosus, Ch. semireductus) in the fauna of the profundal bottom sediments confirmed the eutrophic nature of Lake Zbechy. (Collier-IVI)
W85-06857

PHYTOPLANKTON OF LAKE SIMCOE DURING THE ICE-FREE PERIODS OF 1980-82 AND POTENTIAL RESPONSE TO REDUCED PHOSPHORUS LOADINGS,
Ontario Ministry of the Environment, Rexdale.
K. H. Nicholls, F. M. Forbes, R. Shaw, J. Humber, and L. Nakamoto.
Journal of Great Lakes Research, Vol. 11, No. 1, p 3-12, 1985. 10 Fig, 1 Tab, 37 Ref.

Descriptors: *Phytoplankton, *Lake Simcoe, *Ice, *Phosphorus loading, *Kempenfelt Bay, *Cook Bay, *Ontario, Biomass, Trophic status, Eutrophication, Water pollution effects, Visibility, Municipal wastewater.

Phytoplankton biomass and species composition during 1980-82 demonstrated a clear gradient in trophic status through Lake Simcoe ranging from most enriched in southern Cook Bay to least enriched in the open waters of the main lake. Inner Kempenfelt Bay and Cook Bay phytoplankton showed influence of the nutrient inputs in these regions. A clustering of phytoplankton similarity coefficients demonstrated that the lake contained identifiable regions with high percentage similarities linking sites a) located in proximity and/or b) in areas of the lake defined by similar conditions of nutrient loading and water depth. Two-dimensional ordinations of the ten dominant phytoplankton taxa at each of the nine sampling sites on the lake showed that the best definition of these regions was during the springtime when material inputs from point sources were greatest. After diversion of the two major municipal sewage sources out of the Lake Simcoe basin in lake 1984, calculations show the potential 'improvements' in trophic status of Cook Bay will be a 0.3 cu mm/L decline in average May-October phytoplankton biomass and an increase in Secchi disc visibility of about 80 cm. (Author's abstract)
W85-06860

SEDIMENTATION AND SEDIMENT RESUSPENSION IN LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 2J.
W85-06861

MODEL FOR LAKE-BAY EXCHANGE FLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
For primary bibliographic entry see Field 2L.
W85-06864

NOTE ON EUTROPHIC CHARACTERISTICS OF TWO FRESHWATER BODIES OF KURUKSHETRA, INDIA,
Kurukshetra Univ. (India). Dept. of Zoology.
M. P. Sharma.
Current Science, Vol. 53, No. 23, p 1263-1264, December, 1984. 9 Ref.

Descriptors: *Eutrophication, *India, *Lakes, *Primary productivity, *Zooplankton, Rotifers, Cladocerans, Copepods, Population dynamics, Trophic levels.

A regular and periodic sampling of water was taken during March 1977 through June of 1979 so as to collect information on population ecology for dominant zooplankton species in relation to conductivity, temperature, alkalinity, pH and dissolved oxygen. Rotifers were the most and least abundant component of zooplankton in Nabhkamal and Jyotisar (India), respectively. In the two successive years of study rotifers contributed 58.22% and 46.88%, cladocerans 22.24% and 25.94%, and copepods 19.54% and 27.18% of the total zooplankton in Nabhkamal, whereas, in Jyotisar, cladocerans (58.87% and 70.10%) were followed by copepods (25.58% and 23.50%) and rotifers (15.55% and 6.40%). The annual mean number of total zooplankton was higher in Nabhkamal than in Jyotisar in the two succeeding years of study which probably could be due to differences in their trophic status. (Baker-IVI)
W85-06868

AQUATIC PARAMETERS AND LIFE HISTORY OBSERVATIONS OF THE GREAT BASIN SPADEFOOT TOAD IN UTAH,
Utah Univ., Salt Lake City. Dept. of Biochemistry.
P. Hovingh, B. Benton, and D. Bornholdt.
Great Basin Naturalist, Vol. 45, No. 1, p 22-30, January, 1985. 4 Fig, 1 Tab, 29 Ref.

Descriptors: *Toads, *Reptiles, *Utah, *Bonneville Basin, *Water chemistry, *Life history studies, Hydrogen ion concentration, Phenology, Life cycles, Dissolved solids, Precipitation patterns.

The distribution and breeding habitats of the Great Basin spadefoot toad (Scaphiopus intermontanus) were investigated in the Bonneville Basin of western Utah. The permanent springs and man-made-reservoirs used for breeding were largely found below the 1600 m elevation. pH ranged between 7.2 and 10.4 and total dissolved solids ranged between 170 and 4800 mg/l. The springs were less alkaline than the rain-filled reservoirs. The lack of aquatic vegetation was a common feature of the reservoirs and most of the springs. Observations of breeding without rain are noted as well as the lack of breeding with rain. The snout-vent lengths of adult spadefoots are greater in the Bonneville Basin than in other parts of the Great Basin. Utilization of permanent water sources and stimuli for emergence and breeding, as well as the larger adult size of S. intermontanus in the Bonneville Basin, are discussed in relation to the diverse precipitation patterns, the sparseness of the water sources, and the Holocene history of the Great Basin. (Author's abstract)
W85-06869

BIBLIOGRAPHY TO UPPER MISSISSIPPI RIVER AQUATIC AND WETLAND PLANT LITERATURE,
Arkansas Univ. at Little Rock. Dept. of Biology.
J. H. Peck, and M. M. Smart.
Proceedings of the Iowa Academy of Sciences, Vol. 92, No. 2, p 78-84, March, 1984. 308 Ref.

Descriptors: *Mississippi River, *Aquatic plants, *Wetlands, *Bibliographies, Vegetation, Aquatic vegetation, Limnology, Wildlife, Water management, Macrophytes.

This bibliography presents a reference resource to the extensive literature on aquatic and wetland plants of the Upper Mississippi River taken from journals, serials, books, agency reports, contracted agency reports, theses, and dissertations. The bibliography was compiled from 1977 to 1983. The 308 references were prepared by 270 authors. Topics considered included taxonomy, floristics, ecology, wildlife biology, limnological role, and management programs on macrophytes present in the navigation channel, backwater, and floodplain of the Upper Mississippi River, which stretches from Minneapolis, Minnesota, southward some 1,380 km to Cairo, Illinois. (Baker-IVI)
W85-06871

SPECTRAL ANALYSIS OF THE AUTOMATICALLY RECORDED DATA FROM SLAPY RESERVOIR, CZECHOSLOVAKIA,
Vyzkumny Ustav Vodohspodarsky, Prague (Czechoslovakia).
I. Nesmerak, and M. Straskraba.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 1, p 27-46, 1985. 12 Fig, 9 Tab, 9 Ref.

Descriptors: *Slapy Reservoir, *Czechoslovakia, *Reservoirs, Solar radiation, Temperature, Water temperature, Air temperature, Acidity, Spectral analysis, Limnology.

Data for solar radiation, air temperature, surface water temperature, and pH recorded at 0.5 hr intervals at Slapy Reservoir, Czechoslovakia, were subjected to spectral analysis. The complete series covered the month of July 1978. Three characteristic sections were distinguished. One of these was characterized by low variations, more irregular values and a slowly decreasing trend. Another showed high and regular variations as well as a steeply increasing trend. These sections were analyzed separately in addition to the complete series. The period of 24 hr was most important and represented for each of the parameters of solar radiation, air temperature, and acidity, 60, 38 and 18% of the total variances, respectively. The deterministic periodic component represented 65-96% of the total variance. The cross-correlation and cross-covariance between selected pairs of variables suggested lags of up to 4.5 hrs, the longest lag being observed for surface water temperature and solar radiation. An autoregressive model of the interrelation between the signals was formulated. This study is part of a project to develop a new methodology of ecological (particularly limnological) investigation aimed at overcoming some of the major drawbacks of present methodology. (Baker-IVI)
W85-06881

SCALING OF MICROCOSMS AND THE DIMENSIONAL ANALYSIS OF LAKES,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
D. Uhlmann.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 1, p 47-62, 1985. 10 Fig, 36 Ref.

Descriptors: *Dimensional analysis, *Lakes, *Microcosms, *Scaling functions, Reviews, Ecosystems, Model studies.

Different possibilities for designing and operating microcosms are reviewed. Examples of geometrical and of physiological similarity between systems of different sizes and the corresponding scaling functions have been considered. Examples of similarity analysis and scaling functions as applied to aquatic ecosystems are offered. It seems virtually impossible to base the scaling up of experimental results obtained with micro- and mesocosms once on a standardized set of similarity relations that permits the prediction of all of the essential structures and functions of the full-scale system. One problem which possibly may be partially solved in the near future is the estimation of the relations between underwater irradiance and phytoplankton growth. Scaling of light- and nutrient-dependent phytoplankton growth seems to be important in connection with the comprehensive work done on bioassays by numerous laboratories. In this connection, efforts should be made to obtain better correspondence between microcosms (or bioassays) and full scale systems also in regard of the dynamic response to changes in external conditions. A comparison between model and prototype should include the history of the study subjects, the length of transient periods in response to the forcing function, and the minimum time necessary to attain steady-state conditions. The design of microcosm experiments and the successful application of similarity analysis to scale up their results depend on both the particular goal and the proper identification and selection of the similarity criteria needed to achieve it. Prediction of the behavior of the full scale system is of limited interest only unless verification is possible by data obtained independently of the microcosm experiments. As far as whole lakes of different size are concerned, dimensional analysis indicates that there is no linear relationship between the intensity of the internal materials transport and the absolute depth and length. Thus shallow and deep lakes or small and large lakes may not be compared on a simple linear scale. The effect of water level fluctuation should also not be underestimated. (Baker-IVI)
W85-06882

NUTRIENT LOAD, TROPHIC CONDITION AND RESTORATION PROSPECTS OF LAKE MAGGIORE,
Istituto Italiano di Idrobiologia, Novara.
R. Mosello, and D. Ruggiu.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 1, p 63-75, 1985. 3 Fig, 6 Tab, 28 Ref.

Descriptors: *Lake Maggiore, *Italy, *Switzerland, *Trophic levels, *Lake restoration, Morphometry, Eutrophication, Nutrients, Oligotrophic lakes, Phosphorus, Nitrogen, Chlorophyll, Phytoplankton, Primary productivity.

An assessment of the trophic status of Lake Maggiore (Italy and Switzerland) is made in the light of its trophic evolution in the past few decades as a basis for possible restoration measures. Detailed studies made in the period 1978-1982 on the 17 main tributaries and the atmospheric inputs, as well as estimates relating to residual, undrained areas made it possible to evaluate the P and N loads. The in-lake status of nutrients, chlorophyll a, phytoplankton communities and primary production was monitored during the same period. Having verified that the values of morphometric and hydrological parameters, and of chemical and biological variables fall within the ranges of the OECD group of lakes, the applicability of the OECD approach to trophic assessment was ascertained through a comparison of measured and calculated values of selected variables. The lake is now meso-eutrophic, and a desirable reversion to the original oligotrophic state should be possible by reducing the present phosphorus imput by two thirds. A load reduction of one third could still bring about acceptable conditions. An integrated, whole-basin restoration strategy is emphasized as being best for a lake having a large watershed which includes a number of lakes, some of them highly eutrophic. (Baker-IVI)
W85-06883

DUCK BREEDING ECOLOGY AND HARVEST CHARACTERISTICS ON GRAND RIVER MARSH WILDLIFE AREA,
Wisconsin Dept. of Natural Resources, Madison.
W. E. Wheeler, R. C. Gatti, and G. A. Bartelt.
Technical Bulletin No. 145, 1984. 49 p, 22 Fig, 48 Tab, 86 Ref, 5 Append.

Descriptors: *Lakes, *Wildlife, *Waterfowl, *Wetlands, Ducks, Grand River Marsh, Wisconsin, Hunting, Recreation, Water management, Predation, Vegetation.

Seven lakes and five state wildlife areas, comprising 3% of the area within the 2500-sq mile Grand River Extensive Area (Wisconsin) accomodated up to 14% of the mallards, 30% of the blue-winged teal, and 21% of other species breeding within the area. The Grand River Marsh Wildlife Area represented 0.4% of the area investigated and attracted up to 3% and 6% of the total study area population of mallards and blue-winged teal, respectively. Thus a 100% increase in breeding mallards on public lands would increase population on the entire 2500-sq mile area by only 10%. A drawdown of the main flowage and removal of most carp-favored submergent vegetation, resulted in double the number of breeding ducks present during the pretreatment period. A nesting cover program apparently did not deter predation. Removal of predators did not improve nest success. Only 0.1% of the mallards and 0.5% of the blue-winged teal shot by hunters in the study area were hatched in the study area.
W85-06903

GEOLOGICAL CHARACTER AND MINERAL RESOURCES OF SOUTH CENTRAL LAKE ERIE,
Coastal Engineering Research Center, Fort Belvoir, VA.
S. J. Williams, and E. P. Meisburger.
Miscellaneous Report No. 82-9, October 1982. 62 p, 18 Fig, 2 Tab, 5 Ref, 3 Append. Project No. C31665.

Descriptors: *Lakes, *Sediments, *Beaches, *Dredging, Fill, Bottom sediments, Lake sediments, Presque Isle, Lake Erie, Sand, Gravel, Groins.

The bottom of southern Lake Erie was surveyed to identify deposits of sand and gravel available for dredging and deposition at beach nourishment projects on Presque Isle peninsula. The survey used seismic profiles, sediment cores, and grab samples. Suitable sand and gravel deposits were found in large quantities in two locales. At least 39 million cubic meters of material are witin 2.3 meters of the lake floor in a ridge between Long Point, Ontario, and Presque Isle. A second morainal ridge off Dans Beach, west of Erie, has several million cu m. However, this source is close to shore and 25 km from Presque Isle.
W85-06907

DISTRIBUTION AND RELATIVE ABUNDANCE OF FISHES IN WISCONSIN: III. RED RIVER BASIN,
Wisconsin Dept. of Natural Resources, Madison.
D. Fago.
Technical Bulletin No. 143, 1984. 69 p, 4 Fig, 15 Tab, 19 Ref, 2 Append.

Descriptors: *Lakes, *Streams, *Fish, *Aquatic habitats, Species composition, Red Cedar River Basin, Wisconsin, Baseline studies, Environmental surveys, Fish populations, Populations, Habitats, Surveys, Watersheds, Agricultural watersheds, Species diversity, Aquatic life, Aquatic animals.

The distribution and relative abundance of fish species was studied at about 500 stations in the Red Cedar River basin, Wisconsin, from 1975 to 1981. The agricultural watershed is 4843 sq km in area, with 293 lakes and 2095 km of defined streams. A total of 97 species were identified in the 99,000 specimens. The five most common species were white sucker, bluegill, Johnny darter, yellow perch and bluntnose minnow. The most numerous species were bluegill, white sucker, bluntnose minnow, yellow perch, and common shiner. Rare species included 1 endangered species (crystal darter), 2 threatened species (Ozark minnow and blue sucker), and 7 watch species (lake sturgeon, American eel, pugnose shiner, weed shiner, redfin shiner, greater redhorse, and least darter). Twenty-nine species had not been reported in previous surveys of this basin. Two species, lake whitefish and flathead catfish, found in earlier surveys (1931 and 1963) were not detected in the present survey. The average number of species at one station was 10.
W85-06909

LAKE PONTCHARTRAIN AND VICINITY HURRICANE PROTECTION PLAN; REPORT 1: PROTOTYPE DATA ACQUISITION AND ANALYSIS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. G. Outlaw.
Technical Report HL-82-2, January 1982. Report 1 of a Series. 624 p, 14 Fig, 13 Tab, 263 Plates, 9 Ref, 5 Append.

Descriptors: *Lakes, *Water quality, *Hurricanes, *Tides, *Protection, Data acquisition, Surges, Storms, Lake Pontchartrain, Louisiana, Water currents, Wind, Saline water intrusion, Bonnet Carre Floodway, Floodways, Water level, Water circulation.

Prototype tidal elevation, current, and wind data were acquired and analyzed as a part of a study to evaluate the effects of the Lake Pontchartrain and Vicinity Hurricane Protection Plan on (a) tidal prism and circulation in Lake Pontchartrain, (b) hurricane surge levels in Lake Pontchartrain and vicinity, and (c) water quality in Lake Pontchartrain. Results of the analysis of prototype tidal elevation and current data will be used during verification of a numerical tidal circulation model. Data were included in the analysis from (a) an intensive tidal elevation and current data acquisition program for a duration of approximately 30 days; (b) a water quality program immediately following the intensive program, for monitoring tidal elevations, and, on a less extensive basis, currents, temperature, and conductivity in Lake Pontchartrain; and (c) a supplemental tidal elevation and current data acquisition program to provide additional data for numerical model verification. A water quality transect survey was conducted during both the intensive program and the supplemental survey for dissolved oxygen, pH, temperature, and conductivity. The intensive program also included a 25-hour current boat survey at six ranges in the tidal passes to Lake Pontchartrain and in the Inner Harbor Navigation Canal. Tidal analysis results show that the diurnal O1 and K1 constituents have the largest amplitude in Lakes Pontchartrain and Borgne and indicate that the diurnal tides in Lake Pontchartrain are co-oscillating with little change in constituent amplitude over the lake. (Author)
W85-06939

PHOSPHORUS DYNAMICS IN AN ARKANSAS RESERVOIR: THE IMPORTANCE OF SEASONAL LOADING AND INTERNAL RECYCLING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. H. Kennedy, R. H. Montgomery, W. F. James, and J. Nix.
Miscellaneous paper E-83-1, U.S. Army Environmental and Water Quality Operational Studies, May 1983. Final Report. 18 p, 8 Fig, 12 Ref.

Descriptors: *Phosphorus, *Lakes, *Fate of pollutants, *Water quality, *Reservoirs, *Recycling, *Storm runoff, *Lake sediments, *Seasonal variation, Stratification, Eutrophication, Path of pollutants, Iron, Sedimentation, Mixing, Thermocline, Seiches, Nutrients, Cycling nutrients.

During winter and spring, the majority of the annual P load enters DeGray Lake via storm inflows. P losses by sedimentation of allochthonous material in upstream reaches result in the establishment of longitudinal concentration gradients. Headwater sediments act as a source for P and Fe during anoxic periods. Entrainment of density inflows in or near the thermocline, convective mixing, and seiche activity provide the potential for material transport across the thermocline and may account for euphotic zone P increases observed in the upstream end of the lake during summer. The major P flux in fall is again from water column to sediment. These trends were alo reflected by changes in the chemical composition of sedimenting material collected in sediment traps. These data may provide a perspective from which to evaluate P dynamics in other lakes and reservoirs.
W85-06964

SEASONAL AND SPATIAL DISTRIBUTION OF ZOOPLANKTON IN A FLOOD CONTROL RESERVOIR AND TAILWATER,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
For primary bibliographic entry see Field 6G.
W85-06984

MASS CULTIVATION OF PLANKTONIC FRESHWATER ALGAE FOR THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER (EOM),
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Siedlungswasserwirtschaft.
B. Lusse, O. Hoyer, and C. J. Soeder.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 2, p 67-75, April, 1985. 8 Fig, 2 Tab, 31 Ref.

Descriptors: *Algae growth, *Extracellular organic mater, *Algae, Phytoplankton, Organic matter, Chlorophyta, Cyanophyta, Diatoms, Bacteria.

Extracellular organic matter (EOM) produced by phytoplankton serves as substrate for aquatic bacteria and thereby lead to an input of particulate feed and energy into the food chains of natural waters. Newly designed media were used successfully for the batch-wise massive culture of 3 green algae, 2 cyanobacteria and 2 diatoms in open race-

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way miniponds of 0.25 cu m capacity. Green algae were also grown under chemstatic conditions. Except for cultures of the cyanobacterium Synechocystis salina, it was possible to recover EOM in total amounts of at least 2.5 g/sample. Since the algae always grew in the presence of various undefined types of bacteria, the amount of EOM present at any time was always the result of EOM release from the algae and EOM utilization by bacteria that must have consumed at least the EOM components most readily to be metabolized. Presence of bacteria in the experimental cultures has been one attempt to approximate towards natural conditions; the attempt to simulate the ionic environment in a productive surface water was another. (Baker-IVI)
W85-07026

EXPERIMENTAL INVESTIGATION OF INTRUSIVE GRAVITY CURRENTS ENTERING STABLY STRATIFIED FLUIDS,
Karlsruhe Univ. (Germany, F.R.). Sonderforschungsbereich Ausbreitungs- und Transportvorgaenge in Stroemungen.
K. M. Faust, and E. J. Plate.
Journal of Hydraulic Research, Vol. 22, No. 5, p 315-325, 1984. 9 Fig, 1 Tab, 17 Ref.

Descriptors: *Density stratification, *Gravity currents, *Stratification, *Saline water intrusion, Intrusions, Reservoirs, Lakes, Oceans, Density, Viscosity, Model studies, Mathematical models, Velocity.

Fluid intrusions into a stably stratified environment due to density differences can be observed in reservoirs, lakes, in the atmosphere, and also in the ocean. Laboratory experiments were carried out in a water tank to study the influence of fluid depth, initial density differences, shape of initial density distribution, time and viscosity on velocity and thickness of such intrusions. The influence of the density gradient at the intrusion level can be described by an empirical function. The case of a very sharp interface gradient is compared with previously published results and with boundary gravity currents. A continuously linearly stratified ambient, on the other hand, allows a comparison with the case of the so-called mixed region collapse. Only for these extreme cases does there exist close agreement of theoretical models and experiments and it must be concluded that intrusions are not yet fully understood theoretically. For the intrusions along a sharp interface, Benjamin's energy conserving analysis which was extended by Holyer and Huppert approximately describes the oberved behavior, whereas intrusions into a linearly stratified environment behave very differently from theoretical calculations. Furthermore, Reynolds-number effects seem to play an important role in intrusive flow modelling. (Baker-IVI)
W85-07028

EVALUATION OF A COMMUNITY-BASED INDEX USING BENTHIC INDICATOR-ORGANISMS FOR CLASSIFYING STREAM QUALITY,
Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
For primary bibliographic entry see Field 5A.
W85-07046

VERTICAL LIGHT ATTENUATION AND PHYTOPLANKTON DEVELOPMENT IN LAKE ZURICH,
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
F. Schanz.
Limnology and Oceanography, Vol. 30, No. 2, p 299-310, March, 1985. 7 Ref, 2 Tab, 49 Ref.

Descriptors: *Phytoplankton, *Lake Zurich, *Switzerland, *Light penetration, *Lakes, Biomass, Light intensity, Chlorophyll a, Epilimnion, Thermocline.

Many light-depth profiles based on measurements of photosynthetically available radiation (PAR) in the 0-20 m zone of Lake Zurich (Switzerland) were analyzed with respect to phytoplankton development in the epilimnion and the thermocline. Variations in the average value of the vertical attenuation coefficient with time were closely related to variations in biomass. Inspection of the depth distribution of the natural logarithms of light intensity reveals several straight-line segments. These correspond to zones with differing phytoplankton densities. During the spring bloom and the late summer phytoplankton maximum the biomass development can be followed in detail by interpreting the light-depth curves. The results show that the vertical attenuation coefficient Kd(PAR) is influenced considerably by chlorophyll a; nonchlorophyll-related organic and inorganic suspensoids, however, also seem to be of some importance during periods of low productivity. (Author's abstract)
W85-07069

NUTRIENT INTERNAL CYCLING AND THE TROPHIC REGULATION OF GREEN LAKE, WISCONSIN,
Maine Univ. at Orono. Dept. of Geological Sciences.
R. E. Stauffer.
Limnology and Oceanography, Vol. 30, No. 2, p 347-363, March, 1985. 9 Fig, 9 Tab, 65 Ref.

Descriptors: *Cycling nutrients, *Trophic status, *Green Lake, *Wisconsin, *Diatoms, *Nutrients, Silica, Nitrogen, Phosphorus, Lakes, Dissolved oxygen, Seasonal variation, Limiting nutrients.

Algal nutrients (Si, N, P) and dissolved oxygen were studied in Green Lake, Wisconsin, in 1971-1972, and in 1978-1980 following a reduction of about 35% in total external P loading in December 1976. Despite oxic conditions, there is more P in the hypolimnion than would be expected from the dissolved oxygen and from classical Redfield stoichiometry. Because of a metalimnetic dissolved oxygen minimum in late summer, the calculation and interpretation of the hypolimnetic oxygen deficit is affected by turbulent transport of dissolved oxygen. Vertical fluxes of P into the mixed layer are important in late spring and early summer, but, owing to metalimnetic P depletion, are negligible between mid-July and mid-October. Vertical transport of Si into the mixed layer is negligible in summer and early fall compared with inputs from the land drainage basin. Although P is high at spring turnover, epilimnetic concentrations of P are low and Secchi transparency is high by mid-to-late summer. These seasonal changes are caused by sedimentation of P and low seasonal inputs from the drainage basin. This P is recovered in the hypolimnion and recirculated throughout the lake at fall overturn. It causes silica limitation of the diatom bloom each succeeding spring. The total P content of Green Lake and its seasonal partition among the layers were remarkably stable between 1971 and spring 1980, despite the reduction in external loading in 1976. The hypolimnetic oxygen deficit also showed no significant change between the first and eighth decades of this century. (Author's abstract)
W85-07070

DOES SETTLING SESTON RELEASE SOLUBLE REACTIVE PHOSPHORUS IN THE HYPOLIMNION OF LAKES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland). Inst. of Aquatic Sciences.
R. Gachter, and A. Mares.
Limnology and Oceanography, Vol. 30, No. 2, p 364-371, March, 1985. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Seston, *Phosphorus, *Hypolimnion, *Lake sediments, *Lake Lucerne, *Switzerland, Particulate matter, Organic matter, Carbon, Stratification, Sediments, Anaerobic conditions, Mineralization.

Organic material collected with sediment traps at depths of 20, 40, and 60 m in mesotrophic, phosphorus-limited Lake Lucerne (Switzerland) was decomposed aerobically at a rate of about 0.01/day at 6 C. However, this material is not a source, but rather a sink, for soluble reactive phosphorus (SRP). As a consequence, during stratification, in the upper part of the hypolimnion concentrations of oxygen and SRP decrease simultaneously, and the ratio POC:PP (particulate organic carbon: particulate phosphorus) decreases significantly with increasing sampling depth and hence with increasing age of the seston. Once deposited at the aerobic sediment surface, the particulate matter continues to accumulate SRP. Since settling particles and the aerobic sediment surface both act as sinks for SRP, anaerobic subsurface sediments are the only possible source for the SRP accumulating in the hypolimnion during summer stagnation. The aerobic sediment layer may however become an apparent source for SRP if the supply from deeper anoxic sediments exceeds its biological-chemical sorption capacity. These observations and additional information from the literature indicate that in phosphorus-limiied lakes decomposing organisms do not release, but rather take up, SRP while mineralizing phosphorus-poor organic material. (Author's abstract)
W85-07071

VARIATIONS IN MELOSIRA ISLANDICA VALVE MORPHOLOGY IN LAKE ONTARIO SEDIMENTS RELATED TO EUTROPHICATION AND SILICA DEPLETION,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
E. F. Stoermer, J. A. Wolin, C. L. Schelske, and D. J. Conley.
Limnology and Oceanography, Vol. 30, No. 2, p 414-418, March, 1985. 2 Fig, 13 Ref. EPA grant R810396, NSF grant OCE 82-16588.

Descriptors: *Diatoms, *Melosirsa, *Silica, *Eutrophication, *Lake Ontario, *Great Lakes, *Lake sediments, Water pollution effects, Taxonomy, Paleolimnology, Plant morphology, Phosphorus, Nutrients.

Variation in valve morphology of the freshwater plankton diatom Melosira islandica has led to taxonomic confusion in the limnological literature. Different types of valves were found in Melosira islandica populations preserved in Lake Ontario sediment cores. Three morphotypes were distinguished, the more coarsely structured of which are most abundant in assemblages deposited before 1840. Finely structured forms become more abundant upcore, reaching maximum abundance ca. 1962. The morphological modifications and the decline in biogenic silica accumulation could be attributed to toxic materials entering the Lake Ontario system; however, no specific observational or experimental evidence is known that would support this hypothesis. The changes appear to be related to increased phosphorus loading and consequent silica depletion in Lake Ontario waters. Once silica limitation occurs, the accumulation of diatom frustules is diminished both by the decrease of diatom production and by enhanced dissolution and internal recycling of the available silicon pool. The accumulation of diatom frustules in sediments thus becomes an approximate function of external silicon loading and not of production or of the external supply of phosphorus or other controlling nutrient. The morphological changes in M. islandica may provide a clear index of silicon availability and thus provide a valuable paleolimnological tool for evaluating the nutrient status of lakes in the past. If this index is applied to the Lake Ontario core studied, it implies that maximum phosphorus loading and silica limitation occurred during the 1960's and early 1970's and that efforts to reduce phosphorus loading in the early 1970's were becoming increasingly effective by 1979. (Author's abstract)
W85-07072

SURFACE WAVES IN BASINS OF VARIABLE DEPTH,
California Univ., San Diego, La Jolla. Inst. of Geophysics and Planetary Physics.
J. Miles.
Journal of Fluid Mechanics, Vol. 152, p. 379-389, March, 1985. 1 Fig, 18 Ref.

Descriptors: *Basins, *Surface waves, *Seiches, Waves, Differential equations, Water depth.

The linearized boundary-value problem for surface waves of frequency w in a closed basin of variable depth is reduced to a non-self-adjoint partial differential equation in the plane of the free surface. The corresponding variational form for the eigenvalue k = w(2)/g is constructed. A self-adjoint partial differential equation, for which the variational form is the Raleigh quotient also is constructed. It offers significant advantages over the non-self-adjoint formulation, but at the expense of a more complicated operator. Three relatively simple variational approximations are constructed, two for a class of basins with sloping sides and the third for basins for which the variation of the depth relative to its mean is small. These general results are illustrated by comparison with Rayleigh's results for a semicircular channel, Sen's inverse results for a family of circular basins, and Lamb's results for a shallow circular paraboloid. The eigenvalue for the dominant mode in the paraboloid is determined. (Baker-IVI)
W85-07085

IMPACT OF NITROGEN AND PHOSPHORUS ON (14C)-LIGNOCELLULOSE DECOMPOSITION BY STREAM WOOD MICROFLORA,
Oregon State Univ., Corvallis. Dept. of Microbiology.
N. G. Aumen, P. J. Bottomley, and S. V. Gregory.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1113-1118, May, 1985. 4 Fig, 1 Tab, 29 Ref. NSF grants DEB80-04652, DEB80-12162, DEB80-22634 and DEB81-12455.

Descriptors: *Lignocellulose, *Decomposition, *Stream biota, *Nitrogen, *Phosphorus, Streams, Temperature effects, Wood, Detritus, Microorganisms.

Nutritional and physical factors affecting the decomposition of (C-14)lignocellulose prepared from Douglas fir (Pseudotsuga menziesii) were examined by incubating the labeled substrate with homogenized surface wood scrapings obtained from a Douglas fir log in a Pacific Northwest stream. Decomposition rates of lignocellulose were greater in each of four filter-sterilized sources of stream water than in distilled water alone. Cellulose decomposition was stimulated 50% by the addition of either potassium nitrate or KH2PO4/K2HPO4 and further enhanced (167%) by a combination of both. Lignin decomposition was stimulated 65% only by the addition of both N and P. Lignocellulose decomposition was greatest when supplemental potassium nitrate was supplied in concentrations of at least 10.0 mg of N/liter but not increased further by higher concentrations. The decomposition of lignocellulose increased as the incubation temperature was raised and NO3(-)-N supplementation further increased these rates between three and seven fold over the range of temperatures examined (5 to 22 C). Accumulation of NH4(+) was always observed in culture filtrates of incubations which had been supplemented with KNO3, the quantity being independent of NO3(-) concentrations greater than or equal to 10 mg of N/liter. The role of supplemental NO3(-) in the decomposition of lignocellulose is discussed in relation to wood decomposition and the low concentrations of N found in stream ecosystems of the Pacific Northwest. (Baker-IVI)
W85-07136

NITROGEN DYNAMICS IN STREAM WOOD SAMPLES INCUBATED WITH (14C)LIGNOCELLULOSE AND POTASSIUM (15N)NITRATE,
Oregon State Univ., Corvallis. Dept. of Microbiology.
N. G. Aumen, P. J. Bottomley, and S. V. Gregory.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1119-1123, May, 1985. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Nitrogen cycle, *Streams, *Lignocellulose, Nitrates, Decomposition, Wood, Detritus, Nutrients.

Surface wood samples obtained from a Douglas fir log (Pseudotsuga menziesii) in a Pacific Northwest stream were incubated in vitro with lignocellulose in a defined mineral salts medium supplemented with 10 mg of N/liter of NO3(-). The organic N content of the lignocellulose-wood sample mixture had increased from 132 micro-g of N to a maximum of 231 micro-g of N per treatment after 6 days of incubation. Rates of lignocellulose decomposition were greatest during the first 6 days. Total CO2 evolution was highest at day 6. Filtrate NH4(+)-N increased from background levels to a final value of 57 micro-g of N/treatment. Filtrate NO3(-)-N completely disappeared by day 6 and organic N showed a slight decline between days 12 and 18. The majority of the N-15 that could be recovered appeared in the particulate organic fraction by day 6, and the filtrate NH4(+)-N fraction contained 11 micro-g of N-15 by day 18. The N-15 enrichment values of the filtrate NH4(+) and the inorganic N associated with the particulate fraction had increased to about 20 atom % N-15 by 18 days of incubation, whereas the particulate organic fraction reached its highest enrichment by day 6. Measurements of N2 fixation and denitrification indicated an insignificant gain or loss of N from the experimental system by these processes. Woody debris in stream ecosystems might function as a rapid and efficient sink for exogenous N, resulting in stimulation of wood decomposition and subsequent activation of other N cycling processes. (Baker-IVI)
W85-07137

SURVEY FOR VIRUSES FROM FRESH WATER THAT INFECT A EUCARYOTIC CHLORELLA-LIKE GREEN ALGA,
Nebraska Univ.-Lincoln. Dept. of Plant Pathology.
J. L. Van Etten, C. H. Ban Etten, J. K. Johnson, and D. E. Burbank.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1326-1328, May, 1985. 2 Tab, 11 Ref. DOE grant DE AC02-82-ER12086 and Public Health Service grant GM-32441.

Descriptors: *Plant viruses, *Chlorophyta, Chlorella, Ponds, Streams, Algae, Water analysis, Plant pathology, Viruses.

Twenty freshwater samples were collected from ponds and streams in different geographical regions in the US and assayed for viruses. Four of the 20 samples produced plaques on Chlorella strain NC64A lawns. The virus titer in these water samples varied from 60 to 40000 PFU/ml. A few of the plaques were picked from each of the four samples and partially characterized. All viruses were similar to the polyhedral virus PBCV-1 with regard to host range, morphology and sensitivity to organic solvents. The viruses reacted with PBCV-1 antiserum and the viral DNAs hybridized extensively with PBCV-1 DNA. The ease with which these new lytic viruses were found suggests that viruses which infect this particular strain of Chlorella and possibly other eucaryotic algae are common in freshwater environments. Thirty-five water samples collected in 10 states were assayed for plaque-forming ability on Chlorella strain NC64A. Thirteen of the samples from five states contained at least 1 PFU/10 ml of fresh water. All produced sharply defined, clear plaques. The development of a plaque assay for these eucaryotic algal viruses allows it to be established that large, double stranded DNA-containing viruses are common in aquatic environments. The virus population fluctuates both qualitatively and quantitatively with time in these environments. The role that these viruses play in their aquatic environments is completely unknown. (Baker-IVI)
W85-07138

SPECIFIC UPTAKE RATES OF AMINO ACIDS BY ATTACHED AND FREE-LIVING BACTERIA IN A MESOTROPHIC LAKE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. Simon.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1254-1259, May, 1985. 3 FIg, 3 Tab, 40 Ref.

Descriptors: *Bacteria, *Amino acids, *Mesotrophic lakes, *Lake Constance, Lakes, Seasonal variation, Spatial distribution, Population dynamics, Chlorophyll a, Vertical distribution.

Attached bacteria and small (0.2 to 1.0 micro-m) and large (1.0 to 3.0 micro-m) free living bacteria are compared in terms of specific uptake rates of amino acids in an investigation of their seasonal and vertical fluctuations in Lake Constance. They are also compared with specific uptake rates based on numbers of active cells as shown by autoradiography. Lake Constance was thermally stratified from mid-June to November. The seasonal patterns of the bacterial cell counts correlated only weakly with the net uptake rates of amino acids and the chlorophyll a concentration. Pronounced peaks of the cell counts occurred about 1 week after the peaks of chlorophyll a. The net uptake rates of amino acids correlated fairly well with chloropyll a concentration. High percentages of total cell counts in the fraction 0.2 to 1.0 micro-m occurred between the lake surface and a depth of 20 m and lower percentages occurred below 20 m with a few exceptions. Seasonal patterns of active bacteria were closely related to the net uptake rates of amino acids and the total cell counts. The specific activity index, used as specific uptake rates of amino acids, is a useful indicator of the metabolic activity of different fractions of the bacterial population. If based on acridine orange direct count (AODC) the fluctuations of specific uptake rates for attached bacteria are greatest and those for small free-living bacteria are lowest. At most times and depths, the specific activity of attached bacteria exceeds that of free-living bacteria if based on AODC. If the specific uptake rates for free-living bacteria are based on autoradiographic cell counts, they are in the same range as those for attached bacteria based on AODC. Only the most active free-living cells are counted in this case. A differentiation between small and large free-living bacteria revealed that the seasonal and vertical patterns of their activity differ, although their specific activity index is of the same order of magnitude. (Baker-IVI)
W85-07139

LAKE UNTERSEE, A FIRST ISOTOPE STUDY OF THE LARGEST FRESHWATER LAKE IN THE INTERIOR OF EAST ANTARCTICA,
Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung.
W.-D. Hermichen, P. Kowski, and U. Wand.
Nature, Vol. 315, No. 6015, p 131-133, May, 1985. 3 Fig, 1 Tab, 29 Ref.

Descriptors: *Lake Untersee, *Antarctica, *Isotope studies, Ice cover, Lake ice, Polar regions, Hydrology, Thermal properties, Water chemistry, Sublimation, Melting, Glaciers.

Perennially ice-covered lakes partially bounded by glacier ice are common in some Antarctic coastal regions but very rare inside the continent. Hydrological studies on the largest freshwater lake of interior Antarctica, Lake Untersee (71 degrees 20' S/13 degrees 30' E, surface area 10 sq km, maximum depth > 79 m), show that the lake arose from a melt-water pond during climatic optimum periods in the Holocene. At present, the studied water body is thermally, hydrogeochemically and isotopically homogeneous because of thermal convection during the austral summer. Lake Untersee is fed throughout the year by underwater melting of the adjoining glacier ice. Isotope data suggest a permanent ice cover during its existence. The drainless lake is constantly losing water through sublimation on the surface of the more than 2.5-m-thick ice cover. The salt content suggests that the present water body is the remainder of an amount of melt water at least 50 times as great. (Author's abstract)
W85-07142

EFFECTS OF FLUSHING RATE ON PHOSPHORUS RETENTION IN AN AQUATIC BIOME,
Kashmir Univ., Srinagar (India). Dept. of Botany.
V. Kaul, M. Isaac, and S. N. Pandita.
Environmental Conservation, Vol. 11, No. 4, p 360-362, Winter, 1984. 3 Fig, 11 Ref.

Descriptors: *Phosphorus retention, *Flushing rate, *Lakes, *Dal Lake, *Kashmir, *India, Eu-

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trophication, Evapotranspiration, Water budget, Phosphorus.

The effects of flushing rate on phosphorus retention were investigated over a period of one year on Dal Lake, situated at 1,587 meters above MSL in Srinagar, Kashmir, which has a submediterranean climate. Total phosphorus loading to the Lake reached a peak in the month of June, 1.46 g per sq m per month, followed by 1.18 g per sq m per month in July. Monthly flushing rates of water, calculated from the water budget of the Lake, showed the peak value of 3.9 times for May, primarily due to increased input of water in this month as a result of frequent rains coupled with the snow melt in the upper reaches of the mountainous catchment. P-loading to the Lake from March to July is high, but simultaneously the flushing rate is also comparably high, thereby counterbalancing the former. Statistical analysis reveals a positive correlation between flushing rate of water and P-loading, a negative correlation between flushing rate and retention coefficient of phosphorus, and a negative correlation between P-loading and retention coefficient of phosphous. Evidently the high flushing-rate is a great check on phosphorus accumulation in the system, working in unison with some other natural mechanisms that are operative for removal of phosphorus from the system, which does not show signs of advanced eutrophication. (Baker-IVI)
W85-07147

2I. Water In Plants

MICROCLIMATE OF A RAINFALL SHELTER,
Texas Agricultural Experiment Station, Temple. Blackland Research Center.
W. A. Dugas, Jr., and D. R. Upchurch.
Agronomy Journal, Vol. 76, No. 6, p 867-871, November-December, 1984. 4 Fig, 5 Tab, 4 Ref.

Descriptors: *Microclimate, *Rainfall shelters, Wind, Air temperature, Relative humidity, Canopy, Solar radiation, Water stress, Experimental apparatus, Climate.

To induce water stress on crops grown in areas where extended periods without precipitation during the growing season are infrequent, rainfall shelters are increasingly being used. Shelters are moved over plots during or previous to precipitation. The microclimatic effects of a large (18 x 48 m) fiberglass shelter near Temple, TX were investigated. Air temperature, solar radiation, wind speed, and relative humidity measurements were made throughout two growing seasons to determine the effect of the shelter on the canopy microclimate (relative to the microclimate outside the shelter) when the shelter off and over the plots. When the shelter was over the plots, the effects upon wind speed and radiation, which were affected most, were consistent; radiation was reduced from 30 to 40% and, because of shelter design, wind speed was reduced to nearly zero. Generally, air temperature and humidify effects were dependent upon temperature and radiation levels. Air temperature differentials greater than 6 C developed within an hour after movement of the shelter over the plots, while radiation and wind effects occurred instantaneously. When off the plots, the shelter's microclimatic effects were not detectable. Under certain conditons, however, the shelter may significantly affect the microclimate. Therefore, researchers using shelters need to investigate the microclimate under a shelter for proper interpretation of plant responses to the environment. (Author's abstract)
W85-06185

EFFECT OF FURROW DIKING, SUBSOILING, AND SLOPE POSITION ON CROP YIELDS,
Texas Agricultural Experiment Station, Vernon.
For primary bibliographic entry see Field 3F.
W85-06186

LUXURY WATER USE BY BERMUDAGRASS TURF,
Arizona Univ., Tucson. Coll. of Agriculture.
For primary bibliographic entry see Field 2D.
W85-06189

AGROCLIMATIC CLASSIFICATION OF THE SEMI-ARID TROPICS III. CHARACTERISTICS OF VARIABLES RELEVANT TO CROP PRODUCT POTENTIAL,
Food and Agriculture Organization of the United Nations, Maputo (Mozambique).
S. J. Reddy.
Agricultural Meteorology, Vol. 30, No. 4, p 269-292, January, 1984. 9 Fig, 5 Tab, 23 Ref.

Descriptors: *Soil water, *Semiarid climates, *Crop production, *India, Crop yield, Climate, Soil properties, Temperature effects, Seasonal variation, Rainfall.

Based on a comparison between agroclimatic variables, soil water balance simulation results and crop performance results at selected Indian locations, successful cropping systems on similar soil types with different levels of dependability were identified. With high variability in both the onset and cessation times of the rainy season, then, if the effective rainy period is short (less than 8 weeks) and with early sowing rains, a long duration single crop or intercroping should be adopted, but if these rains are late then a single crop should be grown in alfisols and in the vertisols a rabi single crop should follow a fallow kharif. Or, if the effective rainy period is moderately long (8-13 weeks) and with early sowing rains, intercropping should be adopted, but if these rains are late a single crop should be grown in alfisols, and in vertisols either double cropping or intercropping should be practiced. Under more stable onset and cessation times for sowing rains with a short effective rainy period a single crop should be grown; with a moderate effective rainy period, intercropping should be adopted in alfisols and double cropping in verisols; with a long effective rainy period, double cropping is preferable. (Baker-IVI)
W85-06190

GROWTH BEHAVIOUR OF FIELD GROWN SUGARCANE VARIETIES IN RELATION TO ENVIRONMENTAL PARAMETERS AND SOIL MOISTURE STRESS,
Sugarcane Breeding Inst., Coimbatore (India).
S. Venkataramana, S. Shunmugasundaram, and K. M. Naidu.
Agricultural and Forest Meteorology, Vol. 31, No. 3/4, p 251-260, June, 1984. 3 Tab, 13 Ref.

Descriptors: *Soil water, *Moisture stress, *Plant growth, *Sugarcane, Humidity, Rainfall, Soil properties, Drought resistance, Crop yields, Temperature.

Growth analysis has been used to evaluate various sugarcane varieties for their drought resistance capacity under field conditions. The net assimilation rate I(NAR), which is singularly responsible for growth, was high during the tillering and grand growth period, but declined sharply with the age of the crop. Correlations between weather parameters and growth characteristics have indicated a few salient points. Air temperature and soil temperature possessed a positive correlation with NAR while relative humidity, rainfall and number of rainy days were negatively correlated. Relative growth rate (RGR) was lowered with rise in relative humidity (RH) percent but increased with high air and soil temperature. Leaf area ratio (LAR) was positively related to temperature while RH% had negative association. Specific leaf weight (SLW) and specific leaf area (SLA) were not uniform during crop growth under both normal irrigation and drought conditions. Since sugarcane grows well in warmer climates, radiation coupled with temperature influenced the growth during the early phase. Thus, during the maturity phase the growth parameters did not linearly respond to the changing environmental variables. (Baker-IVI)
W85-06192

SOME SENSITIVITY RESULTS FOR CORN CANOPY TEMPERATURE AND ITS SPATIAL VARIATION INDUCED BY SOIL HYDRAULIC HETEROGENEITY,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
B. J. Choudhury, and C. A. Federer.
Agricultural and Forest Meteorology, Vol. 31, No. 3/4, p 297-317, June, 1984. 14 Fig, 45 Ref.

Descriptors: *Soil-water-plant relationships, *Spatial distribution, *Crop yield, *Corn, *Air temperature, *Canopy, effects, Soil properties, Simulation, Model studies, Soil hydraulic properties.

A simulation model is developed for canopy-air temperature difference for a sweet corn crop and use in sensitivity studies for canopy temperature and its spatial variation induced by soil hydraulic heterogeneity. Simulations are done using mostly clear sky atmospheric parameters, primarily because space-borne infrared sensors would be unable to provide surface temperatures under cloudy conditions. Combining the Montieth transpiration equation with both uptake from a single-layered root zone and change in internal storage of the plant, the continuity equation for water flux in the soil-plant-atmosphere system was solved. The canopy temperatures are obtained from the energy balance equations. The scaling theory is used to model the spatial variability of soil hydraulic properties, and dynamic equations for plant storage water and root zone soil water are used to simulate soil drying and resulting spatial variation of canopy temperatures. (Baker-IVI)
W85-06193

WATER USE BY TAMARILLOS (CYPHOMANDRA BETACEA) WITHIN A SHELTERED ORCHARD ENVIRONMENT,
Ruakura Soil and Plant Research Station, Hamilton (New Zealand).
M. J. Judd, and K. J. McAneney.
Agricultural and Forest Meteorology, Vol. 32, No. 1, p 31-40, July, 1984. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Water use, *Plant growth, *Orchards, *Tamarillos, Canopy, Evaporation, Advection, Transpiration, Solar radiation, Shelter.

The tamarillo is a small sub-tropical tree which is apparently grown as a horticultural crop only in New Zealand. Excision experiments were used to provide a direct measurement of the transpiration of tamarillos within a sheltered orchard. Problems experienced by others through trunk expansion associated with excess water uptake appear minimal, perhaps because of the well watered environment. While the effects of repeated rows of shelter on turbulent transport processes are unknown, the water uptake data presented indicate that they tend to decouple the orchard environment from overhead conditions. This has the result of reducing the influence of the overhead vapor-pressure deficit and consequently tying transpiration closer to net radiation and hence the equilibrium condition. (Baker-IVI)
W85-06195

STABILITY OF NON-WATER-STRESSED BASELINES,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2D.
W85-06198

STOMATAL CONDUCTANCE AND PHOTOSYNTHESIS IN WATER HYACINTH: EFFECTS OF REMOVING WATER FROM ROOTS AS QUANTIFIED BY A FOLIAGE-TEMPERATURE-BASED PLANT WATER STRESS INDEX,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
S. B. Idso, P. J. Pinter, Jr., R. J. Reginato, and K. L. Clawson.
Agricultural and Forest Meteorology, Vol. 32, No, 3/4, p 249-256, September, 1984. 6 Fig, 14 Ref.

Descriptors: *Water stress, *Water hyacinth, *Stomatal conductance, *Photosynthesis, Leaves, Roots, Temperature, Irrigation practices, Stomatal transpiration, Aquatic plants.

Stomatal conductance and net photosynthesis measurements were made over a period of a week in mid-October on two stands of water hyacinths floating in sunken metal stock tanks at Phoenix, Arizona. On the second day of the experiment, all free water in one of the tanks was removed. Foliage temperature measurements were subsequently used to quantify the water stress experienced by the water robbed plants. A plant water stress index derived from the foliage temperature and air vapor pressure deficit data was then used to study the effects of developing water stress on the plant physiological parameters being measured. Detectable levels of water stress did not occur until the day following water removal, and water stress did not become maximal until five days later. Information gained can be useful for farm management practices, particularly about irrigation schemes. (Baker-IVI)
W85-06200

APPLE ROOT DISTRIBUTION AS EFFECTED BY IRRIGATION AT DIFFERENT SOIL WATER LEVELS ON TWO SOIL TYPES,
Department of Agriculture, Potchefstroom (South Africa).
For primary bibliographic entry see Field 3F.
W85-06205

STRESS TOLERANCE IN SOYBEANS. I. EVALUATION OF THREE SCREENING TECHNIQUES FOR HEAT AND DROUGHT TOLERANCE,
Kansas State Univ., Manhattan. Dept. of Agronomy.
M. Bouslama, and W. T. Schapaugh, Jr.
Crop Science, Vol. 24, No. 5, p 933-937, September-October, 1984. 1 Fig, 8 Tab, 19 Ref.

Descriptors: *Water stress, *Drought resistance, *Plant growth, *Soybeans, Heat tolerance, Osmotic pressure.

The genetic variability among 20 soybean cultivars subjected to drought stress were evaluated and a determination was made as to whether these parameters are effective criteria to select for drought and heat tolerance. Three screening techniques were used: first, germinating seed in polyethylene glycol-600 (PEG) at -0.6 MPa osmotic pressure; second, subjecting seedlings to PEG-600 at -0.6 MPa osmotic pressure in hydroponic solution for 14 days; and third, a heat tolerance test based on the cellular membrane thermostability. Two of the 20 cultivars tested were relatively drought tolerant, 2 were relatively susceptible, and the remaining cultivars fell into an intermediate group. The hydroponic seedling and heat tolerance tests gave highly significant correlated findings, including that both drought and heat tolerance were identified in the same cultivars under the condition of the study. The seed germination test may not be used as a reliable procedure for identifying drought tolerant cultivars as it tends to reflect differences in seed quality and has no relation to field performance. The hydroponic seedling test seemed to be the most reliable and potentially useful as a means for screening for drought tolerance in soybeans. (Baker-IVI)
W85-06206

EVIDENCE OF FLOODS ON THE POTOMAC RIVER FROM ANATOMICAL ABNORMALITIES IN THE WOOD OF FLOOD-PLAIN TREES,
Geological Survey, Reston, VA. Water Resources Div.
T. M. Yanosky.
Available from Distr. Br., USGS, 604 S. Pickett St., Alex., Va. 22304. USGS Professional Paper 1296, 1983. 42 p, 18 Fig, 9 Tab, 9 Ref.

Descriptors: *Flood plain, *Flood damage, Vegetation growth, *Ash trees, Floods, Vascular tissues, Woody tissues, *Flood rings, Botanical evidence, *Potomac River, Wood anatomy, Anomalous plant growth, Tree rings.

Ash trees along the Potomac River flood plain near Washington, D.C., were studied to determine changes in wood anatomy related to flood damage, and anomalous growth was compared to flood records for April 15 to August 31, 1930-79. Collectively, anatomical evidence was detected for 33 of the 34 growing-season floods during the study period. Evidence of 12 floods prior to 1930 was also noted, including catastrophic ones in 1889 and 1924. Trees damaged after the transition from earlywood to latewood growth typically formed 'flood rings' of enlarged vessels within the latewood zone. Trees damaged near the beginning of the growth year developed flood rings within, or contiguous with, the earlywood. Both patterns are assumed to have developed when flood-damaged trees produced a second crop of leaves. Trees damaged by high-magnitude floods developed well formed flood rings along the entire height and around the entire circumference of the stem. Small floods were generally associated wtih diffuse or discontinuous anomalies restricted to stem apices. Frequency of flood rings was positively related to flood magnitude, and time of flood generation during the tree-growth season was estimated from the radial position of anomalous growth relative to annual ring width. Reconstructing tree heights in a year of flood-ring formation gives a minimum stage estimate along local stream reaches. Some trees provided evidence of numerous floods. Those with the greatest number of flood rings grew on frequently flooded surfaces subject to flood-flow velocities of at least 1 m/s, and more typically greater than 2 m/s. Tree size, more than age, was related to flood-ring formation. Trees kept small by frequent flood damage had more flood rings than taller trees of comparable age. (USGS)
W85-06360

SURVIVAL ADAPTATIONS OF THREE EUPHOBIA SPP. IN ARID ECOSYSTEM,
Jodhpur Univ. (India). Dept. of Botany.
S. Kuman, and D. N. Sen.
Folia Geobotanica et Phytotaxonomica, Vol. 20, No. 1, p 57-66, 1985. 5 Fig, 1 Tab, 28 Ref.

Descriptors: *Weeds, *Arid lands, *Ecosystems, *Euphorbia, Plant growth, Stomata, Water deficit, Drought tolerance, Habitats, Plant water content, Transpiration.

The three species of Euphorbia (E. hirta, E. granulata, and E. prostrata) investigated are among the weeds adapted best to a dry environment. Water relations of these weeds have been compared with those of species well established in arid ecosystems such as Cyperus rotundus, Prosopis juliflora, P. cineraria and Calotropis procera. The three Euphorbia species showed survival adaptations in terms of the thickness of cuticle, number of hairs, leaf area, stomatal index, relative water content, water deficit, bound water, and plant water content. The thickness of cuticle and density of hairs increased from in-season to off-season while leaf area showed a sharp decrease. E. hirta had the highest relative water content (95%) while E. graulata was characterized by the lowest content (82%). Water deficit increased continuously from in-season to off-season. The plant water content was associated with the soil moisture content i.e., it decreased with depletion of soil moisture. The present study has further proved that plants tend to avoid harsh conditions by reducing their surface area, increasing their bound water content and by a low stomatal index, thick cuticle and by opening their stomata during hours of a low transpiration demand. (Baker-IVI)
W85-06371

INFLUENCE OF DIFFERENT LEVELS OF SOIL MOISTURE AS WELL AS OF NITROGEN AND POTASSIUM FERTILIZER ON THE YIELD AND QUALITY OF POTATOES IN MATURITY GROUP IV. SECOND REPORT: GROWTH, YIELD, AND YIELD COMPONENTS (DER EINFLUSS UNTERSCHIEDLICHER BODENFEUCHTESTUFEN SOWIE STICKSTOFF - UND KALIUMDUNGUNGSSTUFEN AUF ERTRAG UND QUALITAT VON KARTOFFELN DER REIFEGRUPPE IV),
Martin-Luther-Univ. Halle-Wittenberg, Halle (German D.R.).
H. Schmidt, and A. Vetter.
Wissenschaftliche Zeitschrift Martin-Luther-Universitat Halle-Wittenberg, Vol. 34, No. 1, p 50-60, 1985. 9 Fig, 2 Tab, 5 Ref.

Descriptors: *Soil water, *Nitrogen, *Potassium, *Fertilizers, *Plant growth, *Crop yield, *Potatoes, Plant physiology, Fertilization, Tubers, Crop production, Precipitation, Agronomy.

A study was performed in the German Democratic Republic in 1980 and 1981 of the influence of soil moisture and of nitrogen and potassium fertilizers on the growth and yield of potatoes in maturity group IV. Soil moisture during early growth was highly variable in both years, and this affected the length of the flowering period, having an alternating effect with initial soil moisture (ISM). The flowering period was shorter with 300 kg N fertilizer than with 150 kg. Increasing watering from the beginning of bud formation resulted in an increase in the number of stalks and length of shoots, while fertilizer variation did not affect this parameter. An increase in soil moisture between bud formation and the end of flowering caused speedier maturation of vegetation, while high final soil moisture (FSM) retarded maturation. Nitrogen fertilization also retarded maturation, while this effect was observed for potassium only in 1980. To achieve high yields, a soil-moisture content of 40% nFK was required between bud and flower when dry growth conditions prevailed between sprouting and bud formation, while 60% nFK was needed when soil moisture was high or average during early growth. An increase in soil moisture between the end of flowering and abscission level 70 (AL 70) unexpectedly caused a significant increase in yield. Raising nitrogen and potassium fertilization from 150 to 300 kg and from 240 to 480 kg, respectively, did not improve yield. Results of the study led to the following recommendations for soil moisture at the lower levels of fertilization: in order to achieve the highest possible yield for dry early-growth conditions, 40% nFK ISM, 80% nFK FSM; for wet early-growth conditions, 60% nFK ISM, 60% nFK FSM; 300 mm precipitation between bud formation and AL 70 (higher levels decrease yield). Highest yields were 406 dt/ha in 1980 (40/80% nFK) and 451 dt/ha in 1981 (60/80% nFK). Production of dehydrated potatoes, flour, and tubers corresponded to the yield of fresh potatoes. (Gish-IVI)
W85-06523

PLANT PHYSIOLOGICAL METHODS FOR STUDYING EVAPOTRANSPIRATION: PROBLEMS OF TELLING THE FOREST FROM THE TREES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2D.
W85-06674

WATER USE BY ISOLATED TREES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
For primary bibliographic entry see Field 2E.
W85-06677

PLANT COMMUNITIES AND GROUNDWATER LEVELS IN SOUTHERN NASSAU COUNTY, LONG ISLAND, NEW YORK,
City Coll., New York. Dept. of Biology.
For primary bibliographic entry see Field 2F.
W85-06802

EFFECTS OF SODIUM AND POTASSIUM CHLORIDES ON THE GROWTH AND ACCUMULATION OF MINERAL IONS BY CYPERUS INVOLUCRATUS ROTTB,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
For primary bibliographic entry see Field 5C.
W85-06803

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INFLUENCE OF SOIL DROUGHT AND PARTIAL WATERLOGGING ON WATER RELATIONS OF GMELINA ARBOREA SEEDLINGS,
Department of Botany, University of Ibadan, Nigeria, Africa.
O. Osonubi, F. E. Fasehum, and I. O. Fasidi.
Oecologia, Vol. 66, No. 1, p 126-131, April, 1985. 6 Fig, 1 Tab, 14 Ref.

Descriptors: *Soil water, *Waterlogging, *Trees, *Gmelina, *Moisture stress, Transpiration, Plant growth, Plant physiology, Roots.

Stomatal conductance of unstressed, soil drought, and previously drought (predrought) Gmelina arborea seedlings increased in the morning and decreased before or immediately after midday. In the unstressed and predrought seedlings, leaf water potential decreased with increases in transpiration. In soil drought seedlings, there was some evidence of decreased hydraulic conductivity from soil to the plant, as indicated by the shape in the slope of the water potential/transpiration relationship. Root growth of drought plants was greater than in their unstressed counterparts at the lowest soil segment of a pot. The partial recovery of predrought seedlings was attributed to this substantial root growth in the lowest soil segment. In the second experiment, Gmelina arborea seedlings were partially waterlogged, by flooding the polyethylene bag to half its length, for a period of 23 days. Waterlogging induced stomatal closure and reduction in leaf water potential but there was some evidence of tolerance to waterlogging towards the end of treatment. Root growth, shoot and root dry weights were slightly reduced below those of controls. After 9 days of waterlogging, adventitious roots began to form which correlated with depletion of soluble sugars in the shoot but with an increase in the roots. It is suggested that the tolerance of Gmelina plants to either soil drought or waterlogging may partly be due to partitioning of the soluble sugars from shoot to roots for production of roots and formation of adventitious roots respectively which are likely to enhance the flow of water from the soils to the plant. Therefore the plant response is very similar under conditions of increased deficits and surplus of soil water. (Author's abstract)
W85-06858

DISTRIBUTION AND RELATIVE ABUNDANCE OF FISHES IN WISCONSIN: III. RED RIVER BASIN,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 2H.
W85-06909

EFFECTS OF PERMANENTLY RAISED WATER TABLES ON FOREST OVERSTORY VEGETATION IN THE VICINITY OF THE TENNESSEE-TOMBIGBEE WATERWAY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W85-06993

WATER STRESS CONDITIONING OF CORN (ZEA MAYS) IN THE FIELD AND THE GREENHOUSE,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
L. M. Dwyer, and D. W. Stewart.
Canadian Journal of Botany, Vol. 63, No. 4, p 704-710, April, 1985. 5 Fig, 1 Tab, 33 Ref.

Descriptors: *Corn, *Water stress, Leaves, Water potential, Osmotic potential, Plant conductivity, Turgor, Greenhouses, Field conditions.

Leaf water potential, osmotic potential, and leaf conductance were measured on corn (Zea mays L.) under water stress in the field and the greenhouse. Field-grown plants were subjected to several cycles of moderate water stress during vegetative growth, while greenhouse plants were well watered until just before the measurement period began following tasselling. In both the field and the greenhouse, leaf water potential declined at midday. Comparison of leaf water potential and osmotic potential measurements indicated that in both environments, the midday decline in leaf water potential was accompanied by a decline in osmotic potential. Since the decline in osmotic potential was greater than that accounted for by predicted volume changes resulting from normal daily dehydration, it was assumed to indicate osmotic adjustment. Despite these similarities, field-grown plants showed a greater response to water stress. Field plants underwent larger daily changes in leaf water potential and these were accompanied by larger changes in osmotic potential. As a result of this greater osmotic adjustment in the field, conductivity was higher at equivalent leaf water potentials and the critical leaf water potential was lower than in greenhouse-grown plants. In both environments, osmotic adjustment maintained leaf turgor (or pressure potential) in narrow positive range. Although there was no direct relation between turgor potential and leaf conductivity, it is hypothesized that the maintenance of a positive turgor potential during daylight hours is significant for growth since it may allow the moisture- and temperature-sensitive process of leaf expansion to proceed during the warmer daylight hours, even under moderate water stress. (Author's abstract)
W85-07140

2J. Erosion and Sedimentation

RELEASE OF PHOSPHORUS AND METALS FROM SOILS AND SEDIMENTS DURING DISPERSION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
A. Dong, G. V. Simsiman, and G. Chesters.
Soil Science, Vol. 139, No. 2, p 97-99, February, 1985. 1 Tab, 11 Ref. Great Lakes National Program grant R005142.

Descriptors: *Soil properties, *Bottom sediments, *Metals, *Phosphorus, *Dispersion, Menomonee River Basin, Wisconsin, Sediment transport, Resuspension, Lead, Zinc, Nickel, Manganese, Iron, Copper, Chromium, Cadmium, Aluminum.

Particle size distribution and chemical composition of each size fraction are important in characterizing soils and sediments. Ultrasound dispersion for size fractionation may release chemical constituents from the particles. Six soil types and 15 river bottom sediments from the Menomonee River Basin, Wisconsin, were sampled and analyzed for elemental composition. The P, Al, Cd, Cr, Cu, Fe, Mn, Ni Pb, and Zn released from soils and river bottom sediments to the supernatant liquid during dispersion by ultrasound and end-over-end shaking techniques were determined. The ratios of the elements in the supernatant to the total acid-digestible elements on the solid phase varied from 1.0 to 7.3% for soils and 0.3 to 2.0% for sediments, using ultrasound, and 0.05 to 2.6% for soils and 0.03 to 0.7% for sediments, using the sharing method. The ratio provides an estimate of the analytical error caused by dispersion during particle size fractionation. The ratio may indicate the extent of release of elements to the overlying water during resuspension or transport of sediments. Although the release of some elements was higher by the ultrasound treatment than by shaking for sediment samples, the t-test showed no significant difference between the two treatments, partly due to the small number of samples used in the shaking treatment. Because of the ease with which P and Cd are released to solution from river sediments, this phenomenon should be viewed with concern, knowing the importance of these contaminants in rivers and lakes. (Baker-IVI)
W85-06207

VARIABILITY IN MEASURED BEDLOAD-TRANSPORT RATES,
Geological Survey, Nashville, TN.
W. P. Carey.
Water Resources Bulletin, Vol. 21, No. 1, p 39-48, February, 1985. 12 Fig, 8 Ref.

Descriptors: *Bed load, *Sediment transport, *Variability, Flow discharge, Sampling, Probability.

Variability in bedload-transport rates during constant water discharge is an inherent part of the bedload-transport process. Although this variability has been measured extensively in the laboratory, similar information generally is not available from field measurements. During a four-day period of nearly constant water discharge, four sets of consecutively collected bedload samples, ranging from 43 to 120 samples, were obtained at the same cross channel location using a standard 65-pound Helley-Smith bedload sampler. When the measured transport rates are converted to dimensionless rates and plotted as cumulative frequency distributions, they show good agreement with a theoretical probability distribution function of rates derived for the case of ripples on dunes. The distributions show that during constant water discharge individual measured rates at a fixed point vary from near zero to four times the mean rate, and 60% of the sampled rates will be less than the mean. Because of the large variation in transport rates that occurs at every location in the cross section, many observations are required to establish an accurate estimate of the mean rate at any given location. (Author's abstract)
W85-06237

COMPARISON OF THREE METHODS FOR MEASURING RECENT RATES OF SEDIMENT ACCUMULATION,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
J. C. Ritchie, and J. R. McHenry.
Water Resources Bulletin, Vol. 21, No. 1, p 99-103, February, 1985. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Sediment accumulation rate, *Sedimentation, Backwater lakes, Lakes, Reservoirs, Sediment deposition, Cesium radioisotopes, Fallout, Spud method, Bottom contours.

The determination of sediment accumulation rates is important in understanding how these materials are affecting lakes and reservoirs ecosystems. In this study three methods were used to estimate sediment accumulation rates in the impounded backwater lakes behind Lock and Dam Nos. 8 and 9 on the upper Mississippi River. The three methods were: (1) a 'spud' survey, (2) a survey of bottom contours, and (3) the use of fallout cesium-137. The field use of these three methods of determining sediment accumulation and the potential errors and merits involved in each method are discussed. The results from the field study in backwater areas along the upper Mississippi River showed the survey of bottom contour method gave the lowest rate of sediment deposition and the Cs-137 method gave the highest rates. Sediment accumulation rates from 0 to 7.8 cm per year were measured in the study area. All three methods are useful and have unique characteristics for determining rates and patterns of sediment accumulation. Thus the choice of a method to be used in a sediment survey is dependent on the type of information needed and the time available. (Author's abstract)
W85-06244

SHOALING OF PORT OF ASTORIA, OREGON, BY SEDIMENT FROM MT. ST. HELENS ERUPTION,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
L. S. Slotta, C. R. Cobos, and R. S. Mustain.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 160661/AS, Price codes: A05 in paper copy, A01 in microfiche. Oregon Water Resources Research Institute, Corvallis, Project Completion Report, Publication WRRI-89, Corvallis, November 1983, 81 p, 30 Fig, 18 Tab, 30 Ref, Project No. BuRec C-10127-V (1), Contract/Grant No. 14-34-0001-1485(1).

Descriptors: *Sediment transport, *Sedimentation, *Suspended sediments, Silting, Shoals, Volcanoes, Estuaries, Harbors, *Oregon, *Mt. St. Helens, *Columbia River Estuary, Port of Astoria.

Sedimentation suddenly increased in the Lower Columbia River immediately following the May 18, 1980 eruption of Mt. St. Helens. Research

conducted at the Port of Astoria during 1981-1982 permitted determination of the shoaling mechanisms and confirmed that much of the deposited sediment was of recent Mt. St. Helens origin. Sedimentation rates slowly decreased after the eruption but were still higher than pre-eruption rates in early 1983. Circulation and shoaling characteristics at the Port were investigated through field work, a physical model, a numerical circulation model, and a numerical sedimentation model. The physical model provided insight to the overall circulation patterns and tidal exchange of water. The numerical circulation model gave additional information on residence times and flushing rates of water in the dock slips. The numerical sedimentation model gave estimates of sedimentation rates. Field research allowed a more quantitative investigation of shoaling conditions. Sediment deposition rates in the harbor slips were measured using sedimentation buckets. Water currents and circulation were measured. Water samples were collected to characterize suspended sediment concentrations. Core samples of bed material were obtained for various physical analyses. Well-graded silt was the typical suspended sediment and bed material. Clay mineralogy, heavy minerals and microprobe tests indicated that the Columbus River (rather than nearby Youngs Bay) is the primary source of the suspended sediment causing chronic shoaling at the Port and that the Mt. St. Helens eruption contributed to that shoaling.
W85-06302

EVOLUTION OF A DRAINAGE NETWORK: REMOTE SENSING ANALYSIS OF THE NORTH FORK TOUTLE RIVER, MOUNT ST. HELENS, WASHINGTON,
Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W85-06303

CHANNEL CHANGE WORKSHOP PROBLEM NUMBER 3, ELK RIVER, KANSAS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 6G.
W85-06354

MICROSYSTEM SEDIMENT-WATER SIMULATION: A PRACTICAL TECHNIQUE FOR PREDICTING RESERVOIR WATER QUALITY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5B.
W85-06358

MASS MOVEMENT AND EROSION OF A SOUTHERN PENNINE BLANKET PEAT,
Victoria Univ. of Manchester (England). School of Biological Sciences.
J. H. Tallis.
Journal of Ecology, Vol. 73, No. 1, p 283-315, March, 1985. 13 Fig, 7 Tab, 40 Ref.

Descriptors: *Erosion, *Peat bogs, *Featherbed Moss, *England, Pollen analysis, Dating, Degradation, Mass wasting, Soil properties, Air pollution.

Pollen and macrofossil analyses were carried out at nineteen sites within a 1 sq km area of Featherbed Moss, Derbyshire, England. The sites covered a range of uneroded and eroded blanket peat types. Peat accumulation varied considerably, both within and between sites, from about 6 to 96 g/sq m/yr. The most striking differences occurred in the time interval 400-1000 A.D., when some sites showed an increased rate of peat accumulation and others a decreased rate. Two features of the growth of the peat blanket on Featherbed Moss are suggested to have been of major importance in ultimately bringing about its degradation and erosion: a very early spread of peat over flatter ground to the limits imposed by topography; and a rapid buildup of largely unhumified Sphagnum peat over more consolidated peat after 400 A.D. The onset of peat erosion on Featherbed Moss 1000-1200 years ago is interpreted as a natural phenomenon, instituted by a series of bog slides and bursts around the margin of the peat blanket. These led to the formation of drainage gullies extending back into the peat, slumping of the marginal peat downslope, and drawing off of water from the pools of the hummock-hollow complex on the watershed. The death of Sphagnum from air pollution some 200-300 years ago led to renewed peat erosion, which is still in progress. (Baker-IVI)
W85-06368

SOME PROBLEMS ABOUT THE SOIL EROSION IN THE VRANCEA SUBCARPATHIANS (QUELQUES PROBLEMES SUR L'EROSION DES SOLS DANS LES SUBCARPATES DE VRANCEA),
R. Gaspar, E. Untaru, C. C. Cristescu, and F. Roman.
Revue Roumaine Geologie Geophysique et Geographie, Vol. 28, p 67-72, 1984. 2 Fig, 3 Tab.

Descriptors: *Soil erosion, *Catchment areas, Runoff, Floods, Soil properties, Sediment transport, Erosion control, Mathematical equations.

There are presented the research works carried out during a period of 8-10 years in five torrential catchments with areas between 154 and 713 ha, covered by forests in a percentage of 16 to 98%. The maximum runoff coefficients during a high flood were between 0.342 (in the case of the catchment with a sandy-loamy soil) and 0.642 (in the case of the catchment with loamy-clayish soils). The specific erosion varied between 0.03 and 0.53 kWh/year. The channels and the afferent banks contributed with 88-95% of the total sediment transport, the rest was due to the slopes. Forests are an excellent means for maximum discharge diminishing and slope erosion controlling. The soil humidity in the first 20 cm was expressed with respect to the rainfall storm (h) and the antecedent precipitation index (IPA) in regression equations. The highflood waterloading with alluvial materials (Y)-in suspension-was expressed with respect to the flood discharge (X) in regression equations. (Author's abstract)
W85-06420

BANK SEDIMENT TYPE AND SUSPENDED-SEDIMENT TRANSPORT IN SAND-BED STREAMS,
Delaware Univ., Newark. Dept. of Geology.
J. E. Pizzuto.
Journal of Sedimentary Petrology, Vol 55, No. 2, p 222-225, March, 1985. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Sediment transport, *Suspended sediments, Sand, Stream banks, Streams, Clay, Silt.

The percent silt-clay in the banks of 12 sand-bed streams is significantly correlated with the percent of sand carried in suspension. A parameter which explicitly represents the rate of deposition for each grain size provides an even better correlation between the grain sizes in transport and those exposed in the banks. These results, though necessarily limited by the small number of rivers studied, provide a quantitative link between the sediment transport regime of a stream and its sedimentary record. (Authr's abstract)
W85-06421

DIFFERENTIAL TRANSPORT OF FALL-EQUIVALENT SAND GRAINS, LAKE ONTARIO, NEW YORK,
Illinois State Geological Survey Div., Champaign.
C. B. Trask, and B. M. Hand.
Journal of Sedimentary Petrology, Vol. 55, No. 2, p 226-234, March, 1985. 7 Fig, 36 Ref.

Descriptors: *Sediment transport, *Lake Ontario, *New York, Entrainment, Minerals.

Fractions composed of grains having uniform fall velocity were extracted from beach sands collected along the eastern end of Lake Ontario, New York. Heavy-liquid separations and point counts were performed on these fall-equivalent velocity splits to obtain relative abundances of hornblende, augite, hypersthene, garnet, magnetite, and quartz-density lights. Heavy minerals decrease in abundance in the direction of transport, and the degree to which any particular mineral lags behind another lighter mineral is a simple function of the mineral's effective-density ratio. The results confirm that heavy minerals are less transportable than fall-equivalent lights, an effect that may result from differential entrainability, transport within different zones of the beach, or both. (Author's abstract) 35 073187000
W85-06422

SUSPENDED LOAD OF THE DANUBE IN THE DANUBE-DNIEPER WATER SUPPLY SYSTEM (VZVESHENNYE NANOSY DUNAYA V SISTEME VODOKHOSYAISTVENNOGO KOMPLEKSA DUNAI-DNEPR),
V. M. Timchenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 4, p 73-85, 1984. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Suspended load, *Danube River, Suspended sediments, Sediment transport, Sedimentation, Water quality, Weather, Hydrology.

Conditions of influx, transport and accumulation of suspended load of the Danube river in the system of the designed Danube-Dnieper water supply system are studied as an important factor of water quality formation. A characteristic of potential volumes of the Danube suspended loads transported and accumulated in certain areas of the system is made on the basis of data on hydrometeorological conditions and parameters of certain elements of the system with extensive use of modern apparatus for calculating sedimentation processes. (Author's abstract)
W85-06479

INTENSITY OF DENITRIFICATION IN THE RYBINSK RESERVOIR GROUNDS (INTENSIVNOST' DEMITRIFIKATSII V GRUNTAKH RYBINSKOGO VODOKHRANILISHCHA),
I. N. Krylova.
Gidrobiologischeski Zhurnal, Vol. 20, No. 5, p 35-41, 1984. 1 Fig, 4 Tab, 18 Ref.

Descriptors: *Denitrification, *Rybinsk Reservoir, *Watersheds, Nitrates, Seasonal variation, Bottom sediments, Soil chemistry, Microorganisms, Nitrogen.

The acetylene inhibition method was used to determine intensity of biologic denitrification in the Rybinsk reservoir watershed for the vegetation period of 1979. It is shown that the process of nitrate reduction of molecular nitrogen is observed in all the seasons with an autumn maximum found, irrespective of the soil character. It is established that high content of nitrates in the watershed is the basic factor which determines denitrification activity in the bottom sediments of the Rybinsk reservoir under favorable redox conditions. Microflora is found to possess a high potential ability for denitrification. The mean denitrification intensity for the navigation period (163 days) was 3.1 mg N/sq m/day and total nitrogen losses for this time were 2327 t. (Author's abstract)
W85-06481

EVALUATION OF THE CONSUMED ORGANIC SUBSTANCE STOCK AND INTENSITY OF ITS DESTRUCTION IN THE KILIAN DELTA OF THE DANUBE (OTSENKA ZAPASA USVOYAEMOGO ORGANICHESKOGO VESHCHESTVA I INTENSIVNOSTI EGO DESTRUKTSII V VODE KILIISKOI DEL'TY DUNAYA),
I. K. Bashmakova.
Gidrobiologischeski Zhurnal, Vol. 20, No. 5, p 72-78, 1984. 2 Fig, 3 Tab, 22 Ref.

Descriptors: *Organic matter, *Decomposition, *Kilian Delta, *Danube, *USSR, Fate of pollutants, Deltas.

Organic substance destruction processes in the Soviet area of the Danube are quantitatively estimated. The stock both of organic substance on the whole and its biochemically mobile part is determined and the rate of the self-purification process-

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es proceeding in the Kilian delta arms of the Danube is established. (Author's abstract)
W85-06482

MODELING SEDIMENT DETENTION PONDS USING REACTOR THEORY AND ADVECTION-DIFFUSION CONCEPTS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
B. N. Wilson, and B. J. Barfield.
Water Resources Research, Vol. 21, No. 4, p 523-532, April, 1985. 5 Fig, 4 Tab, 20 Ref.

Descriptors: *Detention reservoirs, *Sedimentation, *Reactor theory, *Advection, *Diffusion, Algorithms, Mathematical models, Residence time, Particulate matter, Mass balance.

An algorithm called BASIN was developed to model the sedimentation process in detention ponds. This model was based on a mass balance equation (derived for an infinitesimal layer) that coupled reactor theory concepts with advection-diffusion processes. Reactor theory concepts are used to determine residence time of sediment particles and to mix influent sediment with previously stored flow. Advection-diffusion processes are used to model the settling characteristics of sediment and the vertical diffusion of sediment due to turbulence. The governing differential equation was solved for a maximum of nine different particle size classes to account for the large variation in settling characteristics of a nonuniform distribution. The concentrations from individual particle classes were then combined linearly to obtain a composite effluent concentration. Numerical solutions were obtained by using an implicit finite difference scheme. Predicted results of the model are compared to those observed on two pilot scale ponds for a total of 12 runs. The average percent error between predicted and observed trap efficiency was 5.2 %. The pond model did an excellent job of predicting the shape of the effluent sedimentgraphs. Relative to the peak influent concentration, the peak effluent concentration was predicted with reasonable accuracy. (Moore-IVI)
W85-06506

RESPONSE OF ALLUVIAL RIVERS TO SLOW ACTIVE TECTONIC MOVEMENT,
Chuo Univ., Tokyo (Japan). Inst. of Geosciences.
S. Ouchi.
Geological Society of America Bulletin, Vol. 96, No. 4, p 504-515, April, 1985. 15 Fig, 1 Tab, 37 Ref. NSF project EAR-7727573.

Descriptors: *Alluvial rivers, *Tectonic movement, *Channel morphology, Braided channels, Subsidence, Uplift, Bank erosion, Aggradation, Slopes, Sinuosity, Surface deformation.

Alluvial rivers respond to valley-slope deformation caused by active tectonics in various ways depending on the rate and amount of surficial deformation and on the type of river. On the basis of experimental results and field examples, hypothetical models of river response to anticlinal uplift and synclinal subsidence were developed for different types of alluvial rivers. An experimental braided channel responded to anticlinal uplift across the channel with degradation and terrace formation in the central part of the uplift. With subsidence, aggradation in the central reach was the main response. Transverse bars developed downstream of the subsidence axis. An experimental meandering channel responded to slope steepening with a sinuosity increase. Bank erosion and point-bar growth occurred downstream of the anticlinal axis and upstream of the synclinal axis. Upstream of the uplift axis and downstream of the subsidence axis, where the slope was flattened, water flooded over bars. Local convexity in longitudinal profiles of the middle Rio Grande, New Mexico, is considered to be formed by a domal uplift. Local aggradation and degradation could be explained by the effect of uplift. The San Joaquin River, California, which is now highly controlled, does not show clear adjustment to the rapid subsidence due to groundwater withdrawal. It shows, however, a channel-pattern adjustment to active tectonic subsidence that has been occurring for a long time. The San Antonio and Guadalupe Rivers in Texas both increase their sinuosity significantly where monoclinal movements steepen valley slopes. (Author's abstract)
W85-06517

DRAINAGE INITIATION BY SUBSURFACE FLOW IN SOUTH TARANAKI, NEW ZEALAND,
Victoria Univ., Wellington (New Zealand). Dept. of Geology.
For primary bibliographic entry see Field 2E.
W85-06520

SUSPENDED-SOLIDS LOAD OF THE TRIBUTARIES OF THE SUSSEN SEE (DIE SCHWEBSTOFFBELASTUNG DER ZUFLUSSE ZUM SUSSEN SEE),
Martin-Luther-Univ. Halle-Wittenberg, Halle (German D.R.). Sektion Geographie.
M. Thomas.
Wissenschaftliche Zeitschrift Martin-Luther-Universitat Halle-Wittenberg, Vol. 34, No. 1, p 72-94, 1985. 11 Fig, 3 Tab, 8 Ref.

Descriptors: *Suspended solids, *Sediment load, *Sussen See, *Germany (Democratic Republic), *Tributaries, Water level, Sediments, Precipitation, Lakes, Rivers.

The quantity of suspended solids (SS) was measured at three sites on tributaries to the Susser See, a lake near Halle in the German Democratic Republic, between July 1979 and September 1982. In general, SS load decreased during the measuring period. Values varied within a distinct range, but there were also occasional peak values that exceeded the range by far. At two sites (on the Bose Sieben river at Wimmelburg, W, and Unterrissdorf, U), water level was also measured; this showed that water and SS levels did not always correspond. Arithmetic means for SS levels measured were: 85.6 mg/l at W, 99.9 mg/l at U (which is downstream from W), and 68.5 mg/l at Eisleben (E) on the Wilder Graben. Annual mean values decreased steadily: for W, E, and U, respectively, they were (in mg/l) 122.1, 109.0, and 154.5 in 1979 and 33.5, 34.0, and 42.6 in 1982. Peak values (> 50-75% over the median) occurred most often at E, with highest levels at W; e.g., there was a high of 14 occurrences at E in 1980, a low of 4 at U in 1979; highest levels were 370-4, 660 mg/l for the 1980 mean at W, lowest were 135-810 mg/l for the 1982 mean at U. The data showed that close positive correlations could exist between precipitation, river water level, and SS load, but also that these factors could be negatively correlated. Heavy or long-lasting rainfall was the most common cause of increased SS load and water levels. Cases of increased SS with no preceding rainfall and constant or only slightly increasing water level occurred usually at only one measuring site and were attributed in part to bank collapse and, more likely, to influxes of polluted wastewater. At E and U, higher monthly means in SS content occurred in November, December, and January than at W, and were heavily dependent on weather conditions; at W, maximum levels tended to occur in summer, especially in July. These differences are attributed to geological site and temperature variation. (Gish-IVI)
W85-06524

RECENT SEDIMENTATION RATES AND 210PB FLUXES IN GEORGIAN BAY AND LAKE HURON,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
S. R. Joshi.
Science of the Total Environment, Vol. 41, No. 3, p 219-233, March, 1985. 4 Fig, 3 Tab, 47 Ref.

Descriptors: *Sedimentation, *Lake Huron, *Georgian Bay, *Lead radioisotopes, Cesium radioisotopes, Great Lakes, Radionuclides, Sediment transport, Lake sediments.

In 1974 sedimentation rates were measured in four depositional basins of Lake Huron from Pb-210 profiles. A fifth core, collected at station 5, was disturbed during transportation. In order to assign Pb-210 dates to all major sedimentary regions of Lake Huron and Georgian Bay, sediment cores from remaining zones, including station 5, were obtained and analyzed in 1980. The measured fluxes of Pb-210 at the sediment/water interface are discussed in relation to the inputs of atmospheric Pb-210 to the Great Lakes region. The Cs-137 profiles in these sediment cores are also assessed. Except for one location, the rates show marginal to good agreement with those estimated from palynological measurements at four of the five study locations. Cs-137 profiles at study locations suggest that the top portions of the sediment cores were satisfactorily retrieved during coring and sectioning operations. Considerable downward migration of Cs-137 is noted at three locations. The fluxes of excess Pb-210 vary between 0.06 and 0.27 pCi/sq cm/yr. The average depositional flux is considerably lower than the flux of atmospheric Pb-210. The deposition of atmospheric Pb-210 in Lake Huron and Georgian Bay sediments may be limited by the supply of scavenging particulates. (Baker-IVI)
W85-06547

SIMULATION OF CHANNEL STEEPENING IN THE MARALA-RAVI LINK CANAL,
Irrigation Dept., Lampang (Thailand).
K. V. H. Smith, and S. Kaewyen.
Proceedings of the Institution of Civil Engineers, Vol. 79, Part 2, p 203-209, March, 1985. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Marala-Ravi Link Canal, *Pakistan, *Channel morphology, *Channel erosion, *Channels, *Sediment transport, Sedimentation, Flow, Water diversion, Sediment erosion, Computer models, Flow discharge.

The Marala-Ravi Link Canal was constructed in Pakistan to convey water between different tributaries of the River Indus in order to make up water deficiencies resulting from diversions elsewhere. Because of its large designed discharge capacity, it was included in an observation program which monitored discharges, sediment transport, some bed elevations and so on. By using a computer program set up to model flow resistance and sediment transport in sand-bed canals, the steepening of the canal bed during the first years of use was satisfactorily simulated. The numerical technique has reproduced fairly well the behavior of the Marala-Ravi Link Canal. Once sediment deposition had raised the channel bed by about a meter near the headworks, the reduced channel cross section made it impossible to carry the intended discharge of about 623 cu m/sec. Had the same canal been required to convey its maximum discharge capacity on a continuous basis, rather than intermittently, the original cross-section and slope would probably have remained stable. (Baker-IVI)
W85-06580

SEDIMENTATION AND SEDIMENT ANALYSIS IN MUGGEL LAKE (SEDIMENTATION UND SEDIMENTANALYTIK IM MUGGELSEE),
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
For primary bibliographic entry see Field 2H.
W85-06653

RELATIONSHIP OF WATER VOLUME AND WATER QUALITY PARAMETERS (ZUM ZUSAMMENHANG VON PARAMETERN DER WASSERMENGEN UND WASSERBESCHAFFENHEIT),
Forschungszentrum fuer Wassertechnik, Dresden (German D.R.).
For primary bibliographic entry see Field 5B.
W85-06662

SEASONAL SUCCESSION AND MICROLAMINA FORMATION IN A MEROMICTIC LAKE DISPLAYING VARVED SEDIMENTS,
Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
M. Dickman.
Sedimentology, Vol. 32, No. 1, p 109-118, Febru-

ary, 1985. 11 Fig, 3 Tab, 29 Ref.

Descriptors: *Lake sediments, *Seasonal variation, *Succession, *Meromictic lakes, *Toronto, *Ontario, *Varved sediments, *Microlamina, Anaerobic conditions, Sediments, Bacteria, Profundal waters, Phytoplankton, Organic matter, Stratification, Sulfur, Sulfides, Calcite.

In a small meromictic lake near Toronto, Canada, a mass mortality of photosynthetic bacteria followed the ventilation of the chemocline during fall (autumn) and resulted in 3.8 g/sq m/day of organic matter being deposited as a dark layer in sediment traps which were suspended in the permanently anaerobic zone. This mass mortality of photosynthetic bacteria occurred in late autumn following the annual thermal destratification of the lake's mixolimnion. Wind mixing during this period of homeothermy resulted in the introduction of low levels of dissolved oxygen into the lake's chemocline. The ensuing mass mortality of photosynthetic bacteria resulted in the release of elemental sulfur as the sulfur-rich bacteria decomposed and sank to the bottom of the lake. The ferrous ions in the water below a depth of 15 m in Crawford Lake reacted with this sulfur to form black ferrous sulfides and pyrite which formed a dark microlamina on the lake floor. Each dark microlamina was overlain by a light colored (calcite-rich) layer which was deposited each spring and summer during the 3 yr period of this study. The mechanism of microlamina formation elucidated here has been based on the examination of biweekly sediment trap information. This approach has permitted an explanation of the mechanisms by which specific events such as calcite precipitation and phytoplankton seasonal succession are transcribed into the sediment record. (Author's abstract)
W85-06699

210PB-DERIVED SEDIMENT ACCUMULATION AND MIXING RATES FOR THE GREATER PUGET SOUND REGION,
Washington Univ., Seattle. School of Oceanography.
R. Carpenter, M. L. Peterson, and J. T. Bennett.
Marine Geology, Vol. 64, No. 3/4, p 291-312, April, 1985. 4 Fig, 3 Tab, 38 Ref.

Descriptors: *Sediments, *Puget Sound, *Lead radioisotopes, *Mixing, Isotope studies, Sediment mixing, Geochemistry, Coastal waters.

Recent sediment accumulation rates of 46-1200 mg/sq cm/yr are calculated from excess Pb-210 activity profiles in 44 sediment cores from 27 sites in the greater Puget Sound region. Rates calculated for nine stations in the deeper waters of central Puget Sound average 480 mg/sq cm/yr and are greatest between Seattle and Tacoma near the southern end of this region. The standard error of this mean is + or - 113 mg/sq cm/yr. Magnitudes and geographic trends of Pb-210 derived accumulation rates agree with limited data on sediment inputs and transport paths. Their accuracy is further supported by several independent approaches, including comparison with particle fluxes collected in year-long series of sediment trap deployments at two sites. Accumulation rates are calculated assuming no mixing beneath surface mixed layers of 2-22 cm. Sediment mixing coefficients in these surface layers average at least 43 sq cm/yr, four times greater than those reported in open Washington coast sediments. The difference is attributed to the greater benthic biomass in Puget Sound sediments. Particle residence times in surface mixed layers vary from 1.5 to 68 years and introduce corresponding uncertainties in ages of horizons beneath the mixed layers. For most of this region, these residence times will cause a 20-30 year time lag in achieving an equivalent response of surface sediment chemical concentrations to changes in concentrations in freshly depositing particles, for constituents whose stability and phase associations resemble those of Pb-210. These time lags limit the ability of sediment chemistry monitoring programs to recognize recent changes in composition and fluxes of chemicals to sediments. Recent fluxes calculated from the product of surface sediment chemical concentration and accumulation rates will be inaccurate for chemicals if their input concentrations have changed in the last 20-30 years. (Author's abstract)
W85-06701

TRANSFORMATION OF THE OB RIVER CHANNEL DOWNSTREAM OF THE NOVOSIBIRSK HYDROELECTRIC STATION,
For primary bibliographic entry see Field 6G.
W85-06710

WATER QUALITY FROM EROSION CONTROL STRUCTURES IN NEBRASKA,
Nebraska Univ.-Lincoln.
J. S. Schepers, D. D. Francis, and L. N. Mielke.
Journal of Environmental Quality, Vol. 14, No. 2, p 186-190, April/June, 1985. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Water quality, *Erosion control, *Nebraska, Sedimentation basins, Model studies, Terracing, Best management practices, Nutrients, Nitrogen, Phosphorus, Rainfall, Water pollution control.

Runoff collected from terrace and sediment-control basins having tile-outlet systems was compared with runoff water quality from Maple Creek in northeastern Nebraska. This study was part of a Model Implementation Project (MIP) initiated in 1978 to accelerate land treatment for erosion control and development of best management practices (BMPs). Soils in the area are very erosive (Nora-Crofton complex) when subjected to high-intensity rainfall in the spring and summer. Sediment concentrations in runoff from the terraces and sediment basins were initially high and comparable to stream concentrations until a pool of runoff water formed around the riser inlet of the tile discharge system. Formation of a pool allowed sediment to settle out away from the riser inlet, thus reducing sediment losses from the field. Sediment-born N and P accounted for 85 to 98% of total N and P losses from the land. Because tile-outlet terraces and sediment basins effectively reduced sediment and nutrient concentrations in runoff, they proved to be an effective BMP for use by producers. (Author's abstract)
W85-06716

SEDIMENTOLOGY AND EVOLUTION OF OHIWA HARBOUR, A BARRIER-IMPOUNDED ESTUARINE LAGOON IN BAY OF PLENTY,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2L.
W85-06798

ROLE OF GROUND FROST, SNOW COVER, ICE BREAK-UP AND FLOODING IN THE FLUVIAL PROCESSES OF THE OULANKA RIVER, NE FINLAND,
Oulu Univ. (Finland). Dept. of Geology.
L. Koutaniemi.
Fennia, Vol. 162, No. 2, p 127-161, 1984. 25 Fig, 5 Tab, 78 Ref.

Descriptors: *Frost, *Snow cover, *Ice breakup, *Flooding, *Oulanka River, *Finland, Seasonal variation, Channel morphology, Meanders, Stream banks, Erosion, Deposition, Bank erosion.

The significance of ground frost in the river banks, the winter snow cover, the ice break-up and the spring high water levels in shaping the relief of the meandering section of the Oulanka river was assessed. Field studies covering a 7-year period were carried out on two migrating meanders in an area where the river is constantly re-arranging its former terraces, which are rich in sand horizons. The importance of the snow and ground frost period manifested itself in two ways. Firstly, this 'rest season' appeared to be highly critical for gathering the discharge reserve which is then released at the spring high water season, which accounts for a half of the total annual discharge and initiates major changes in the river channel. Secondly, the freezing of the banks, frequently reaching over a meter in depth, did not as such exercise any direct effect on the activity of fluvial processes but was certainly found to control the process of material erosion in a pattern referred to as the two-cycle bank retreat. On the whole the ice drive appeared to be minor significance, but this may merely be due to the obscuring effects of later higher water levels. Fluvial processes bore evidence of 'erosion' and 'deposition' years. The higher the bank erosion, the lower the point bar net budget. This is shown to be due to the fact bank erosion increases in linear manner with the severity of the spring floods, whereas the net budget of depositional environments. i.e. the relationship between degradation and aggradation, tends to decline with an increase in flood height. Intensive bank erosion appeared to be associated with pronounced scouring of the point bars and vice versa. This in turn implies that annual fluctuations in the equilibrium of the river take place between the two poles of erosion and accumulation. At least on the basis of short-term trends in the meander behavior of the river, these two factors have been in a state of quasi-equilibrium with erosion dominant. (Collier-IVI)
W85-06806

PRESENT TIME REGIME OF SEDIMENT DISCHARGE IN THE MOUTH REGION OF THE RIVER OB (SOVREMENNYI REZHIM STOKA NANOSOV V UST'EVOI OBLASTI R. OBI),
K. V. Rasumikhina.
Vestnik Leningradskogo Universiteta Geologiia-Geografiia, Vol. 24, p 65-73, 1984. 3 Tab, 14 Ref.

Descriptors: *Sediment discharge, *River mouth, *River Ob, *USSR, Deltas, Particle size, Sandbars, Annual distribution.

The main regularities of sediment discharge regime and grain size distribution in the mouth region of the River Ob are considered. Information on annual variability of sediment discharge for many years in the main water courses of the delta was obtained. An approximate estimation of the direction and the intensity of sediment transfer on the Yamsalski bar is given. (Author's abstract)
W85-06807

EFFECT OF TILT ON SEDIMENT TRAP EFFICIENCY,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 7B.
W85-06850

WIND-RELATED RESUSPENSION OF SEDIMENTS IN THE PEEL-HARVEY ESTUARINE SYSTEM,
Western Australia Univ., Nedlands. Dept. of Soil Science and Plant Nutrition.
For primary bibliographic entry see Field 2L.
W85-06851

SEDIMENTATION AND SEDIMENT RESUSPENSION IN LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
F. Rosa.
Journal of Great Lakes Research, Vol. 11, No. 1, p 13-25, 1985. 9 Fig, 2 Tab, 30 Ref.

Descriptors: *Lake Ontario, *Sedimentation, *Resuspension, *Stratification, *Great Lakes, Trap efficiency, Turnover time, Thermal stratification, Epilimnion, Fate of pollutants.

From March to November 1981, seasonal variations in the weekly sedimentation rates of particulate matter were investigated at an inshore and at an offshore site in Lake Ontario. Sedimentation rates at both sites showed extremely high variability from week to week; minimum to maximum rates varied by a factor of 10 for the offshore site and by a factor of 40 for the inshore site. The variability in the offshore rates was mainly due to the amount of particulate matter in the epilimnion, and in the inshore rates was mainly due to bottom sediment resuspension. Offshore sedimentation rates of total suspended matter measured in the thermocline were a function of the total suspended matter

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concentrations in the epilimnion. Sedimentation rates measured in the thermocline were higher than those measured at the top of the hypolimnion showing particulate matter retention in the thermocline. Sedimentation rates measured at 5 meters above the bottom at both stations were extremely variable with time and the inshore rates at times exceeded the offshore rates by a factor of 50. This major difference was observed during fall turnover, when previously sedimented material and associated contaminants were resuspended at the inshore site. Since the net downward flux is a function of epilimnetic concentrations, it is clear that inshore resuspension occurs continuously but at varying intensities. (Author's abstract)
W85-06861

MODEL-PROTOTYPE COMPARISON STUDY OF DIKE SYSTEMS, MISSISSIPPI RIVER: POTAMOLOGY INVESTIGATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W85-06892

GEOLOGICAL CHARACTER AND MINERAL RESOURCES OF SOUTH CENTRAL LAKE ERIE,
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 2H.
W85-06907

LONGSHORE SAND TRANSPORT STUDY AT CHANNEL ISLANDS HARBOR, CALIFORNIA,
Coastal Engineering Research Center, Fort Belvoir, VA.
R. O. Bruno, R. G. Dean, C. G. Gable, and T. L. Walton.
Technical Paper No. 81-2, April 1981. 48 p, 18 Fig, 5 Tab, 23 Ref, 2 Append. Project No. F31232.

Descriptors: *Sediment transport, *Hydraulics, *Waves, *Breakwaters, *Protection, Littoral zone, Sand, Shore protection, Dredging, Channel Islands, California, Coastal engineering.

A field experiment was conducted to develop correlations between wave characteristics and longshore sediment transport. The waves were measured by two near-bottom mounted pressure transducers and by visual observation when pressure transducers were not in operation. The average longshore sediment transport rates were determined from sequential volumetric surveys behind an offshore breakwater which was regarded as a total trap. The data analyzed encompass a period of 2 years, 1 year after each dredging cycle. Spectral analysis of the pressure gage wave data were conducted and yielded one direction per frequency. The correlations include immersed weight sediment transport rate, I, versus longshore component of wave energy flux at breaking, Pls. The most widely used correlation constant, K, in the relationship I = k times Pls is 0.77. The value determined from the data was K = 0.98, based on the Pls values directed toward the trap. One feature of this type of trap is the potential for overtrapping if the waves are directed nearly normal to shore. (Author)
W85-06918

EROSION CONTROL OF SCOUR DURING CONSTRUCTION; REPORT 5: EXPERIMENTAL MEASUREMENTS OF REFRACTION AND DIFFRACTION DOWNCOAST OF AN OBLIQUE BREAKWATER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W85-06920

SOUTH FORK TILLATOBA CREEK DROP STRUCTURE, MISSISSIPPI: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W85-06923

STUDY OF CUTOFF BENDWAYS ON THE TOMBIGBEE RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W85-06928

METHOD TO FORECAST SEDIMENTATION RATES RESULTING FROM THE SETTLEMENT OF SUSPENDED SOLIDS WITHIN SEMIENCLOSED HARBORS,
Coastal Engineering Research Center, Fort Belvoir, VA.
C. H. Everts.
Coastal Engineering Technical Aid No. 81-6, June 1981. 19 p, 7 Fig, 1 Tab, 6 Ref. Project No. D31235.

Descriptors: *Sedimentation rates, *Harbors, *Coastal engineering, Model studies, *Mathematical models, Tides, Suspended sediment, Dillingham Harbor, Alaska, Rivers, Navigation, Water currents, Bed load, Forecasting, Shoals.

A method is given for estimating the sedimentation rate in a semienclosed harbor before construction. It can be applied to situations where the harbor is almost totally enclosed; bedload transport is negligible; deposition is nearly uniform throughout the harbor; sediment will not be resuspended after deposition; and tide or river stage rise causes currents which move water and suspended sediment into the harbor. A sample problem is solved for Dillingham Harbor, Alaska, which is an enclosed half-tide harbor requiring almost continuous dredging during the summer months. Results of the mathematical model were about 10%-15% less than measured results. Settling velocity distribution was a crucial factor.
W85-06929

SUMMARY REPORT: MODEL-PROTOTYPE COMPARISON STUDY OF DIKE SYSTEMS, MISSISSIPPI RIVER; POTAMOLOGY INVESTIGATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W85-06962

EROSION ON VERY STONY FOREST SOIL DURING PHENOMENAL RAIN IN WEBSTER COUNTY, WEST VIRGINIA,
Northeastern Forest Experiment Station, Broomall, PA.
J. H. Patric, and W. E. Kidd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-128140. Research Paper NE-501, 1982. 13 p, 11 Fig, 23 Ref.

Descriptors: *Soil erosion, *Washouts, *Weathering, *Erosion control, *Roads, *Sediment load, *Logging, *Stream degradation, Rockslides, Forest soils, Road construction, Paving, Detritus, Forest management, Sediment transport, Soil management, Soil conservation, Soil stabilization.

On July 15 and 16, 1979, at least 6 inches of rain fell in central West Virginia during a 3 hr period. Six miles of logging roads were examined for soil erosion and sediment delivery to streams. Erosion as negligible on very stony soils where logging roads were litter covered, road grades were < 15%, and volumes of overland flow on logging roads had been small. The average rate of erosion from logging roads was about 5 tons/acre of logged over land. Severest erosion ranged from 0.6 to 0.8 ton of soil and rock per ft of road. Approximately two-thirds of the detritus from the most severely eroded road was thought to reach a nearby river and contribute to its sediment load, but only about one-third of the detritus reached the river from less severely eroded roads. Construction of an erosion pavement on most of the roads prevented greater soil loss. These studies suggest that with proper location and management of logging roads, erosion on very stony soils may be held to little in excess of geologic rates.
W85-06967

ENGINEERING GEOLOGY AND GEOMORPHOLOGY OF STREAMBANK EROSION; REPORT 2: YAZOO RIVER BASIN UPLANDS, MISSISSIPPI,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
C. B. Whitten, and D. M. Patrick.
Technical Report GL-79-7, October 1981. Report 2 of a Series. 197 p, 94 Fig, 11 Tab, 33 Ref.

Descriptors: *Stream degradation, *Stream erosion, *Bank erosion, *Channel erosion, *Channeling, *Sediment discharge, *Dam effects, *Land use, Slope degradation, Stream discharge, Streamflow, River basins, Streams, Erosion control.

Four streams of the hill region of the Yazoo River exhibiting excessive streambank erosion were examined by chronological sequences of aerial photographs, field observations, maps and surveys to detect events that affected the hydraulic and geomorphic conditions. Results showed that land use practices in the Delta from the 1800's to the present increased flow and sediment discharge. In the uplands, land use practices during the 1800's and early 1900's also increased flow and sediment discharge. Channelization during the early 1900's increased channel slopes. Meander cutoffs made on the Mississippi, Yazoo, Tallhatchie, and Coldwater Rivers from 1921 to 1953 increased channel slopes. In the late 1930's, conservation practices decreased flow and sediment discharge in the uplands. Dam construction on the four streams in the 1940's and 1950's coupled with channelization below the dams increased stream degradation by increasing channel slope and the release of sediment-free water below the dam. Continued channelization since the 1940's has increased channel slopes. Channelization is cited as the main factor in streambed and streambank erosion. Channel degradation believed to be caused by the increased gradient and the other mentioned factors is advancing up the major channels and their tributaries.
W85-06996

VERTICAL DISPERSION OF SPHERICAL, HEAVY PARTICLES IN TURBULENT OPEN CHANNEL FLOW,
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
M. Bouvard, and S. Petkovic.
Journal of Hydraulic Research, Vol. 23, No. 1, p 5-20, 1985. 12 Fig, 2 Tab, 14 Ref.

Descriptors: *Turbulent flow, *Particulates, *Open channel flow, *Vertical dispersion, Dispersion, Velocity, Flow, Lift, Drag, Hydraulic properties.

The results of an experimental study on the motion of heavy particles (heavier than water) in an open channel flow over a smooth bed are presented. Some aspects of the diffusion and dispersion of the particles are analyzed and especially the effects of lift force and the quadratic nature of drag forces when present. This investigation shows that from isolated particle experiments one obtains a better insight into the mechanisms governing solid particle diffusion and dispersion in turbulent channel flow, than from studies based on the conventional concept of particle concentration. In particular, the particle diameter and the effects of the lift and drag force, if proportional to the square of relative velocity, appear to be the dominant influence in the solid particle dispersion phenomenon. Under identical hydraulic conditions and with the same particle settling velocity in still water, the vertical particle dispersion increases with the diameter. Close to the channel bottom a deficit of particle presence, known as the peripheral layer in blood flow, is noted. The longitudinal particle velocities are lower than the flow velocities due to particle inertia. The longitudinal relative particle velocity is proportional to the shear velocity. Measured vertical downward velocities are 30% lower than particle settling velocities in still water, which is not in accordance with the usual hypothesis adopted in the classical suspension theory. The ultrason-

ic velocity meter, acting like a sonic laser, has proved to be very useful for measuring turbulent flow velocities. (Baker-IVI)
W85-07031

BED DEFORMATION IN CURVED ALLUVIAL CHANNELS,
Waterloopkundig Lab. te Delft (Netherlands).
N. Struiksma, K. W. Olesen, C. Flokstra, and H. J. de Vriend.
Journal of Hydraulic Research, Vol. 23, No. 1, p 57-79, 1985. 16 Fig, 2 Tab, 26 Ref.

Descriptors: *Alluvial channels, *Bed deformation, *River bends, Rivers, Channels, River beds, Flow, Bars, Pools, Bed slope, Model studies, Linear analysis, Wave length.

Large scale bed deformation was studied in alluvial rivers with relatively stable banks. The point bar and pool formation in river bends cannot be described on the basis of local conditions only, that is, the lateral balance between the upslope force induced by the spiral flow and the downslope gravitational force both acting on the grains moving along the bed. The lateral bed slope in a bend is also influenced by transitional effects due to a difference between the conditions upstream and those in the bend. These lead to a substantial overshoot of the lateral bed slope, generally of the same order of magnitude as the slope generated by the local conditions. The wave form of the longitudinal bed profiles in long circular bends is explained with the aid of a linear analysis of the water and sediment motion for the steady state. The main result of this analysis is that it leads to estimates of the wave length and bed oscillation damping rates. A simplified linear analysis, in which the influence of streamline curvature is totally neglected, clearly indicates which effects are the most important for the bed deformation in alluvial rivers. The choice of a specific sediment transport formula determines the sediment transport parameter b, important for bed deformation. It affects the rate of damping in such a way that a decrease of the factor leads to considerable increase of damping. The linear analysis also shows that alluvial similarity in scale models of rivers cannot be achieved if vertical distortion is applied to fulfill the roughness condition. The significant results of this study include an explanation of first bed deformation in river bends in the light of the results of lab experiments in curved flumes with fixed banks. The deformation is then explained in terms of wave length and damping with a linear analysis of the water and sediment motion for the steady state. Finally, the results of computations with a non-linear two-dimensional model are presented, simulating three curved flume experiments. (Baker-IVI)
W85-07033

ENTRAINED AND BED-LOAD SAND CONCENTRATIONS IN WAVES,
Dewberry and Davis, Fairfax, VA.
R. J. Hallermeier.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 111, No. 3, p 567-586, May, 1985. 6 Fig, 36 Ref, 1 Append.

Descriptors: *Entrainment, *Bed load, *Waves, *Sand, Sediment load, Coastal waters, Particulate matter, Suspended sediment.

Using various types of basic empirical results, equations were developed for average volumetric concentration of sediment moving as bed load in nearshore wave environments. Laboratory and natural situations have appreciably different dependences of bed-load concentration on peak flow velocity, with laboratory sediment concentrations being commonly larger than those in nature. Critical examination of published concentration measurements isolates several subsets of near-bed data for quartz sands which allow the two expressions for bed-load concentration to be evaluated. Field and laboratory results in separate categories exhibit distinct functional trends and some quantitative magnitudes agreeing with calculated bed-load concentrations, so that calculation might give a reference value useful for suspended-load computation. Evidence permits a firm conclusion that laboratory near-bed processes and suspended sediment concentrations in usual conditions do not pertain to important field situations. (Author's abstract)
W85-07080

STREAMBANK STABILITY,
Owens (F.W.) and Associates, Inc., Louisville, KY.
F. M. Springer, Jr, C. R. Ullrich, and D. J. Hagerty.
Journal of Geotechnical Engineering, Vol. 111, No. 5, p 624-640, May, 1985. 10 Fig, 7 Tab, 10 Ref, 1 Append.

Descriptors: *Bank erosion, *Bank stability, *Stream banks, *Ohio River, Bank erosion, Computers, Tension cracks, Sand, Groundwater, Flood hydrographs.

The sliding wedge mechanism of erosion of alluvial streambanks was investigated for Ohio River banks. Streambanks were assumed to fail by sliding along sand partings underlying cohesive upper layers. Computer wedge stability analyses indicated that bank stability is most sensitive to the depth of water present in tension cracks behind the face of the bank. Of lesser importance, but of some significance to stability, are the values of the effective angle of internal friction of the sand seams in such banks and the values of unit weight of the soils composing these banks. Changes in the inclination of the sand seams, the coefficients of permeability of the sand seams, the height of capillary rise in the sand seams, the inclination of the top of the bank, the height of the bank, and the flood hydrograph are all of minor importance in changing the stability of the kind of banks studied in this analysis. The time-rate of tension crack formation is a significant factor affecting the total amount of material removed at a particular site in a failing river bank. When it was assumed that tension cracks would form downward from horizontal surfaces in streambanks to only limited depths, analysis predicted the formation of multiple-layered, stepped riverbanks, such as those actually observed in actual river bank failures. (Moore-IVI)
W85-07082

2K. Chemical Processes

DRAINAGE LOSSES OF POTASSIUM FROM A YELLOW-GREY EARTH SOIL,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
C. M. Smith, P. E. H. Gregg, and R. W. Tillman.
New Zealand Journal of Agricultural Research, Vol. 27, No. 3, p 389-397, 1984. 4 Fig, 6 Tab, 11 Ref.

Descriptors: *Potassium, *Drainage, *Pastures, *New Zealand, Leaching, Surface runoff, Tile drainage, Water pollution sources, Rainfall, Grazing, Fertilizers.

Regular potassium topdressing is necessary to maintain high pasture production levels in many areas of New Zealand. Leaching losses of potassium may vary, depending on the soil type, drainage and slope. Dissolved potassium was measured in surface runoff and tile (subsurface) drainage waters from pastures on a yellow-grey earth soil (Tokomaru silt loam). Surface runoff potassium losses from drained and undrained bounded (6 degree) plots were generally very low. The largest loss occurred when topdressing closely preceded (1 day) runoff from an undrained, recently grazed pasture. Under these conditions, total K loss averaged 5.6 kg/ha in 15 weeks, whereas the equivalent fertilizer loss was 6.4% (3.5 kg/ha). A detectable fertilizer effect persisted for 9 weeks. Potassium losses in tile drainage waters from grazed pastures were also minimal, averaging 4.7 and 4.1 kg/ha per year for unfertilized and autumn-fertilized pastures respectively. Surface runoff may be the most important process annually but losses will be of consequence only when heavy rain immediately follows fertilization, and possibly grazing. (Moore-IVI)
W85-06183

SOIL STRUCTURE EFFECTS AND LEACHING OF SODIUM FOLLOWING SODIUM CHLORIDE FERTILISER APPLICATIONS,
Lincoln Coll. (New Zealand). Dept. of Soil Science.
A. S. Black, and B. M. S. Abdul-Hakim.
New Zealand Journal of Agricultural Research, Vol. 27, No. 3, p 399-403, 1984. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Sodium chloride, *Fertilizers, *Sodium, *Leaching, *Soil structure, Calcium, Magnesium, Soil crusting, Electrical conductivity, Soil properties.

Rates of 0, 400, and 2000 kg/ha sodium chloride (NaCl) were applied to a Templeton silt loam in a field trial in May 1981. Soil samples were collected at intervals until October 1981. Although some sodium (Na(+)) was leached to 60 cm during winter, most remained in the upper 20 cm of soil. This resulted in some increase in calcium and magnesium leaching, and produced deterioration in soil structure, observed as crusting and reduced stability indices using the Emerson test. Structure breakdown was associated with low electrical conductivity of soil extracts, and exchangeable Na(+) percentages as low as 2. (Author's abstract)
W85-06184

CONCURRENT DENITRIFICATION AND OXYGEN UPTAKE IN MICROBIAL FILMS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
S. E. Strand, A. J. McDonnell, and R. F. Unz.
Water Research, Vol. 19, No. 3, p 335-344, 1985. 7 Fig, 8 Tab, 61 Ref.

Descriptors: *Denitrification, *Oxygen, *Microbial films, Microorganisms, Films, Nutrients, Dissolved oxygen, Mathematical models.

Mixed microbial films were grown on the inner walls of a tubular reactor with recirculation of the reactor contents and continuous flow-through of nutrient solution. The loss of total oxidized nitrogen was correlated to film population, the nitrite concentration and the dissolved oxygen concentration in the reactor. When film population was greater than 0.5 x 10 to the 9th power cells/sq cm, reactor dissolved oxygen concentration greater than 1 mg/l had little effect on the nitrate loss. Nitrate loss declined for film populations greater than 2 x 10 to the 9th power cells/sq cm. Models based on Monod and zero-order microbial kinetics were calibrated using these data and a nonlinear least squares method. There was little difference in the residual errors with these methods. (Author's abstract)
W85-06226

PARTICLE DISCRIMINATION EFFECTS IN THE DETERMINATION OF TRACE METALS IN NATURAL FRESH WATERS,
Oslo Univ. (Norway). Inst. for Kjemi.
For primary bibliographic entry see Field 5A.
W85-06252

USE OF THE L'VOV PLATFORM AND MOLYBDENUM COATING FOR THE DETERMINATION OF VOLATILE ELEMENTS IN THERMOMINERAL WATERS BY ATOMIC ABSORPTION SPECTROMETRY,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 5A.
W85-06253

STUDIES ON DESTRUCTION OF ORGANIC SUBSTANCE OF HIGHER AQUATIC PLANTS BY LABORATORY WATER COURSE MODELS (IZUCHENIE DESTRUKTSII ORGANICHESKOGO VESHCHESTVA VYSSHIKH VODNYKH RACTENII NA LABOPATORNYKH MODELYAKH VODOTOKOV),
G. N. Oleinik, and V. M. Yakushin.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 20-27. 4 Fig, 2 Tab, 22 Ref.

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Descriptors: *Decomposition, *Organic matter, *Aquatic plants, *Model studies, Water chemistry, Bacteria, Macrophytes.

Decomposition of different higher aquatic plants under laboratory conditions is investigated by means of water course models. It is established that the rate and decomposition completeness as well as dynamics of hydrochemical and bacteriological indices are determined by the peculiarities of the macrophyte chemical content. Differences between the decomposition of higher aquatic plants in closed vessels and in water course models are shown. (Author's abstract)
W85-06376

CARBON FLOW IN THE PELAGIC ZONE OF A SHALLOW TURBID IMPOUNDMENT, WURAS DAM,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W85-06391

TRANSFORMATIONS OF NITROGEN FOLLOWING AN EPILIMNETIC NITROGEN FERTILIZATION IN CASTLE LAKE, CA: 1. EPILITHIC PERIPHYTON RESPONSES,
California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 2H.
W85-06397

UPTAKE OF PHOSPHATE AND INORGANIC NITROGEN BY A SEDIMENT-ALGAL SYSTEM IN A SUBARCTIC LAKE,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W85-06415

CERTAIN RESULTS OF MUD DEPOSIT FRESHENING IN THE LIMAN SASYK (NEKOTORYE REZUL'TATY OPRESNENIYA ILOVYKH OTLOZHENII LIMANA SASYK),
For primary bibliographic entry see Field 2L.
W85-06476

STUDY OF THE PH OF RAIN IN LAFAYETTE, LOUISIANA,
University of Southwestern Louisiana, Lafayette. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W85-06489

SOLUBLE PHOSPHORUS RELEASE FROM ORGANIC SOILS,
Agricultural Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 5B.
W85-06635

DO-PROCESS MODELS FOR SHALLOW SYSTEMS. PART 1: PONDS AND LAKES,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
A. Gnauck, and W. Winkler.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 109-124, 1983. 9 Fig, 6 Tab, 29 Ref.

Descriptors: *Ponds, *Lakes, *Dissolved oxygen, Model studies, Water quality, Solar irradiation, Plankton, Water temperature, Mathematical models.

Model statements are presented for describing the dissolved oxygen (DO) concentration in dependence on various system quantities and five different shallow water bodies. A nonlinear model in the form of a polynomial and with parameter estimation by means of recursive regression proves suitable. It is a blackbox model in which the water temperature, the biomass of phytoplankton and zooplankton and the solar irradiation are the most important input quantities. For all investigations performed by normal and recursive regressive methods a connection between the number of inputs, the convergency of the parameters and the ability of the model output to follow the system output was considered. Dissolved oxygen concentrations cause disturbances, where the recursive algorithm is not able to follow the system output. During oversaturations the error between real and estimated DO runs up to 100%. Changes of the weighting factors and of the starting matrix of the algorithm delivered unessential model improvements. The best correspondence of model and system output was obtained by autocorrelation models with performance indices of about 97%. The investigations show that the precision of the estimation and the following applications depend on the adaptability of the model structure to the real problem on the number of data sets and on the number of parameters used. If the investigated objects have a different state behavior over a year, it should be possible to describe the global system behavior by means of separate models valid for a restricted zone only. Comparing the results obtained by modelling shallow lakes with those of drinking water reservoirs and rivers, it is noted that the regression method used is more effective than in the cases regarded in this paper. (Baker-IVI)
W85-06655

SALT AND WATER TRANSPORT IN UNSATURATED SOIL FOR NON-CONSERVATIVE SYSTEMS,
Arizona Univ., Tucson. Dept. of Mathematics.
For primary bibliographic entry see Field 2G.
W85-06686

MINERALOGICAL CHANGES ALONG THE FRESHWATER/SALTWATER INTERFACE OF A MODERN AQUIFER,
Florida Univ., Gainesville. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W85-06700

LABORATORY INVESTIGATION OF LEACHATE CHEMISTRY FROM SIX APPALACHIAN FOREST FLOOR TYPES SUBJECTED TO SIMULATED ACID RAIN,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
D. R. De Walle, G. C. Ribblett, J. D. Helvey, and J. Kochenderfer.
Journal of Environmental Quality, Vol. 14, No. 2, p 234-240, April/June, 1985. 2 Fig, 5 Tab, 16 Ref.

Descriptors: *Leachate, *Forest soils, *Acid rain, *Soil chemistry, Organic acids, Hydrogen ion concentration, Oak trees, Pine trees, Calcium, Magnesium, Calcium, Hemlock trees, Water pollution effects.

In order to determine the role of the forest floor in neutralization of strong acidity in acid rain, simulated acid rain at pH 4.0 was applied under laboratory conditions to forest floor samples from six Appalachian forest types. Effects of forest type, storm size, and repeated storm applications on leachate chemistry were investigated. Forest floor leachate from a hemlock forest (Tsuga canadensis (L.) Carr.) showed significantly lower pH (mean pH 3.9) than other leachate types due to high concentrations of organic acids. Cove hardwood forest found in an area with calcareous soil parent material produced forest floor leachate with a significantly higher pH (mean pH 6.5) than other forest types. Forest floor leachates from mixed oak (Quercus spp.), northern hardwood, red pine (Pinus resinosa Ait.), and white pine (P. strobus L.) forest were intermediate in pH (mean pH 4.1-4.4) due to the acidifying influence of organic acid leaching balanced against the neutralizing effect of H(+) exchange for Ca(2+) in the forest floor. Weak acidity concentrations obtained by Gran plots were well correlated with 400-nm wavelength transmittance and anion deficits in the leachates. Organic anions dominated leachates from hemlock and mixed oak forest types. Increasing storm sizes caused reduced ionic concentrations, especially of H(+), Mg(2+), and Ca(2+), but three repeated storms produced no consistent significant reductions in loads or concentrations. (Author's abstract)
W85-06721

DISSOLVED SILICON IN A NORTH WALES CATCHMENT OF HIGH RELIEF,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
D. T. E. Hunt, and P. Foster.
Water Resources, Vol. 19, No. 4, p 415-421, 1985. 6 Fig, 2 Tab, 28 Ref.

Descriptors: *Afon Anafon, *Wales, *Silicon, *High relief, *Topography, Nitrogen, Discharge, Catchments, Nitrates, Salinity, Afforestation, Tracers.

Concentrations of dissolved silicon and nitrogen in the Afon Anafon, a river draining the mountainous region of North Wales, were monitored over an annual cycle. As a result of high relief the silicon concentration in the baseflow was diluted by surface flow and interflow. This led to low silicon concentrations in the river water (maximum 1540 micro-g/l, minimum less than 100 micro-g/l) an inverse relationship between silicon concentration and discharge and a low removal rate of silicon by dissolution from the catchment of 0.07 mg silicon dioxide per sq cm/yr. Nitrate concentrations, in contrast, showed a typical seasonal variation and were less affected by variations in the discharge. The conclusion that silicon concentration in the Anafon is a strong function of discharge and therefore highly variable on a relatively small time scale does not invalidate the use of dissolved silicon as a tracer of major fluvial discharges in coastal waters. Data on dissolved silicon in large catchments indicates that the concentration is invariably not significantly diluted by inflow. In rivers of high relief and limited length, the residence time of the inflow will be insufficient to allow it to acquire concentrations of dissolved silicon comparable to that of baseflow before reaching the coast. Waters along the North Wales coast in the region of the Menai Strait receive the fresh water discharges from the Anafon and similar small rivers draining catchments of high relief. The use of silicate as a tracer in these coastal waters is totally inappropriate. Marked temporal variations in the silicon levels in the fluvial discharges will inflict upon the receiving waters a salinity to silicate relationship of considerable complexity. (Baker-IVI)
W85-06728

EFFECT OF STORMS ON NITRIFICATION RATES IN A SMALL STREAM,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. B. Williamson, and J. G. Cooke.
Water Research, Vol. 19, No. 4, p 435-440, 1985. 6 Fig, 11 Ref.

Descriptors: *Nitrification, *Streams, *Waiohewa Stream, *Rotorua, *New Zealand, Nitrogen, Nitrites, Nitrates, Ammonia, Nitrogen cycle, Scouring, Storms.

The impact of storms on nitrification rates was examined over a 2 month period in the Waiohewa Stream, Rotorua, New Zealand. This stream receives high concentrations of geothermally derived ammonia. Changes in mass flows of ammonium and nitrogen (nitrate plus nitrite) were used to calculate apparent nitrification rates. Concentrations of nitrogen and ammonium at both upstream and downstream sites were clearly influenced by flow, although they showed quite different behavior. The results suggest that under baseflow conditions there is no apparent increase of nitrification with time since the last flood event, due to a build up of nitrifiers in the surficial sediments of the stream. In situ measurements showed sudden reduction in benthic nitrifying activity after storm events followed by gradual recovery during stable periods. These organisms are susceptible to removal by scouring at high flow, which leads to a decrease in nitrification rate. Studies on the Waiohewa Stream have found a variation in apparent nitrification rates (ANR) from 36 to 108 mg/sq m/hr of N which can largely be explained by the preceeding hydrological conditions. The recovery period for ANR is quite long, greater than 14 days after one storm, after the system has been per-

turbed by high flows. Any study of stream water quality parameters controlled by sediment-related phenomena should consider not only current hydrological conditions but also those occurring in the stream's recent history. (Baker-IVI)
W85-06730

DETERMINATION OF CL-, NO3- AND SO42- IN PORE WATERS OF SEDIMENTS,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofftechnologie und Chemie.
R.-D. Wilken, and H. H. Kock.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 477-479, March, 1985. 4 Fig, 2 Tab, 3 Ref.

Descriptors: *Ion chromatography, *Interstitial water, *Chlorides, *Nitrates, *Sulfates, Elbe River, Germany (Federal Republic), Water analysis, Chromatography.

Ion chromatography was employed as the most suitable method for determining chloride, nitrate, and sulfate ions in pore waters of sediments. An eluent mixture of 0.003 molar NaHC03 and 0.0024 molar Na2C03 was used. Detection limits of the technique approximate those of classical methods, color of pore water liquids is not a problem (as it would be with photometric techniques), no interference from varying concentrations of other ions could be detected, usually no more than 100 microliter of sample was needed, all three anions could be determined in one step, and the method was automated and could be conducted with reasonable staff effort. Results are presented for three samples of Elbe River (northern Federal Republic of Germany) sediment core material: (1) from Muehlenberger Loch, in the limnic region, near the city of Hamburg, (2) from the mixing zone, near the Stoer River mouth, and (3) from the outer estuary (Neufelder Watt). Pore water analyses were conducted for samples at 5-cm intervals from the surface to at least 30 cm depth in the sediment. (Rochester-IVI)
W85-06756

RADIONUCLIDE SORPTION AND DESORPTION REACTIONS WITH INTERBED MATERIALS FROM THE COLUMBIA RIVER BASALT FORMATION,
Atomics International Div., Richland, WA. Energy Systems Group.
For primary bibliographic entry see Field 5B.
W85-06773

INTERACTION OF GROUNDWATER AND BASALT FISSURE SURFACES AND ITS EFFECT ON THE MIGRATION OF ACTINIDES,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5B.
W85-06774

WITHOUT WATER THE WORK OF DEATH WOULD BE INCOMPLETE,
Glasgow Univ. (Scotland). Dept. of Microbiology.
A. C. Wardlaw.
Glasgow Naturalist, Vol. 20, No. 5, p 421-433, 1984. 3 Fig, 4 Tab, 5 Ref.

Descriptors: *Decomposition, *Biodegradation, Bacteria, Fungi, Soil, Wastewater, Seawater, Microbial decomposition, Chlorinated hydrocarbons, Biological magnification, Food chains.

The carbon cycle and the role of bacteria and small fungi in it are reviewed, and factors that may prevent natural microbial degradation of organic material are discussed. Microbes are the primary agents of decomposition on land and in the sea; water is a necessity for their activities. Although not visible, bacteria are abundant in many habitats, such as soil, human skin, human feces, and seawater. There are six main factors that regulate the microbial degradation of organic materials, as follows: (1) intrinsic biodegradability of the substrate, (2) access of the microbes to the substrate, (3) presence of water or moisture, (4) temperature in the range 0-100 degrees C, (5) presence of oxygen, and (6) absence of preservative substances. Natural organic substances are intrinsically biodegradable. Man-made substances, such as plastics and pesticides, tend to be very resistant to microbial attack. Chlorinated hydrocarbons present a special problem, because they resist biodegradation, are not visible to the naked eye, and tend to become more concentrated in organisms as they ascend through the food chain. Examples of prevention of biodegradation can be found as a result of failure of each of the six necessary conditions to be met. Deliberate employment of these factors occurs in preservation of foods. Natural occurrences of absence of the factors, such as when artifacts sink into oxygen-less, acidic bog muds, account for preservation of biodegradable materials. (Rochester-IVI)
W85-06800

INFLUENCE OF A KARST ON CHEMICAL COMPOSITION OF RIVER WATERS AND THE DISSOLVED SUBSTANCES FLOW (VLIYANIE KARSTA NA KHIMICHESKII SOSTAV RECHNYKH VOD I STOK RASTVORENNYKH VESHCHESTV),
L. V. Balkova.
Vestnik Leningradskogo Universiteta Geologiia-Geograffiia, Vol. 24, p 92-96, 1984. 4 Tab, 4 Ref.

Descriptors: *Rivers, *Chemical composition, *Dissolved solids, *Bashkiria, *USSR, *Karst, Geohydrology, Salts, Basins, Salt balance.

The formation of the water-salt balance of river basins of the Bashkiria under the conditions of karst formation was studied. The salt balance components, such as atmospheric ion receipt salt evaporation, and the influence of water flow on chemical flow were analyzed. Special attention was given to the influence of the lithology of karsting rocks on chemical composition of river waters and the flow of dissolved substances. The chemical compositon of river waters in karsting and nonkarsting basins was compared. General salt balance and salt balance for some kinds of ions in the river basins of the Bashkiria were calculated. (Author's abstract)
W85-06809

CHEMICAL EQUILIBRIUM MODEL FOR THE ILLINOIS BASIN FORMATION WATERS,
University of Western Ontario, London. Dept. of Geology.
H. W. Nesbitt.
American Journal of Science, Vol. 285, No. 5, p 436-458, May, 1985. 4 Fig, 1 Tab, 29 Ref, 1 Append.

Descriptors: *Model studies, *Illinois Basin, *Geohydrology, *Groundwater, *Chemical reactions, Water chemistry, Clay minerals, Sandstone, Calcium, Sodium, Diagenesis, Magnesium.

The chemical composition of formation waters collected from Pennsylvanian and Mississippian (Aux Vase Sandstone and younger) strata probably are controlled by mineral transformation reactions involving kaolinite, illite, a sodic clay mineral, and calcite rather than being controlled by cation exchange reactions between the solutions and clay minerals. The reactions involve conversion of the constituents, kaolinite, calcite, and aqueous Na(+) (+ or - illite), to a sodic-clay mineral and aqueous Ca2(+) (+ or - illite) during subsurface concentration of the waters, but the reactions proceed in the reverse direction, when the relatively concentrated formation waters are mixed with dilute near-surface meteoric waters. The reactions are late diagenetic in that they are proceeding now. They mask evidence of other early diagenetic reactions as well as evidence concerning the composition of the original solutions of the basin. Generally, no significant amounts of Mg have been added to or removed from the present formation waters during their chemical evolution; consequently, there is no evidence for chloritization or for dolomitization of the sedimentary rocks by the solutions now in the basin. Only if the bulk of the solutes were derived from seawater would Mg have to be removed from the formation waters, and Mg extraction would have had to occur during an early diagenetic stage. (Author's abstract)
W85-06872

STREAM WATER QUALITY IN THE COAL REGION OF TENNESSEE,
Northeastern Forest Experiment Station, Berea, KY.
For primary bibliographic entry see Field 5C.
W85-06980

SIGNIFICANCE OF SOLVATION PHENOMENA FOR THE PARTITION OF HALOGENATED ORGANIC COMPOUNDS BETWEEN WATER AND A PARAFFINIC PHASE (DIE BEDEUTUNG DER SOLVATATION FUR DIE VERTEILUNG VON HALOGENORGANISCHEN VERBINDUNGEN ZWISCHEN WASSER UND EINER PARAFFINPHASE),
Essen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich Chemie.
P. Belouschek, and V. Neitzel.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 2, p 51-55, April, 1985. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Solvation phenomena, *Partitioning, *Halogenated hydrocarbons, *Paraffinic phase, Thermodynamics, Chemical reactions, Hydration.

The distribution behavior of halogenated organic compounds (halobenzenes and chlorophenols) between water and a paraffinic phase (decane/decanol) is characterized by changes of intermolecular interactions arising between the partitioning substances and the adjacent water or paraffin molecules. These phenomena may be described by means of the thermodynamic parameters of transfer. The influence of the solvation or hydration on the distribution is distinctly indicated by the temperature dependence of the partition coefficient. The importance of solvation in favor of the distribution behavior is clearly evident when correlating the free enthalpies of transfer and solution of the halogenated organic compounds. (Author's abstract)
W85-07024

BEHAVIOUR OF DISSOLVED IODINE IN THE UPPER ST. LAWRENCE ESTUARY,
Centre Champlain des Sciences de la Mer (Quebec).
K. Takayanagi, and D. Cossa.
Canadian Journal of Earth Sciences, Vol. 22, No. 4, p 644-646, April, 1985. 4 Fig, 13 Ref.

Descriptors: *St. Lawrence Estuary, *Iodine, *Iodate, Estuaries, Salinity, Mixing, Seawater, Water chemistry.

The behavior of dissolved total iodine and iodate in the upper St. Lawrence Estuary was determined by both field and laboratory experiments. The concentration of total iodine, in general increased with increasing salinity from undetectable at salinity 0 0/00 to 0.40 micro-M at salinity 33.9 0/00 (seawater). The concentration of total iodine linearly correlates with salinity with a correlation coefficient of 0.96. During the mixing between river water and seawater in the estuary, both total iodine and iodate were conservative and no interconversion occurred between them. The laboratory mixing experiments confirmed this phenomena. Iodate, the thermodynamically stable species, was the predominant species throughout the estuary, constituting up to 90% of the total dissolved iodine. (Baker-IVI)
W85-07036

APPLICATION OF REVERSED-PHASE LIQUID CHROMATOGRAPHY TO DISSOLVED ORGANIC MATTER IN ESTUARINE SEAWATER,
Hiroshima Univ. (Japan). Faculty of Integrated Arts and Sciences.
For primary bibliographic entry see Field 5A.
W85-07065

NEW METHOD FOR MONITORING TEMPORAL TRENDS IN THE ACIDITY OF FRESH WATERS,

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Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 5A.
W85-07143

2L. Estuaries

RESPONSE OF PLANKTONIC AND MICROBENTHIC ALGAL ASSEMBLAGES TO NUTRIENT ENRICHMENT IN SHALLOW COASTAL WATERS, SOUTHWEST SWEDEN,
Lund Univ. (Sweden). Dept. of Marine Botany.
E. Graneli, and K. Sundback.
Journal of Experimental Marine Biology and Ecology, Vol. 85, No. 3, p 253-268, 1985. 8 Fig, 2 Tab, 29 Ref.

Descriptors: *Sweden, *Phytoplankton, *Nutrients, *Coastal waters, Microbiological studies, Nitrogen, Phosphorus, Algae, Benthic flora, Biomass, Algal growth, Solar radiation.

Field and laboratory nutrient enrichment experiments were performed using natural phytoplankton and microphytobenthic assemblages from the brackish water Oeresund, Sweden. The response of algae from a low nutrient area, Falsterbo Canal, was compared to that of algae from a polluted, nutrient rich area, Lomma Bay. Both phytophankton and microphytobenthos were nitrogen limited in the Falsterbo area. The phytoplankton responded with a much higher increase in chlorophyll than the microphytobenthos. The slower increase in microphytobenthos biomass can be explained in two ways: the biomass of microphytobenthos is initially high because of adequate nutrient conditions, and the microphytobenthos receive light only through the sediment so that light becomes the factor that is most limiting, not nutrient availability. Water from Lomma Bay, which contained high concentrations of inorganic nitrogen, stimulated phytoplankton growth markedly, and, when P was added as well, an even higher biomass was obtained. (Baker-IVI)
W85-06210

EFFECTS OF MUSSEL AQUACULTURE ON THE NITROGEN CYCLE AND BENTHIC COMMUNITIES IN KENEPURU SOUND, MARLBOROUGH SOUNDS, NEW ZEALAND,
Cawthron Inst., Nelson (New Zealand).
H. F. Kaspar, P. A. Gillespie, I. C. Boyer, and A. L. MacKenzie.
Marine Biology, Vol. 85, No. 2, p 127-136, February, 1985. 7 Fig, 6 Tab, 29 Ref.

Descriptors: *Kenepuru Sound, *Marlborough Sounds, *New Zealand, *Mussels, *Aquaculture, *Nitrogen, Cycling nutrients, Benthic environment, Sediments.

Fluctuations in the meat condition of farmed green-lipped mussels in the Marlborough Sounds, New Zealand, may be related to the availability of inorganic nitrogen to phytoplankton, a major food for mussels. Nitrogen pools and transformations and benthic communities at a mussel farm and a nearby reference site without direct influence of marine farming in Kenepuru Sound, were compared on four dates between September 1982 and May 1983. The organic nitrogen pool in the top 12 cm sediment was 7.4 to 10.8 mol/sq m at the mussel farm and 6.1 to 8.9 mol/sq m at the reference site. The water analysis showed a more or less even distribution of chemical species throughout the water column. The higher volatile solids content of the mussel-farm sediment indicated an elevated organic-matter content at this site. No significant differences in the water chemistry could be found between the mussel farm and the reference site. Sediments at the mussel farm site were slightly finer textured than those of the reference site. The sediment surface at both sites supported a large epibenthic microflora which was visible as a yellow green mat. The rates of nitrogen mineralization in the mussel-farm sediment were markedly higher than in the reference sediment. (Baker-IVI)
W85-06211

NITROGEN, PHOSPHORUS AND PRIMARY PRODUCTION IN THE POMERANIAN BAY,
Akademia Rolnicza w Szczecinie (Poland). Inst. of Fisheries, Oceanography and Protection of the Sea.
J. Kubiak.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 439-447, 1983. 1 Fig, 5 Tab, 39 Ref.

Descriptors: *Pomeranian Bay, *Baltic Sea, *Nitrogen, *Phosphorus, *Primary productivity, Eutrophication, Phytoplankton, Nutrients, Ammonium, Limiting nutrients, Marine environment.

The Pomeranian Bay in the south-western part of the Baltic sea has an area of 4300 sq km and a volume of 51.4 cu km and contains a fresh-water inflow of 17.3 cu km/a from a catchment area of 137,220 sq km. Data were evaluated from 18 investigations at 14 stations in the years 1976-1978: 229-235 hydrochemical measurements and 75 phytoplankton investigations. It can be demonstrated by multiple regression analyses that the nutrient concentrations are mainly determined by the freshwater inflow and the mixing ratios, phytoplankton having a secondary effect. Of the nutrients, mainly ammonium influences the phytoplankton development and the oxygen production, the full utilization of the nitrogen stock being limited by an N/P ratio of 48 in the surface water and of 41 in the bottom water layers. Obviously, a limitation of the primary production is out of the question due to the high turnover rates of phosphorus. The N/P ratio is also a clear evidence of the great influence of the inflowing nitrate-rich freshwater on the nutrient situation of the bay. (Author's abstract)
W85-06270

MACROPHYTE VEGETATION AT THE RIVER KYRONJOKI ESTUARY IN 1982,
Jyvaeskylae Univ. (Finland). Inst. for Environment Research.
J. J. Merilainen.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 61-76, 1984. 9 Fig, 4 Tab, 25 Ref, 2 Append.

Descriptors: *Macrophytes, *Aquatic plants, *Estuarine environment, *River Kyronjoki, *Finland, Vegetation, Biomass, Aerial photography, Mapping, Spatial distribution, Acidity, Water pollution effects.

This study presents maps of large areas of macrophyte vegetation in the upper part of the River Kyronjoki estuary (Finland) in the southern Bothnian Bay (63 degrees 20' N). The vegetation maps are based on color slides taken on August 17, 1982 from a height of 900 m. The more scanty vegetation of the lower estuary was also described. The study is part of a large scale investigation into the conditions prevailing at the estuary, on the basis of which is should be possible to observe the natural succession, as well as the possible biological effects caused by the extensive works in the course of the river. More than two-thirds of the total area mapped (17.97 sq km) was covered with aquatic plants, open water accounted for a quarter and shore vegetation 6% of the total. Phragmites australis, Scirpus lacustris, Nuphar lutea and Nymphaea candida were the most important species of the area. The previously documented deleterious influence of the acid waters in aquatic animals in the limnic zone was not pronounced on the vegetation. However, the distribution of some species was possibly restricted by the acidity, e.g. the Potamogeton perfoliatus zone, important in the outer estuary, was totally absent from the limnic zone. The plant biomass of the upper estuary. 0.4 kg dry mass per square meter (about 6,400 tons for the whole area) was very high compared with the few values hitherto reported from the Bothnian Bay and its inlets. (Author's abstract)
W85-06297

PLANT ZONATION AND THE EFFECTS OF THE SPRING-NEAP TIDAL CYCLE ON SOIL AERATION IN A HUMBER SALT MARSH,
Hull Univ. (England). Dept. of Plant Biology.
W. Armstrong, E. J. Wright, S. Lythe, and T. J. Gaynard.
Journal of Ecology, Vol. 73, No. 1, p 323-339, March, 1985. 10 Fig, 37 Ref.

Descriptors: *Species distribution, *Salt marshes, *Vegetation, *Tidal effects, Seasonal variation, Drainage, Topography, Soil aeration, England, Welwick.

Relationships were sought between species distribution, soil aeration and tidal activity in Welwick (England) a well zoned, upgraded salt marsh. Redox potential was used as an index of soil aeration and was measured with platinum electrodes permanently installed in the soil to various depths in major vegetation zones. Tidal activity and drainage, influenced by topography and elevation, clearly had strong roles to play in creating substantial temporal and zonal differences in the aeration of soils within a salt marsh ecosystem. At Welwick, the zonal distribution of the vegetation correlated with, and consequently could be dependent upon, differences in degree and temporal pattern of soil aeration. Three basic aeration patterns emerged at Welwick in summer. The first was characteristic of Spartina-dominated sites with reducing conditions persistent throughout much of the profile and indifferent to periods of exposure. Neap tides were responsible only for a series of peaks indicating brief intervals of surface oxidation. The second pattern was characteristic of Puccinellia, Halimione and Elymus sites. A tidal effect caused by high spring tides, occurred only monthly. Finally there was a pattern associated with the general salt marsh and its sub-sites. The high spring tides of early July had no significant effect on the general salt marsh and there was thus a longer period of oxidation, free from fluctuations, than at any other site. Although there is a close relationship between soil aeration and tidal activity, and in turn the vegetation types are closely related to the frequency of tidal flooding, it does not necessarily follow that there is a causal relationship between soil aeration and vegetation type. Little evidence for the persistence of an aerated layer trapped between tide and water table has emerged in this study. (Baker-IVI)
W85-06369

NUTRIENT ENRICHMENT OF CHESAPEAKE BAY AND ITS IMPACT ON THE HABITAT OF STRIPED BASS: A SPECULATIVE HYPOTHESIS,
Delaware Univ., Lewes. Coll. of Marine Studies.
K. S. Price, D. A. Flemer, J. L. Taft, G. B. Mackiernan, and W. Nehlsen.
Transactions of the Americal Fisheries Society, Vol. 114, No. 1, p 97-106, January, 1985. 6 Fig, 2 Tab, 23 Ref.

Descriptors: *Chesapeake Bay, *Fish, *Population dynamics, Nutrients, Dissolved oxygen, Nitrogen, Phosphorus, Temperature effects, Bays.

Stocks of striped bass Morone saxatilis have declined in the Chesapeake Bay system over the last decade. Evidence is presented for the working hypothesis that the decline has resulted, in part, from loss of deep-water habitat for adults, caused by limiting concentrations of dissolved oxygen that are related, in turn, to nutrient enrichment and greater planktonic production. A related hypothesis is that changes in the near-shore habitat for juvenile striped bass, involving severe declines in submerged aquatic vegetation due to nutrient-driven planktonic shading, also have contributed to the decline of striped bass. Nutrients (nitrogen and phosphorus) and chlorophyll a, an indicator of phytoplankton biomass, have increased in many areas of the bay and tributaries over the past 20 to 30 years. These trends are qualitatively correlated with greater deoxygenation of the deep channel in the mid and upper bay. During the late 1970s, summer concentrations as low as 2 ml/liter approached to within 7-8 m of the surface, allowing water stressful to striped bass to intrude onto shoal areas of the bay. The volume of Chesapeake Bay bottom waters containing 0.5 ml O2/liter or less was about 15 times greater in July 1980 than in July 1950. The combination of the expanding hypoxic pool and summer temperatures above preferred levels for adult striped bass may contribute to an oxygen-temperature squeeze that forces adults onto shoal areas of the bay or out of the

upper bay. Many of these shoal areas now lack suitable cover for juvenile striped bass and their prey. Strong intraspecific competition among striped bass may be occurring there. (Author's abstract)
W85-06409

RESIDENCE TIME OF WATER IN NARRAGANSETT BAY,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
M. E. Q. Pilson.
Estuaries, Vol. 8, No. 1, p 2-14, March, 1985. 6 Fig, 8 Tab, 32 Ref.

Descriptors: *Narragansett Bay, *Rhode Island, *Flushing, Bays, Salinity, Wind speed.

For Narragansett Bay, Rhode Island, newly calculated and archival data for the area, mean depth, total volume, mean salinity and fresh water input are presented. Estimates of the residence time of the water, derived from 22 sets of monthly mean values, were related to estimates of the fresh water input according to an empirical relationship involving the flushing time in days, and the fresh water input in cu m per S. Adding estimates of the mean wind speed into a multiple regression increased the correlation coefficient only to 0.864. At the long-term mean rate of fresh water input (105 cu m per s) the flushing time in 26 days. At the lowest mean monthly input rate observed the flushing time was nearly 40 days, while at the highest mean monthly input rate in the data set (325 cu m per s) the flushing time was about 10 days. Known sources of random error appear sufficient to account for most of the deviations from the relationship. The evidence suggests that variation in the flushing time is largely determined by variation in the fresh water input.
W85-06411

SEASONAL VARIATION OF DISSOLVED ORGANIC MATTER IN FUNKA BAY,
Hokkaido Univ., Sapporo (Japan). Research Inst. of North Pacific Fisheries.
H. Yoshida, Y. Maita, and A. Shiomoto.
Bulletin of the Faculty of Fisheries, Hokkaido University, Vol. 35, No. 4, p 254-270, 1984. 7 Fig, 2 Tab, 44 Ref.

Descriptors: *Funka Bay, *Dissolved solids, *Seasonal variation, Lipids, Polysaccharides, Amino acids, Monosaccharides, Carbohydrates, Amino acids, Chlorophyll.

The seasonal variation of dissolved organic matter (DOM), i.e., total dissolved lipids (DL), total dissolved polysaccharides (DPS), total dissolved monosaccharides (DMS), total dissolved combined amino acids (DCAA), and total dissolved free amino acids (DFAA), was investigated in Funka Bay from January 1983 to January 1984 using R/V Ushio Maru. Each component of DOM changed drastically in relation to time and space. The concentration ranges and the mean values of DL, DPS, DMS, DCAA and DFAA in station 30, were 11-200 (76, n = 134), 33-2800 (220, n = 155), 28-1200 (120, n = 156), 37-3700 (240, n = 156) and 1.5-400 (30, n = 156) as microg C/l, respectively. Concentrations of DOM increased during the periods when diatom bloomed in the spring and when water temperature rose in the summer. Standing stocks of DOM throughout the water column (from surface to 92 m in depth) were estimated at 9.7 g C/sq m for DL, 64.0 g C/sq m for DPS, 21.6 g C/sq m for DMS, 54.1 g C/sq m for DCAA and 3.6 g C/sq m for DFAA in the spring, and at 8.0 g C/sq m for DL, 22.0 g C/sq m for DPS, 20.1 g C/sq m for DMS, 46.7 g C/sq m for DCAA and 6.3 g C/sq m for DFAA in the summer. In the fall, carbohydrates and amino acids also increased in response to the higher concentration of chlorophyll a. Standing stocks of DOM throughout the water column were estimated at 25.2 g C/sq m for DPS, 10.6 g C/sq m for DMS, 16.6 g C/sq m for DCAA and 2.3 g C/sq m for DFAA during this period. The water depth in which higher concentrations of DOM were formed differed both vertically and temporally. It is presumed that these results reflected increases and decreases in the DOM components. (Author's abstract)
W85-06441

FRESH WATER-SALT WATER INTERFACE IN FRENCH FLANDERS (L'INTERFACE EAU DOUCE-EAU SALEE EN FLANDRES FRANCAISES),
Angers Univ., Besancon (France). Lab. de Geologie Structurale et Appliquee.
J. Mania, and V. Meens.
Bulletin de la Societe Geologique de la France, Vol. 26, No. 7, p 1281-1291, 1984. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Seawater, *Saline water intrusion, *Encroachment, *Coastal aquifers, *Maritim Flanders, Groundwaters, Agricultural dewatering, Drainage.

The encroachment of sea water into the coastal aquifer of the Maritim Flanders over about 700 sq km, is investigated. Special consideration is given to the interference of agricultural dewatering on the position of the interface between fresh and shallow saline groundwaters. Dewatering increases the salinity of groundwaters. These groundwaters are then transferred through distributtion channels for successive industrial uses. Measurements of hydraulic conductivity, salinity and water levels during low and high water cycles have been taken using 258 piezometers distributed on 86 observation sites during 1979-1980. A comparison was made of field results and simulations of interface fluctuations obtained by using a mathematical model with boundary elements on heterogeneous anisotropic soil. This comparison allowed the optimization of the dewatering system which will be used. Three simulated maps (at one, three and five days) of the geographical evolution of saline zones induced by systematic drainage are given. (Baker-IVI)
W85-06447

ENERGY RESERVE IN ORGANIC MATTER AND IN SOME REDUCED MINERAL COMPOUNDS OF THE BLACK SEA (ZAPAS ENERGII V ORGANICHESKOM VESHCHESTVE I NEKOTORYKH VOSSTANOVLENNYKH MINERAL'NYKH SOEDINENIYAKH VOD CHERNOGO MORYA),
B. A. Skopintsev, A. A. Novoselov, and L. I. Man'Kovskaya.
Okeanologiya, Vol. 24, No. 5, p 764-771, November/December, 1984. 3 Tab, 35 Ref.

Descriptors: *Energy, *Organic matter, *Black Sea, Phytoplankton, Anaerobic conditions.

Calculating in a manner similar to that used to determine energy reserves for the World Ocean organic matter (OM), energy reserve in the Black Sea organic matter and annual phytoplankton production were determined to be 1.3 times 10 to the 16th power Kcal and 0.9 times 10 to the 15th power Kcal, respectively. However, there is every reason to suppose that the data on OM caloricity for the anaerobic zone are lower than true values, as the volume of this zone is 87% of the whole volume of the Black Sea water, and since the OM of this zone is more reduced (less oxidized) than the OM of the anaerobic zone. Energy reserve in hydrogen sulfide (sulfides) and in ammonium nitrogen of the anaerobic zone is 1.7 times 10 to 16th power Kcal and 2.1 times 10 to the 15th power Kcal, respectively. (Author's abstract)
W85-06456

METHOD OF PERFORMING ECOTOXICOLOGICAL EXPERIMENTS IN SITU (METODIKA POSTANOVKI EKOTOKSIKOLOGISCHESKOGO EKSPERIMENTA IN SITU),
A. G. Andrushaitis, A. K. Avens, and Z. K. A. Seisuma.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 76-81, 1984. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Gulf of Riga, *Baltic Sea, *Ecosystems, *Water analysis, Monitoring, Water quality control, Energy transfer, Sediment transport.

The use of ecological enclosures significantly increases the efficiency of eco-toxicological experiments and studies made of matter and energy transport in water communities. The present state of the art of this method is described along with ways in which it can be improved in the future. An experiment concerning the pollution of controlled ecosystems in the Gulf of Riga (Baltic Sea) is described in detail. A specially constructed 1.5 cubic meter PVC closed system allowed studies to be made of the effect of pollutants on zoo-, phyto- and bacterioplankton in the littoral zone of the Sea. (Author's abstract)
W85-06464

CERTAIN RESULTS OF MUD DEPOSIT FRESHENING IN THE LIMAN SASYK (NEKOTORYE REZUL'TATY OPRESNENIYA ILOVYKH OTLOZHENII LIMANA SASYK),
B. I. Novikov.
Gidrobiologischeski Zhurnal Vol. 20, No. 3, p 70-73. 1984. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Estuarine environment, *Chlorides, *Mud, *Liman Sasyk, Salts, Porous media, Diffusion, Sediments.

Chlorine-ion content in liman muds is studied in the initial period of water freshening. By comparing the results with earlier obtained data and considering the main regularities in salt diffusion in porous media it is shown that the available freshening procedure is not quite efficient and impose no restraints on salt delivery from mud deposits to water masses. (Author's abstract)
W85-06476

MISSISSIPPI RIVER OUTFLOW PATTERNS SEEN BY SEASAT RADAR,
Hawaii Inst. of Geophysics, Honolulu. Planetary Geosciences Div.
L. R. Gaddis, and P. J. Mouginis-Mark.
Geology, Vol. 13, No. 4, p 227-230, April, 1985. 3 Fig, 1 Tab, 15 Ref. NASA grant 956434.

Descriptors: *Mississippi River Delta, *Satellite technology, *Radar, *Waves, Remote sensing, Deltas, River discharge, Coastal areas, Gulf of Mexico.

A new kind of ocean surface feature has been observed on Seasat synthetic aperture radar (SAR) images of the Mississippi River Birdfoot Delta and adjacent Gulf of Mexico waters. Although ocean surface wave patterns have been detected by Seasat SAR in several coastal areas, their origin was attributed to the interaction between oceanic currents and bottom topography. In contrast, no such correlation was found between surface wave patterns and bathymetry at the Mississippi Delta, where the morphometry and distribution of the detected waveforms suggest a river discharge origin. Although contemporaneous data from the Landsat D Thematic Mapper are not available, visible and infrared images acquired at other times generally support this hypothesis; the boundaries of the turbid, cooler river water correspond well to those of the surface wave patterns detected by the Seasat SAR. (Author's abstract)
W85-06519

RESIDUAL CURRENTS IN PORT TALBOT HARBOUR; A MATHEMATICAL MODEL STUDY,
Bristol Univ. (England). Dept. of Civil Engineering.
R. A. Falconer.
Proceedings of the Institution of Civil Engineers, Vol. 79, Part 2, p 33-53, March, 1985. 11 Fig, 21 Ref.

Descriptors: *Port Talbot Harbor, *Wales, *Estuaries, *Mathematical models, *Water currents, Flooding, Coastal waters, Tidal waters, Channels, Harbors, Velocity.

The development and application of a mathematical model to predict the tide induced circulation within a narrow entranced harbor, Port Talbot Harbor, in Swansea Bay, Wales, is described. The harbor experiences exceptionally large spring tidal ranges. The model was specifically developed to

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predict the residual circulation, or horizontal secondary currents, in a non-linear flow field and hence particular emphasis was placed on the finite difference representation of the convective accelerations and the shear stress terms. The time centering of the convective accelerations led to a stable finite difference scheme, and the adopted representation of the cross-product accelerations appeared to overcome the occurrence of grid scale oscillations. For the flood tide, the high velocity gradients at the tip and immediately downstream of the main breakwater, the narrow entrance of this particular harbor and the corresponding adverse pressure gradients led to the generation of pronounced secondary currents in the mathematical model. These residual currents persisted well into the ebb tide and were expected to be stronger in the actual harbor than as predicted in the model. The mathematical model appeared to simulate satisfactorily the flooding and drying of shallow areas in Port Talbot Harbor which, for the high spring tides, was relatively extensive at low water. The treatment of the open boundary, which was parallel to the longitudinal axis of the dredged channel, seemed to be relatively unimportant in predicting the velocity field within the harbor. The assumption of a horizontal water surface slope and a normal velocity component only along the open boundary did not appear to give rise to erroneous predictions of the internal velocity field. This non-conservative momentum boundary condition can often lead to erroneous results - particularly when tidal eddies are being simulated. (Baker-IVI)
W85-06578

CHEMICAL COMPOSITION OF AQUATIC VEGETATION IN SOME TYPICAL WETLANDS OF KASHMIR,
Himachal Pradesh Univ., Simla (India). Dept. of Biosciences.
For primary bibliographic entry see Field 2H.
W85-06651

PRODELTA ENVIRONMENT OF A FJORD: SUSPENDED PARTICLE DYNAMICS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Centre.
For primary bibliographic entry see Field 2H.
W85-06698

210PB-DERIVED SEDIMENT ACCUMULATION AND MIXING RATES FOR THE GREATER PUGET SOUND REGION,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2J.
W85-06701

SEDIMENT, SEASON, AND SALINITY EFFECTS ON PHOSPHORUS CONCENTRATIONS IN AN ESTUARY,
Agricultural Research Service, Beltsville, MD.
For primary bibliographic entry see Field 5C.
W85-06727

SIMULATION STUDY OF EUTROPHICATION IN HIROSIHIMA BAY,
Hiroshima Univ. (Japan). Inst. of Environmental Chemistry.
T. Mukai, K. Takimoto, T. Shibata, and H. Abe.
Water Research, Vol. 1, No. 4, p 511-525, 1985. 23 Fig, 2 Tab, 30 Ref.

Descriptors: *Hiroshima Bay, *Japan, *Eutrophication, Particulates, Dissolved solids, Organic matter, Carbon cycle, Model studies, Phytoplankton, Nutrients, Advection, Diffusion.

A phytoplankton model, which includes a carbon cycle combined with a constant current obtained by the computation of tidal curents, was applied to the coastal region of Hiroshima Bay, Japan. The transformation rate constants for the carbon cycle were experimentally evaluated. The modeling approach as developed has several advantages: the transformation rate constants were evaluated in the non-steady state and were described as functions of environmental parameters. Thus it is possible to analyze closely the eutrophication in the coastal region. Information of the grazing of phytoplankton by zooplankton and zooplankton concentration are not directly required for this stimulation study. The rate constants are relatively easy to estimate experimentally using light-dark bottles in comparison with the grazing model, but it is difficult to evaluate the rate constants in winter because of small variations in carbon concentrations. Disadvantages include the estimation of some rate constants being necessary compared with nutrient loading models, and the complexity and expense of the simulation. As detritus is not taken into consideration in the carbon cycle model, this model is a simplified one. Data on detritus are lacking in the coastal region. In general terms, carbon increased by phytoplankton growth was about 10 times carbon augmented by inflow from land at the shore in summer. Sinking plays an important role in the elimination of particulate organic matter. On the other hand, horizontal advection and turbulent diffusion are important factors for the diminution of dissolved organic matter. (Baker-IVI)
W85-06739

SEDIMENTOLOGY AND EVOLUTION OF OHIWA HARBOUR, A BARRIER-IMPOUNDED ESTUARINE LAGOON IN BAY OF PLENTY,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
B. M. Richmond, C. S. Nelson, and T. R. Healy.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 4, p 461-478, 1984. 12 Fig, 7 Tab, 41 Ref.

Descriptors: *Sedimentology, *Estuarine environment, *Lagoons, *Bay of Plenty, *Ohiwa Harbour, *New Zealand, Harbors, Sediments, Bedforms, Tidal flats, Barriers, Sandspits, Benthos.

Ohiwa Harbour is a 24 sq km estuarine lagoon impounded by the 6 km long Ohope spit in the west and the 0.7 km long Ohiwa spit in the east. These barrier sand spits are presently separated by a c. 340 m-wide inlet channel where the maximum harbor depth of 14 m occurs. Seventy percent of the harbor consists of tidal flats supporting a rich shelly benthos and diversified by stands of mangrove and backed locally by salt marsh. Lower harbor sediment in barrier beach, dune and entrance shoal and channel environments are well sorted, negatively-skewed, medium to fine sands. In contrast, upper harbor sediments are poorly to very poorly sorted, positively-skewed, medium to very fine (silty) sands, the coarser of these deposits occurring in channel and restricted harbor beach environments, and the finer in intertidal flat, creek, and channel bank areas. The terrigenous mineralogy is consistent with a dominantly acid volcanic provenance, directly from the tephra mantle of the catchment and, most importantly, indirectly from the oceanic littoral zone. Sediment dispersal is dominated by tidal currents. Speeds decrease systematically up-harbor from maximum values of 100-150 cm/s at the inlet channel to 5-10 cm/s in upper-harbor reaches. Current ripples, megaripples, and sand waves characterize the high energy, current-dominated lower harbour deposits, whereas small-scale current and wave ripples, together with biogenic markings and burrows, characterize the lower energy, inner harbor deposits. Small amplitude, wind-forced waves are important for resuspending and moving sediment in intertidal areas, particularly on the upper tidal flats. Most areas of the harbor are affected by biological processes. Rapid growth of Ohope barrier spit resulted from increased eastwards transport of littoral sands around Whakatane Heads, west of Ohiwa Harbor. The probable cause of this was the infilling of the up-drift Rangitaiki Plains embayment which was essentially completed soon after the time of the Taupo Pumice eruption (AS 131). Over the last 2000 years Ohope spit has accreted laterally eastwards at an average rate of about 3 m/y, Ohiwa spit has concomitantly eroded, and there has been accelerated infilling of Ohiwa Harbour. (Author's abstract)
W85-06798

WIND-RELATED RESUSPENSION OF SEDIMENTS IN THE PEEL-HARVEY ESTUARINE SYSTEM,
Western Australia Univ., Nedlands. Dept. of Soil Science and Plant Nutrition.
J. O. Gabrielson, and R. J. Lukatelich.
Estuarine, Coastal and Shelf Sciences, Vol. 20, No. 2, p 135-145, February, 1985. 3 Fig, 5 Tab, 26 Ref.

Descriptors: *Peel-Harvey Estuary, *Western Australia, *Resuspension, *Wind, Fetch, Waves, Sedimentation, Primary productivity, Estuaries, Suspended sediments.

The Peel-Harvey Estuarine System, located 80 km south of Perth, Western Australia, consists of two large interconnected coastal plain lagoon with a 5 km long, narrow channel connecting it to the ocean. Peel Inlet, 75 sq km, is nearly circular and consists of a central basin and wide peripheral platforms which occupy more than half the total area. Harvey Estuary is a 20 km long lagoon in an inter-dune depression, reaching 2.5 m depth in its central basin. The tidal regime of the system is atypical in that it is dominated by long term changes in sea level which result in water level changes of up to 50 cm over a 5 to 15 day period. Easterly winds are prevalent in summer, punctuated by a reliable sea breeeze which develops about mid-day. In winter the passage of cold fronts over the southern part of the state brings westerly gales and most of the higher velocities are associated with these storms. Resuspension of bottom sediments accounted for 69-92% of the mean deposition rates (11.6 to 69.3 g/sq m/day) measured at 5 sites in the Peel-Harvey Estuarine System. Deposition rates at all but one of the sites were found to be correlated with a function of wind combining a fetch factor with the number of hours of winds greater than 5 m/sec, weighted by the third power of wind velocity. The exception was the only site with a cover of benthic algae during the study. Wind related resuspension greatly affects the forms and amounts of productivity in this system. (Baker-IVI)
W85-06851

OBSERVED FLUXES OF WATER, SALT AND SUSPENDED SEDIMENT IN A PARTLY MIXED ESTUARY,
Institute for Marine Environmental Research, Plymouth (England).
R. J. Uncles, R. C. A. Elliott, and S. A. Weston.
Estuarine, Coastal and Shelf Science, Vol. 20, No. 2, p 147-167, February, 1985. 10 Fig, 1 Tab, 39 Ref. Department of the Environment contract DGR 480/48.

Descriptors: *Estuary, *Salt, *Suspended sediment, *Tamar Estuary, *England, *Circulation, Salinity, Tides, Sediment balance, Water balance, Turbidity.

Residual fluxes of water, salt and suspended sediment were observed at seven stations along the Tamar Estuary (England). The data include measurements over single spring and neap tidal cycles, and are generally applicable to medium or high run-off conditions. Surface to bed differences in salinity are typically of the order of several parts per thousand. Gravitational circulation is an important component of residual flow in the deep, lower reaches of the estuary. Here, Stokes drift is insignificant. In the shallow upper reaches, the major residual currents are generated by Stokes drift and freshwater inputs. Data were compared with predictions from Hansen and Rattray's model of estuarine circulation. Salt fluxes due to tidal pumping and vertical shear are directed up-estuary at spring tides, tidal pumping being dominant. Tidal pumping of salt is also directed up-estuary at neap tides, although it is insignificant in the lower reaches, where vertical shear dominates. Tidal pumping of suspended sediment is directed up-estuary near the head at spring tides, and probably contributes to the formation of the turbidity maximum. The existence of the turbidity maximum was predicted using a simplified model of the transport of water and sediment. The model shows that an additional mechanism for the existence of the turbidity maximum is an up-estuary maximum in the tidal current speeds (and thus resuspension). In the

lower reaches, transport of suspended sediment is directed down-estuary at both spring and neap tides, and sediment is essentially flushed to sea with the fresh water. (Author's abstract)
W85-06852

EFFECTS OF ENVIRONMENTAL GRADIENTS CONCERNING WATER QUALITIES ON THE STRUCTURE OF THE PHYTOPLANKTON COMMUNITY IN THE COASTAL SEA,
Hiroshima Univ. (Japan). Inst. of Environmental Chemistry.
T. Mukai, and K. Takimoto.
Estuarine, Coastal and Shelf Science, Vol. 20, No. 2, p 169-181, February, 1985. 6 Fig, 3 Tab, 17 Ref.

Descriptors: *Coastal water, *Seto Inland Sea, *Japan, *Water chemistry, *Phytoplankton, Water quality, Inland seas, Species diversity, Species composition.

The effects on the structure of the phytoplankton community of in situ water quality gradients formed during mixing of coastal with oceanic waters were investigated over a wide area of the Seto Inland Sea, Japan. As shown by use of the diversity index, the community structure of the phytoplankton varied almost constantly along the in situ environmental gradients. These observations represent the direct or indirect response of the phytoplankton community to environmental gradients which occur in situ and which create a series of variations of the habitat of the phytoplankton community. Their effects were reflected in the structure of the phytoplankton community, not in biomass. It was difficult to establish quantitatively the extent of their effects because of the variability in the degree of the environmental gradients which occur in situ.
W85-06853

COMPARATIVE STUDY OF MERCURY CONTAMINATION IN THE TAGUS ESTUARY (PORTUGAL) AND MAJOR FRENCH ESTUARIES (GIRONDE, LOIRE, RHONE),
Ecole Normale Superieure, Paris (France).
For primary bibliographic entry see Field 5B.
W85-06854

OBSERVATIONS ON THE ECOLOGICAL IMPORTANCE OF SALT MARSHES IN THE CUMBERLAND BASIN, A MACROTIDAL ESTUARY IN THE BAY OF FUNDY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
D. C. Gordon, Jr., P. J. Cranford, and C. Desplanque.
Estuarine, Coastal and Shelf Science, Vol. 20, No. 2, p 205-227, February, 1985. 7 Fig, 7 Tab, 48 Ref.

Descriptors: *Salt marshes, *Marshes, *Cumberland Basin, *Estuaries, *Bay of Fundy, *New Brunswick, *Nova Scotia, Spartina, Species composition, Tides, Primary production, Turbidity, Tidal energy, Carbon.

The Cumberland Basin, a 118 sq km estuary at the head of the Bay of Fundy which has an average tidal range of about 11 m, contains large tracts of salt marsh (15% of the area below highest high water). Low marsh (below about 0.9 m above mean high water) is composed almost exclusively of Spartina alterniflora while the vegetation on high marsh is more diverse but dominated by Spartina patens. Because of its higher elevation, high marsh is flooded infrequently for short periods by only extreme high tides. Low marsh is inundated much more frequently by water as much as 4 m deep for periods as long as 4 h per tide. Temporal variability in the occurrence of extreme tides influences the flooding frequency of high marsh for any given month and year. Using a modification of Smalley's method, the mean annual net aerial primary production (NAPP) of low and high marsh is estimated to be 272 and 172 g C/sq m, respectively. Vegetation turnover times average 1.0 and 2.0 y for low and high marsh, respectively. Because of abundant tidal energy, much of the low marsh production appears to be exported and distributed widely about the estuary. Since high levels of turbidity suppress phytoplankton production, salt marshes produce approximately half of the carbon fixed photosynthetically in the Cumberland Basin. It is concluded that salt marshes play a major ecological role in the Cumberland Basin. (Author's abstract)
W85-06855

MODEL FOR LAKE-BAY EXCHANGE FLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
A. Klapwijk, and W. J. Snodgrass.
Journal of Great Lakes Research, Vol. 11, No. 1, p 43-52, 1985. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Model studies, *Seiches, *Lake Ontario, *Hamilton Harbour, *Great Lakes, *Exchange flow, *Bays, Mathematical models, Stratification, Water transport, Mixing, Dissolved solids.

Transient inflows and outflows of water between Lake Ontario and Hamilton Harbour, driven by lake seiches, can be parameterized as a two-directional exchange flow. Estimates of exchange flows made from current measurements by others result in unlikely values. A model was developed for exchange flow during summer stratification in which two distinct flow patterns exist (i) lake water enters the harbor's hypolimnion, displacing an equal volume of hypolimnetic water to the epilimnion and then of epilimnetic water to the lake and (ii) lake water exchanges directly with the harbor's epilimnion. The temporal variation of exchange flows are estimated from a TDS budget and temperature data. They suggest that weekly estimates of epilimnetic exchange vary from 1 to 5 times Q (the average annual flow rate) while hypolimnetic exchange varies from 0 to 15 times Q for a 3-year period. The calculations suggest that stratification and lake seiches significantly increase the 'pumping' action of exchange flow in summertime compared to the remainder of the year. (Author's abstract)
W85-06864

FRONTAL ZONE ANALYSIS AT THE MOUTH OF A FJORD - JERVIS INLET, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Oceanography.
T. R. Parsons, H. M. Dovey, W. O. Cochlan, R. I. Perry, and P. B. Crean.
Sarsia, Vol. 69, No. 2, p 133-137, 1984. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Jervis Inlet, *British Columbia, *Fjords, *Productivity, *Frontal zones, Zooplankton, Phytoplankton, Primary productivity, Chlorophyll, Temperature, Salinity, Tidal waters.

The entrance to Jervis Inlet, a fjord on the coast of British Columbia, was investigated for the possible presence of a frontal zone. Historical data on tidal exchange was combined with temperature/salinity reports and data collected on a cruise into the inlet during June of 1983. Near-surface fluorescence transects indicate no substantial increase of chlorophyll a in the outer part of Jervis Inlet from Malaspina Strait to Hotham Sound. There was a large increase in the northern past of Agamemnon Channel with a pronounced maximum near its junction with Jervis Inlet. Nitrate concentrations throughout the region were generally below the limit of detection in the uppermost 2 m but increased to about 20 microg-at/l below the pycnocline. Phytoplankton species present at all stations included Skeletonema costatum, Chaetoceros sp., and Noctiluca sp. Zooplankton samples at all six productivity stations were dominated by herbivorous copepods, medusae, siphonophores, ctenophores, and euphausiids. Jervis Inlet differs from Saanich Inlet in not having a frontal zone located at its mouth. The depth at the mouth of Jervis Inlet is about 250 m while that at the mouth of Saanich Inlet is about 50 m. (Baker-IVI)
W85-06876

DELTA13C EVIDENCE OF THE ORIGINS AND FATES OF ORGANIC CARBON IN ESTUARINE AND NEARSHORE FOOD WEBS,
Washington Univ., Seattle. Fisheries Research Inst.
C. A. Simenstad, and R. C. Wissmar.
Marine Ecology, Vol. 22, No. 2, p 141-152, 1985. 5 Fig, 3 Tab, 77 Ref. Washington Sea Grant R/F-37.

Descriptors: *Organic carbon, *Estuarine environment, *Hood Canal, *Puget Sound, *Coastal waters, *Carbon radioisotopes, *Food chains, *Washington, Isotope studies, Fjords, Seasonal variation, Primary production, Inorganic carbon.

Origins and fates of organic carbon in estuarine and nearshore marine food webs of Hood Canal, a fjord extension of Puget Sound, Washington (USA), were evaluated seasonally using stable carbon isotopes (delta C-13). Delta C-13 was measured in: (1) autotrophic sources in terrestrial, estuarine, and nearshore marine habitats; (2) particulate and dissolved organic carbon (POC, DOC) in riverine, estuarine, and nearshore marine waters; (3) primary and secondary consumers in selected estuarine and marine littoral and neritic food webs. Autotrophic sources in terrestrial, riverine, salt marshmeadow, and neritic habitats were generally more C-13-depleted (averaging -30, -26, and -22%, respectively) than sources in estuarine and marine littoral habitats (-8 and -23%). The isotopic composition of neritic consumers indicated that their food sources originated directly from phytoplankton production. In contrast, the delta C-13 of primary and secondary consumers (-11% to -23%) in estuarine and marine littoral habitats suggested that the most important sources of organic carbon to these food webs were autochthonous, originating primarily from eelgrass, epiphytes, and macroalgae. Estuarine detritus deposits, sestonic POC, and sediments had widely ranging delta C-13 values (-9.7 to -28.9%), indicating diverse origins. However, POC associated with surface foam in estuarine littoral waters and DOC in marine littoral waters both had isotopic values most similar to estuarine autotrophs and consumers, suggesting the potential importance of dissolved and foam organics in food-web pathways. Depletion as high as Delta 8% occurred in autotrophs, DOC, and some consumer organisms in estuarine and nearshore marine habitats during winter. This seasonal depletion in delta C-13 originates from variable imports of dissolved inorganic carbon (DIC) transported by freshwater and may reflect the influence of extensive freshwater storage in Hood Canal during fall and winter. These results indicate the need for further elucidation of the complex biological and chemical mechanisms of formation, cycling, and degradation of particulate and dissolved organics from autochthonous sources to estuarine and nearshore marine food webs. (Author's abstract)
W85-06877

OBSERVATIONS OF THE SUSPENDED MATTER DISTRIBUTION DYNAMICS IN THE ELBE ESTUARY FROM TIME SERIES AERIAL PHOTOGRAPHS,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)
R. Doerffer.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 1, p 127-150, 1985. 29 Fig, 20 Ref.

Descriptors: *Suspended matter, *Elbe Estuary, *Germany (Federal Republic), *Time series analysis, Aerial photography, Estuaries, Distribution patterns, Tidal waters.

The suspended matter distribution dynamics in the Elbe River at Luhesand (Federal Republic of Germany) was observed for one tidal cycle using a time series of aerial photographs taken with color film and a wide angle lens. The 1 x 1 km section was mapped from altitudes of 800-1000 m. The sampling interval was about 5-7 minutes for periods of about 1 hour for different phases of the tidal cycle. The images were geometrically corrected with a digital image processing system. The density of the red layer of the film was used as a relative indicator of the suspended matter distribution. The images show complicate patterns in the surface distribution, which are changing during the tidal cycle. Typical features are large fields with an extension of some hundred meters and suspended matter clouds with a typical diameter of about 2-m

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as well as long bands caused by ship traffic. The history of a single cloud cannot be traced with the sampling rate of 6 minutes due to fast current velocity and turbulence structure. The distribution structure on the scale of some hundred meters is changing in a different way from the transport of the material forming these structures. A comparison of the distribution with the bathymetry indicates that the topography has the main influence on the small scale local current regime which is on the other hand the main factor determining the distribution and the transport. Another important mechanism, which determines the suspended matter content in the fairway region, is based on the turbulences caused by ship traffic. (Baker-IVI)
W85-06885

EXAMINATION OF TIDAL FLATS, VOL. 2: IDENTIFIED VALUES REVIEW.
Virginia Inst. of Marine Science, Gloucester Point.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-131797, Report No. FHWA/RD-80-182, June 1982. Final Report. Federal Highway Administration, Office of Research, Washington, DC. R.J. Diaz, editor. 47 p, 1 Fig, 2 Tab, 368 Ref.

Descriptors: *Tidal flats, *Evaluation, *Data collections, *Highway effects, *Ecological effects, *Environmental effects, *Wildlife habitats, *Wetlands, Literature review, Habitats, Data interpretation, Waterfowl, Value, Primary productivity, Dredging, Marsh management, Salt marshes.

This report is the second volume of three, documenting a study titled 'Evaluation of Tidal Flat Areas for Highway Planning and Design.' It summarizes the available data from the literature concerning physical, chemical, and biological processes characteristic of the tidal flat environment. Human activities which impact upon the tidal flat environment include dredging and filling, removal of grass beds, recreational and commercial activities, and highway construction. There are a large number of variables involved in evaluating tidal flats. Many of these parameters may act synergistically to create a significantly greater effect than if that variable were considered alone. The evaluation methodology for tidal flat wetlands should rank the salient features of each habitat on a scale of importance values. Features important for ranking are: primary and benthic secondary production, habitat utilization, feeding ground, protective nursery or refuge, shellfish, role in material flow (oxygen, nutrients, pollutants) and waterfowl utilization.
W85-06895

ANIMAL SUBSTRATE RELATIONSHIPS AND PRODUCTIVITY OF INVERTEBRATE MACROBENTHOS OF MISSISSIPPI SOUND AND ADJACENT COASTAL AREAS: A BIBLIOGRAPHY WITH ABSTRACTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. D. Lunz, and H. L. Horstmann.
Miscellaneous Paper EL-81-12, December 1981. Final Report. 143 p, Intra-Army Order FC-81-0020.

Descriptors: *Bibliographics, *Estuaries, *Invertebrates, *Benthos, *Aquatic habitats, *Aquatic animals, Habitats, Mississippi Sound, Aquatic life, Fish, Water quality, Stress, Marine environment.

A bibliography with abstracts and annotations presents information on animal-substrate interaction and benthic invertebrate secondary production relative to the Mississippi Sound and adjacent areas. Other subjects include benthic community pattern classification, the short- and long-term temporal dynamics of benthic faunal communities, benthic pelagic coupling in terms of water quality and pelagic productivity, and benthic responses to stress.
W85-06911

LAKE PONTCHARTRAIN AND VICINITY HURRICANE PROTECTION PLAN; REPORT 1: PROTOTYPE DATA ACQUISITION AND ANALYSIS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2H.
W85-06939

ECOLOGY OF COASTAL WATERS: A SYSTEMS APPROACH,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
K. H. Mann.
Volume 8: Studies in Ecology, University of California Press, Berkeley, CA. 1982. 332 p, 102 Fig, 22 Tab, 594 Ref.

Descriptors: *Coastal waters, *Ecology, *Estuaries, *Ecological effects, *Ecosystems, *Primary productivity, *Ecological processes, Grazing, Predation, Secondary productivity, Detritus, Decomposition, Cycling nutrients.

This book presents a synthesis of current knowledge of the ecological processes occurring in coastal waters worldwide, focussing on the large-scale processes that affect organisms or populations, rather than on the individual organisms or populations themselves. The processes discussed include primary production, grazing, predation, secondary production, detritus formation, decomposition, energy flow, nutrient cycling, and so on, for which the principles involved are enunciated and key references given. The author has concentrated on recent work, producing a book for professionals in research and management.
W85-06945

USER GUIDE FOR CE-QUAL-ELV2: A LONGITUDINAL-VERTICAL, TIME-VARYING ESTUARINE WATER QUALITY MODEL,
Edinger (J.E.) Associates, Inc., Wayne, PA.
E. M. Buchak, and J. E. Edinger.
Instruction Report EL-82-1, December 1982. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 101 p, 5 Fig, 2 Tab, 22 Ref, 8 Append. Contract/Grant No. P.O. DACW39-81-M-2788.

Descriptors: *Model studies, *Computer models, *Estuaries, *Water quality, Fortran, *Computer programs, *Turbulent flow, *Tidal effects, Hydrologic models, Mathematical models, Simulation analysis, Mathematical studies, Models, Mathematical equations, Wind tides.

This report is the user guide for a FORTRAN program that permits time-varying hydrodynamic and transport simulations of estuaries. It also includes a summary of the development of this program, with emphasis on the characteristics of estuaries, estuarine boundary conditions, turbulence, and validation tests. CE-QUAL-ELV2, an acronym for the Estuarine Longitudinal-Vertical 2-Dimensional model, consists of the original Laterally Averaged Estuary Model (LAEM) plus the Water Quality Transport Module (WQTM). The LAEM program was developed for a test application to the Potomac Estuary from the then-current version of the Laterally Averaged Reservoir Model (LARM). The References section of this report lists all the available documents describing the related development of the LARM and LAEM programs. This report contains an overview of the capabilities of CE-QUAL-ELV2; a summary of its theoretical foundation and a discussion of the validation tests; a synopsis of estuarine characteristics, including turbulence, with reference to the Patuxent Estuary; and a detailed discussion of the application procedure, again with reference to the Patuxent example. The appendices contain an input data description with examples and user notes for two auxiliary codes. (Author's abstract)
W85-06957

OBSERVATIONS OF CURRENTS AND WATER PROPERTIES IN COMMENCEMENT BAY,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
G. A. Cannon, and M. W. Grigsby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-108795. NOAA Technical Memorandum OMPA-22, August 1982. 37 p. 19 Fig, 1 Tab, 6 Ref.

Descriptors: *Bays, *Water currents, *Water properties, *Sediment transport, *Water metering, Water measurement, Water analysis, Washington.

Observations of currents and water properties have been made in Commencement Bay, Washington, to provide background information which would be useful in describing physical transport processes in the Bay, and hence, the fate and effect of any dissolved and suspended contaminants. Observations were made during low river runoff commencing in March 1980 and during a higher runoff period commencing March 1981 using moored subsurface current meter arrays and CTD surveys. Each survey entailed shipboard water property measurements for about three days during deployment of the current meter arrays. The arrays provided additional water property and current measurements continuously for approximately sixty days. This data report includes a description of the experiments and representative data presentations. It is intended to provide relatively quick dissemination of the observations for those with special needs. Additional analyses and interpretations will be made at a later time.
W85-06959

BALTIMORE HARBOR AND CHANNELS DEEPENING STUDY: CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 6G.
W85-06968

EXPERIMENTAL INVESTIGATION OF INTRUSIVE GRAVITY CURRENTS ENTERING STABLY STRATIFIED FLUIDS,
Karlsruhe Univ. (Germany, F.R.). Sonderforschungsbereich Ausbreitungs- und Transportvorgaenge in Stroemungen.
For primary bibliographic entry see Field 2H.
W85-07028

BEHAVIOUR OF DISSOLVED IODINE IN THE UPPER ST. LAWRENCE ESTUARY,
Centre Champlain des Sciences de la Mer (Quebec).
For primary bibliographic entry see Field 2K.
W85-07036

CONTROL BY ORGANIC COATINGS OF THE SURFACE CHARGE OF ESTUARINE SUSPENDED PARTICLES,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
T. C. Loder, and P. S. Liss.
Limnology and Oceanography, Vol. 30, No. 2, p 418-421, March, 1985. 2 Fig, 15 Ref. National Environment Research Council grant GR3/3164.

Descriptors: *Organic coatings, *Surface charge, *Suspended particles, *Particulate matter, Electrophoretic mobility, Charge, Iron, Seawater, Salinity.

The electrophoretic mobility (U sub E), and hence the surface charge, of suspended particles from a wide variety of estuaries has been reported to be always negative and to fall in the range -0.7 to -2.0 x 10 to the -8th power sq m/s/V; similarly, U sub E measurements on suspended particles from fresh and seawater also indicate negatively charged particles with U sub E values in a somewhat narrower range than that given above for estuarine particles. This uniformity is often attributed to the presence of organic or oxide surface coatings on the particles. Iron oxide particles formed in situ in organic-free water exhibit the expected positive charge but, on immersion in water containing its natural organic material, rapidly acquire the negative change normally found for field samples. When whole natural samples (water plus suspended particles) were photooxidized with ultraviolet radiation and the organic matter was broken down, U sub E for all suspended particles became more positive. The

breakdown of organic coatings leads to more positive values for U sub E in these iron rich samples. (Collier-IVI)
W85-07073

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SOLAR DESALINATION,
A. A. Delyannis, and E. Delyannis.
Desalination, Vol. 50, p 71-81, October/November, 1984. 2 Fig, 27 Ref.

Descriptors: *Water supply development, *Desalination, *SOLERAS Project, *Solar energy, Reverse osmosis, Distillation, Energy, Solar ponds, Economic aspects.

An analysis is given of the characteristics and operation of conventional solar stills. The potential use of solar ponds is discussed. Recent trends in combining solar energy collection with other processes, such as MSF-distillation and reverse osmosis, are outlined. A brief description is offered of the SOLERAS project. Solar desalination exhibits a considerable economic advantage over other seawater distillation processes, because of cost-free energy and reduced operating costs. Another advantage of the process is its simplicity, as no moving parts are involved. The output of a solar still can only be increased either by increasing the water evaporating surface or the overall efficiency. The overall efficiency of a solar desalting unit is often determined by the ratio of product condensate to the theoretical amount of salt water expected to vaporize, the ratio of the heat of evaporation of the distillate to the solar heat reaching the apparatus. The operating efficiency of a solar still increases exponentially with increasing brine temperature, but heat losses increase in the same way. The productivity of a solar still expresses the amount of distillate produced per unit area of the water surface. There are two ways of increasing the fresh water yield from standard greenhouse distillation units: rain collection; and the use of preheated water or waste hot water as the feed. Direct or indirect use of solar energy may also be combined with other desalination processes, without necessarily having the production of hot water as an intermediate stage. Wind energy to produce electricity or photovoltaics may be combined with reverse osmosis or electrodialysis. (Baker-IVI)
W85-06690

DESALINATION BY THE SALINE WATER CONVERSION CORPORATION OF SAUDI ARABIA,
Saline Water Conversion Corp., Riyadh (Saudi Arabia).
A. M. Al-Golaikah.
Desalination, Vol. 50, p 83-86, October/November, 1984. 1 Tab.

Descriptors: *Water supply development, *Desalination, *Saudi Arabia, Seawater, Drinking water, Water supply, Water demand, Water management, Planning.

The shortage of water has greatly influenced life on the Arabian Peninsula. In 1928, two distillation plants were imported to alleviate a serious water shortage in Jeddah. In 1942 a group of US technologists was brought in to do an overall survey of Saudi Arabia's resources and needs. A five-year development plan for the Kingdom began in 1975 and included some huge projects for desalinating seawater to meet the needs of existing coastal Saudi Arabian cities, as well as new communities and industrial centers along the coasts. In the East, along the Arabian Gulf, desalination plants now extend from Al-Khafji in the uppermost Northeastern corner, to Al-Khobar. Lying between Al-Khafji and Al-Khobar is Al-Jubail, site of the largest desalination plant in the world. Saudi Arabia is clearly the world's largest producer of potable water from the sea. (Baker-IVI)
W85-06691

DEVELOPMENT OF DESALINATION IN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Chemical and Wood Technology.
B. A. Bolto.
Desalination, Vol. 50, p 103-114, October-November, 1984. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Desalination, *Australia, *Seawater, *Water supply development, Reviews, Distillation, Magnetic dealkalization, Sirotherm desalination, Ion-exchange processes, Sirofloc clarification, Economic aspects.

There has been a long established need for augmenting water supplies in Australia, such as by desalination of brackish surface or groundwater and of seawater. Progress in the installation of desalination plants is reviewed, and the future of the technology discussed. The technology is developing on two fronts: large-scale installations associated with industrial developments and salinity control schemes aimed at maintaining the quality of existing surface waters, and smaller-scale installations using existing marginal or brackish water resources to provide potable water in regions lacking adequate fresh water. Until 1975 more than half the desalting units established in Australia were based on distillation of seawater. Generally the plants are to provide drinking water for communities involved with petroleum exploration, mining, or tourism. Since 1975 only one-fifth of the plants established have relied on distillation, usually with seawater as the feed, as reverse osmosis has become more and more accepted for producing potable quality water from brackish groundwater. New techniques being investigated in Australia include the use of magnetic dealkalization, Sirotherm desalination (an ion-exchange process which uses hot water rather than chemicals as the regenerant and has distinct advantages in terms of operating costs, energy requirements and effluent disposal), and Sirofloc clarification, which is an extention of the magnetic particle technology to remove turbidity and color. Economic aspects of desalinization are considered briefly. (Baker-IVI)
W85-06693

REVERSE OSMOSIS MEMBRANE RESEARCH IN CHINA,
Academia Sinica, Dalian (China). Dalian Inst. of Chemical Physics.
L. Zheng.
Desalination, Vol. 50, p 115-124, October/November, 1984. 3 Tab. 85 Ref.

Descriptors: *Desalination, *China (People's Republic), *Reverse osmosis, *Membranes, Reviews, Ultrafiltration, Membrane processes.

The main achievements of reverse osmosis (RO) membrane research and the application of these membranes in the People's Republic of China are discussed. Reverse osmosis equipment and ultrafiltration membranes are also discussed. In 1970 the influence of the molecular weight of cellulose acetate (CA) on membrane performance was investigated. Three types of membranes made from Eastman CA and from Chinese CA materials were compared. The CA membrane was first used for desalination of seawater and brackish water. Among the aromatic nitrogen-containing RO membrane materials, only aromatic polyamide type material has been investigated in China. Ten polyamide materials with different viscosities and molecular weight distributions were studied in 1973. A study of the structural characteristics of an aromatic polyamide type asymmetric RO membrane formed from heated and evaporated casting solutions, using an electron microscope, showed micelles to be a significant characteristic. Other studies investigated the evaporation and gelation of DP-1 membranes and the composition of the casting solution and conditions for the preparation of the membranes. In 1975 a study was made of antioxidation of aromatic polymide RO membranes using an aromatic polyamide membrane with a sulfone group in the polymer main chain. The strongly acidic ionic sulfonated polysulfone RO membranes, possessing excellent anti-acid, anti-base and anti-bacterial properties have been studied in China since 1978. More recent research has investigated ultrathin layer composite RO membranes. (Baker-IVI)
W85-06694

STUDY OF COMBINED ACID/ADDITIVE SEAWATER FEED TREATMENT,
Cox, Cannizzaro and Associates, Inc., Centerport, NY.
B. Cox.
Desalination, Vol. 51, No. 2, p 149-162, 1984. 3 Fig, 10 Tab, 6 Ref.

Descriptors: *Desalination, *Seawater, *Additives, *Distillation, Corrosion control, Scale control, Water supply development.

A new hybrid chemical treatment of the seawater feed for MSF distillation plants is described. The advantages and disadvantages of various scale control techniques are discussed along with the details of combined treatment and its huge economic potential. The hybrid acid/additive seawater feed treatment described can be applied beneficially to any MSF plant. If the existing plant operates at 90 degrees C with polyphosphate, use of the high pH hybrid treatment will increase the output by 64%, reduce unit water costs by one-third, eliminate the need for acid cleaning, and protect the plant from corrosion. If the existing plant operates at 112 degrees C using a high temperature polyelectrolyte, use of the hybrid treatment will increase water production by 22% and reduce unit water costs by 13%. It will also eliminate the need for acid cleanings and will protect the plant from corrosion. If the existing plant operates at 121 degrees C using acid treatment, changing to the hybrid treatment will permit continued high temperature operation with tremendously reduced corrosion and plant maintenance. Plant life will be doubled or trebled. If the plant is in the design stage, designing for the use of the hybrid treatment will reduce capital costs 35% compared to polyphosphate, and 16% compared to high temperature polyelectrolyte, as well as greatly reducing operating costs. (Baker-IVI)
W85-07092

FIELD TRIAL OF REVERSE OSMOSIS IN THE EL KHANKA DESERT, EGYPT,
National Research Centre, Cairo (Egypt).
M. G. A. Khedr, A. H. Abd El Wahab, J. Kaschemekat, and J. Mohn.
Desalination, Vol. 51, No. 2, p 173-181, August, 1984. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Desalination, *Reverse osmosis, *El Khanka Kaliobia, *Egypt, Cellulose acetate membranes, Membrane processes, Bentonite, Stabilization, Hyperfiltration.

Installation and operation of a reverse osmosis test facility at El Khanka Kaliobia, Egypt has been undertaken. The test plant is a plate system of nominal output of 45 cu m/day, and has been in operation since January 1979. The results of the first three years of operation are considered. Two prototype reverse osmosis modules were tested, the G3 module during the first phase and the G4 module during the second phase. The two types of membranes used were a blend cellulose di- and triacetate membrane and a bentonite-stabilized cellulose acetate membrane. The trial showed that hyperfiltration units having flat plate modules of medium capacity can be successfully used for the treatment of local brackish water in industrial sites in the desert to produce fresh water for drinking and industrial purposes. Mechanical and desalting efficiency of bentonite-stabilized cellulose acetate membranes combined with periodic chemical washes in long term operation is proven. (Baker-IVI)
W85-07093

PERFORMANCE OF MULTIPLE EFFECT DIFFUSION STILLS,
King Abdulaziz Univ., Jeddah (Saudi Arabia).

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Dept. of Mechanical Engineering.
M. M. Elsayed, K. Fathalah, J. Shams, and J. Sabbagh.
Desalination, Vol. 51, No. 2, p 183-199, August, 1984. 12 Fig, 2 Tab, 7 Ref.

Descriptors: *Diffusion stills, *Mathematical models, Conductivity, Desalination, Diffusion, Distillation, Temperature effects.

Experimental testing of a three-effect diffusion still is carried out. The experiment is designed to test the effect of the heating fluid temperature input to the still, Th, and the feed rate of desalinated water to the still F on the performance of the still. The results produced several empirical relations to predict the following in terms of the Th and F: the average temperature of each effect, the rate of distillate produced by each effect, and the performance ratio of the still. In addition, a mathematical simulation is given for the n-effect diffusion still. The mathematical model is verified by comparing its results with the experimental results of the three-effect diffusion still. The model is further used to predict the performance of a ten-effect diffusion still at the following parametric conditions: various values of the dimensionless parameters N3 and N4, various heating medium temperatures input to the still, and various feed rates to the still. The increase in the feed rate to the still reduced the performance ratio. The variations of the dimensionless numbers N3 and N4 had a negligible effect on the performance ratio of the still. The increase in the heating water temperature and/or the decrease in the cooling water temperature improves the performance ratio of the still. (Baker-IVI)
W85-07094

CELLULOSE TRIACETATE MEMBRANES FOR SEAWATER DESALINATION,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
S. V. Josh, and A. V. Rao.
Desalination, Vol. 51, No. 3, p 307-312, September, 1984. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Desalination, *Cellulose triacetate membranes, *Membrane processes, Reverse osmosis, Membranes.

The aim of this study was to obtain a clear, gel- and fiber-free solution of suitable cellulose triacetate (CTA) concentration, to obtain perfect, reproducible membranes without pinholes, and to obtain a membrane for higher rejection for seawater. Several casting formulations were detailed and the necessary proportions of each component are worked out from the observations. Experimental data on reverse osmosis using a sodium chloride solution by CTA membranes are presented. The investigation involved studies on the composition of membrane casting solutions and their effects on the performance. A higher polymer concentration (11-13%) is found suitable for production of a uniform and highly salt rejecting membrane. Salt rejection of 99.0% and 4-5 GFD product water flux were obtained at 1000 psi operating pressure using 30,000 ppm total dissolved solids, seawater in the initial experiments. Proper control over these two parameters is primarily important for evaluating high salt rejection membranes. (Baker-IVI)
W85-07096

3B. Water Yield Improvement

HYDRAULIC TECHNIQUE FOR DESIGNING SCAVENGER-PRODUCTION WELL COUPLES TO WITHDRAW FRESHWATER FROM AQUIFERS CONTAINING SALINE WATER,
Geological Survey, San Juan, PR. Water Resources Div.
A. Zack, and R. Munoz-Candelario.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157725/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, Puerto Rico Water Resources Research Institute, Mayaquez, Sept 1984. 50 p, 20 Fig, 3 Ref, Project No. OWRT A-075-PR (1), Contract/Grant No. 14-34-0001-2141.

Descriptors: *Combination wells, *Saline water, Hydraulic design, Well hydraulics, Well yield, Well water, Coastal aquifers, *Puerto Rico, Saline-freshwater interfaces.

Aquifers in coastal areas of Puerto Rico often contain very limited quantities of freshwater, occurring as a thin lens at the surface of the water table. Many wells have been abandoned because they were inadvertently screened in saltwater parts of the aquifer. It was found in this study that scavenger-production well couples installed in abandoned wells, screened in both fresh and saltwater parts of the aquifer, provided an effective method for extracting only the freshwater from the well. Withdrawing a sufficient quantity of low-chloride water using the couple depended upon the degree of upward movement of saltwater within the aquifer when the well was pumped. Vertical saltwater movement depended upon the relative concentrations of chloride in the borehole and the distribution of horizontal and vertical hydraulic conductivity of the aquifer. The results show that for any well screened in an aquifer containing both freshwater and saltwater, there exists a family of curves representing all combinations of pumping rates and corresponding chloride loads for the scavenger well and the production well pumping simultaneously from the well. The curves are derived empirically by splitting the total chloride load withdrawn from a well into the individual loads production and scavenger wells at various pumping rates. The curves developed permit the optimization of freshwater withdrawals based on pumping desired rates and levels of chloride concentration required for each well. The techniques can be applied to any other wells which exhibit radial flow and maintain the same well efficiency over a wide range of pumping rates.
W85-06316

DEVELOPMENT OF A COMPREHENSIVE UPPER COLORADO RIVER BASIN MODEL FOR ANALYZING ENERGY DEVELOPMENT IMPACTS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 4A.
W85-06323

DEVELOPMENT OF A PREDICTIVE IRRIGATION SCHEDULING INDEX USING ELECTROPHYTOGRAMS,
Arizona Univ., Tucson. Dept. of Electrical Engineering.
For primary bibliographic entry see Field 3F.
W85-06326

CHANGE IN THE HYDROPHYSICAL PROPERTIES OF PEAT-BOG SOILS AFTER APPLICATION OF HYDROLYZED POLYACRYLONITRILE,
Akademiya Navuk BSSR, Minsk. Peat Inst.
I. I. Lishtvan, A. A. Terent'yev, A. I. Sorokin, A. M. Abramets, and V. S. Brezgunov.
Soviet Soil Science, Vol. 16, No. 5, p 116-121, September/October, 1984. 4 Tab, 16 Ref. Translated from Pochvovedeniye, No. 9, p 123-127, 1984.

Descriptors: *Soil properties, *Soil water, *Polyacrylonitrile, *Peat, Water content, Physicochemical properties, Moisture content, Bogs, Soil physical properties, Soil conditioners.

The effect of hydrolyzed polyacrylonitrile (HPAN) on the hydrophysical properties, structure, and biological activity of Peat-Bog soils was studied in the field. To study the effect of HPAN on moisture distribution in the upper soil horizons, the soil was sampled periodically during the season from the 0- to 20-cm layer. The results of the field tests confirmed the efficacy of HPAN as a conditioner for Peat-Bog soils. The macrostructure of the soil remained water stable during the entire growing period and the conditioning effect of HPAN was greater in seasons with less rain because of the lesser leaching of the polymer by rainwater and its lesser migration into the depth of the soil. The stability of the water-stable structure of Peat-Bog soils during the season after application of HPAN depended on the crop grown. This was associated with the number of mechanical soil cultivations that mix the upper soil layers. Small amounts of HPAN (60 kg/ha) had an effect in the field which was approximately the same as that of larger amounts. The addition of 500 kg HPAN/ha did not produce any significant increase in the content of water stable fractions in the soil. The method of application and soil-surface preparation also influence the effect of HPAN as a soil conditioner. In addition to affecting the hydrophysical properties of Peat-Bog soils, HPAN also reduces their biological activity. (Baker-IVI)
W85-06752

STIROMAL, A NEW EFFECTIVE SOIL STRUCTURING AND HYDROPHOBIZING AGENT,
O. A. Agafonov, A. D. Akbasova, I. A. Katicheva, I. A. Romanov, and O. G. Us'Yarov.
Soviet Soil Science, Vol. 16, No. 5, p 122-125, September/October, 1984. 2 Fig, 3 Tab, 5 Ref. Translated from Pochvovedeniye, No. 4, p 109-112, 1984.

Descriptors: *Soil water, *Moisture availability, *Evaporation control, Aggregates, Irrigation, Erosion control, Soil properties, Soil conditioners.

The possibility of using hydrolyzed stiromal to produce water-resistant aggregates and serve as an evaporation suppressor is discussed. Positive results were obtained in Sod-Podzolic soils and Solonetzes. Two clay loam soils, a sod-Prozolic soil and a Solonetz were treated with the compound in solution. The technical effectiveness of hydrolyzed stiromal (a copolymer of styrene and maleic anhydride) when used to treat the soils was equivalent to that of the best-known conditioners; the optimum amount is 0.05%. The given agent sharply decreases the rate and height of the capillary rise of water and reduces evaporation from the soil regardless of the humidity of the air. It may be effective in controlling unproductive losses of moisture through evaporation, soil crusting, and water, wind and irrigation erosion. A high calcium chloride content in the soil decreases its effectiveness. (Baker-IVI)
W85-06753

PUTTING WASTEWATER TO WORK,
El Paso, TX.
For primary bibliographic entry see Field 3D.
W85-06816

3C. Use Of Water Of Impaired Quality

IRRIGATION WITH BRACKISH WATER UNDER DESERT CONDITIONS; I. PROBLEMS AND SOLUTIONS IN PRODUCTION OF ONIONS (ALLIUM CEPA L.),
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Applied Research Inst.
D. Pasternak, Y. De Malach, and I. Borovic.
Agriculture Water Management, Vol. 9, No. 3, p 225-235, November, 1984. 3 Fig, 7 Tab, 11 Ref.

Descriptors: *Onions, *Brackish water, *Irrigation water, Crop production, Deserts, Electrical conductivity, Sprinkler irrigation, Drip irrigation, Crop yield.

To identify the problems and suggest solutions for onion production under brackish water irrigation in a desert environment, a series of trials with brackish water (electrical conductivity, ECi = 4.4 dS/m) and fresh water ECi = 1.2 dS/m) was conducted, using both sprinkler and drip irrigation systems. Under sprinkler irrigation with brackish water the mean electrical conductivity of the saturated soil extract (ECe) was about 6.0 dS/m and the yield reduction was 60%. With drip irrigation, the ECe under the drippers was about 5.0 dS/m and the yield reduction was 30%. Sprinkler irrigation affected yield through a reduction in both bulb size and bulb number per unit area. Drip irrigation affected the bulb number only. In the latter system seedling death occurred during the first 40 days

following field emergence. Yield reduction was completely prevented by germinating and establishing the field with freshwater irrigation before transferring to brackish water irrigation, 45 days after sowing. With the sprinkler system, onion yield with brackish water irrigation could be increased by either increasing the sowing density or by alternating between brackish and freshwater irrigation. (Author's abstract)
W85-06282

SALINE COOLING TOWER WATER FOR IRRIGATION IN MINNESOTA: I. CROP AND SOIL EFFECTS,
Montana Agricultural Experiment Station, Huntley, MT. Southern Agricultural Research Center.
R. E. Engel, G. L. Malzer, and F. G. Bergsrud.
Journal of Environmental Quality, Vol. 14, No. 1, p 32-36, January/March, 1985. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Cooling water, *Saline water, *Irrigation water, *Minnesota, Corn, Alfalfa, Soil water, Soil solution, Salinity, Rainfall, Leaching, Sulfates, Electrical conductivity, Calcium, Magnesium.

Saline cooling tower water (CTW) from the Northern States Power coal-fired plant in Sherburne County, MN was used to irrigate a Hubbard loamy sand (Udorthentic Haploboroll). The objectives of this study were to determine the changes in soil solution salinity, to measure salt accumulations in the soil profile (0- to 240-cm), and to assess the impact of CTW on crop production. In a 3-yr field study, CTW (2.2 dS/m) was applied at two rates to alfalfa (Medicago sativa L.), corn (Zea mays L.) and fallow areas. Analysis of the soil water for electrical conductivity (ECSW) at 75 cm indicated that an increase in salt concentration occurred over the growing season. Maximum seasonal ECSW at 75 cm in the cropped areas (3.0-4.0 dS/m) were higher than in the fallow areas (2.0-2.5 dS/m). Rainfall between the growing seasons, however, was adequate to leach the upper 75 cm of this coarse-textured soil and prevent a stepwise buildup of salts from one year to the next. After an initial buildup, ECSW at 225 cm was relatively stable. For the last 2 yr, ECSW at 225 cm was consistently higher under alfalfa than corn or fallow areas. A seasonal buildup of SO4 occurred during the growing season. In the fall, SO4 accumulations in the 0- to 60-cm soil layer were highest under corn. By the following spring, there was no difference between the three cropping systems. Rainfall was very effective in leaching seasonal accumulations of SO4 from the soil. A lower Ca/Mg ratio in the CTW, as compared with the soil, resulted in increased concentration of Mg in the 0- to 60- and 60- to 150-cm soil layers. Corn grain and alfalfa production averaged 8440 and 8230 kg/ha for the last two seasons, respectively, and were not adversely affected by salinity produced from the CTW application. (Author's abstract)
W85-06615

SALINE COOLING TOWER WATER FOR IRRIGATION IN MINNESOTA: II. DRAINAGE WATER COMPOSITION, LEACHING FRACTION, AND EFFECT ON AQUIFER QUALITY,
Montana Agricultural Experiment Station, Huntley, MT. Southern Agricultural Research Center.
R. E. Engel, G. L. Malzer, and F. G. Bergsrud.
Journal of Environmental Quality, Vol. 14, No. 1, p 36-40, January/March, 1985. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Irrigation water, *Saline water, *Drainage water, *Leaching, *Minnesota, Cooling water, Groundwater pollution, Alfalfa, Corn, Calcium, Sulfates, Aquifer.

Saline cooling tower water (CTW) from the Sherburne County electrical power plant in Minnesota is being considered as an irrigation water source on surrounding croplands. Since the soils are coarse-textured and this region receives an average 66 cm rainfall annually, salt will leach into the underlying aquifer. This study was undertaken to determine composition of drainage waters, leaching fractions (LF), and quality of the underlying aquifer (10-12 m) as affected by irrigation with CTW at two rates under three cropping systems. In a 3-yr field study (1979-1981), alfalfa (Medicago sativa L.), corn (Zea mays L.), and fallow plots were irrigated at rates that replaced net water deficits (I1) and twice the net water deficits (I2) in the cropped areas. The soil at this site was a Hubbard loamy sand (Udorthentic Haploboroll). Lysimeters, 57 cm in diam., were buried 150 cm below tile plots to monitor the composition of the drainage waters and to determine the LF. Wells were installed in all plots to monitor deep movement of the CTW salts into the aquifer. Application of CTW increased the concentration of Ca and SO4 in the drainage waters. These ions together comprised 70-75% of the total ion equivalents measured. Salt concentrations were generally higher under alfalfa than corn and fallow, reflecting its higher water requirement. Drainage waters were undersaturated with respect to gypsum; thus, SO4 added from the irrigation water stayed in solution. The LF under the I2 rate averaged 0.58. The LF under the alfalfa and corn (I1 rate) averaged 0.34 and 0.38, respectively. The LFs under the I1 rate were higher than anticipated. Apparently, even when irrigation was scheduled at a rate consistent with satisfactory crop growth, a considerable amount of water - and in turn salts - were lost from the soil profile due to heavy, erratic precipitation. Salt concentrations in the aquifer increased greatly over the 3 yr. Sulfate concentrations peaked at 6.4 mmol/L in 1981, over 20 times greater than background levels and higher than U.S. Environmental Protection Agency drinking water standards. (Author's abstract)
W85-06616

3D. Conservation In Domestic and Municipal Use

MUNICIPAL DEMAND FOR WATER IN KUWAIT: METHODOLOGICAL ISSUES AND EMPIRICAL RESULTS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6D.
W85-06497

PUTTING WASTEWATER TO WORK,
El Paso, TX.
J. W. Rogers.
EPA Journal, Vol. 11, No. 3, p 5-6, April, 1985. 2 Fig.

Descriptors: *Water conservation, *El Paso, *Texas, *Water supply development, *Wastewater treatment, Water recirculation, Sewage, Water treatment, Drinking water.

El Paso, Texas becomes this year the first large community in the United States to stretch its dwindling water resources by pumping reprocessed sewage into its major underground aquifer. Over 65% of the city's water is taken from this aquifer. A grant of $20.5 million was obtained from the EPA to pay part of the $32 million total cost of plant construction. The treatment system uses biological and activated carbon processes to remove all organic and nitrogen compounds. Operating costs are projected at 85 cents per thousand gallons and is well within the range of water charges under El Paso's graduated water rate system. The city also has an effective program to reduce individual water consumption. The water rate structure includes a five step increasing rate for residential customers and a three step increasing rate for all other customers. Concrete ground storage reservoirs are lined with plastic to reduce the water loss and eight to 10 miles of deteriorated water lines are replaced each year. These and other conservation measures have reduced water use from 216 gallons per person per day in 1977 to 185 gallons in 1984. (Baker-IVI)
W85-06816

3F. Conservation In Agriculture

EFFECT OF FURROW DIKING, SUBSOILING, AND SLOPE POSITION ON CROP YIELDS,
Texas Agricultural Experiment Station, Vernon.
C. J. Gerard, P. D. Sexton, and D. M. Conover.
Agronomy Journal, Vol. 76, No. 6, p 945-950, November-December, 1984. 5 Fig, 9 Tab, 10 Ref.

Descriptors: *Furrow diking, *Subsoiling, *Slope, *Crop yield, *Texas, Sorghum, Cotton, Runoff, Water conservation.

The effects of furrow diking and subsoiling on runoff and crop yields were evaluated on gently sloping land in the Rolling Plains of Texas. Diking and subsoiling reduced runoff and significantly increased yields of sorghum (Sorghum bicolor (L.) Moench) and cotton (Gossypium hirsutum L.). Yields of diked sorghum and cotton were 108 and 32% higher than the check, respectively. Yields of sorghum on the diked treatment on an Abilene loam soil (fine, mixed, thermic Pachic Argiustoll) averaged about 2550, 3300, and 3590 kg/ha or about 302, 140, and 42% more than the check treatment on the upper, middle, and lower parts of the slope, respectively. In contrast, cotton yields on the diked treatment on a Miles fine sandy loam soil (fine-loamy, mixed, thermic udic Paleustalf) averaged about 465, 515, and 475 kg/ha or about 57, 37, and 11% more than the check on the upper, middle, and lower parts of the slope, respectively. Response to subsoiling varied with years and crops. Results show that a determinant crop such as sorghum is more critically affected by loss of water due to runoff than the less determinant cotton crop. These studies show that furrow diking is effective in reducing runoff and increasing crop yields and that location on the slope has a significant effect on yields. (Author's abstract)
W85-06186

EFFECTS OF REGULATED WATER DEFICITS ON PEAR TREE GROWTH, FLOWERING, FRUIT GROWTH, AND YIELD,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
P. D. Mitchell, P. H. Jerie, and D. J. Chalmers.
Journal of the American Society of Horticultural Sciences, Vol. 109, No. 5, p 604-606, September, 1984. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Irrigation practices, *Plant growth, *Crop yield, *Water deficit, *Pear trees, Flowering, Evaporation.

Three levels of water deficit generated by 3 levels of irrigation applied at times of rapid vegetative growth and/or slow fruit growth were compared to determine their suitability for restricting vegetative growth on 5 year old Bartlett pear trees trained to a Tatura Trellis. For the period of Regulated Deficit Irrigation (RDI), the amount of water applied replaced 92%, 47%, and 23% of the evaporation calculated over the planting square (Eps). In the subsequent period of rapid fruit growth until harvest, all trees were irrigated with 150% Eps to ensure that the wetting pattern from the trickle system wetted the entire root zone. Additional water increased vegetative growth. RDI did not decrease final fruit size or yield. Blossom density was increased in the following spring by RDI with flower clusters/sq cm of limb cross sectional area of 2.39, 2.01, and 1.36 respectively on the 0.23, 0.46 and 0.92 Eps treatments. The effect of RDI on blossoming also has major practical implications. The pear trees in this experiment had entered a biennial bearing habit, and blossom density was increased in the off-season. Close investigation of RDI is warranted on species and cultivars with pronounced biennial characteristics. (Baker-IVI)
W85-06204

APPLE ROOT DISTRIBUTION AS EFFECTED BY IRRIGATION AT DIFFERENT SOIL WATER LEVELS ON TWO SOIL TYPES,
Department of Agriculture, Potchefstroom (South Africa).
D. J. Beukes.
Journal of the American Society of Horticultural Sciences, Vol. 109, No. 5, p 723-728, September, 1984. 4 Fig, 4 Tab, 7 Ref.

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Descriptors: *Soil water, *Irrigation effects, *Apple trees, *Roots, Density, Soil types, Plant growth, Water stress, Soil water depletion.

Apple trees were grown in a field trial at soil water depletion (SWD) levels of 15% (wet) and 75% (dry). Water extraction depths were divided into 3 or 4 depth increments, and ranged from 700 to 1100 mm, depending on the treatments and rooting depth. Treatments were applied from the end of shoot extension growth until harvest. In a loamy sand and a loam soil, root distribution was affected primarily by the soil water regime. Irrigation at different depletion levels had little effect on root diameter distribution for the Dundee form. After 3 years the 0-600 mm loamy sand soil layer contained 88.0% of the roots for the 15% SWD (wet) and 57.7% for the 75% SWD (dry) levels. After 2 experimental seasons, the majority of roots were concentrated in the top 600 mm of soil for the wet treatment. In contrast, under dry treatment, root development extended down to 1100 mm but density decreased. In the loam soil series in the 0-600 mm soil layer the wet treatment gave the higher concentration of roots of the 2 depletion levels compared. This soil layer had a mean root content of 86.2% for the wet, compared to 78.6% for the dry treatment. The loam under the dry treatment developed more roots with depth than the wet treatment, but not to so great an extent as was true for the loamy sand soil. Treatment effects were probably diminished in the loam soil due to a higher soil bulk density. (Baker-IVI)
W85-06205

FURROW IRRIGATION DESIGN FOR VERTISOLS,
Euroconsult, Arnhem (Netherlands).
L. K. Smedema.
Agricultural Water Management, Vol. 9, No. 3, p 211-218, November, 1984. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Furrow irrigation, *Vertisols, *Irrigation design, Soil properties, Irrigation patterns, Infiltration, Slope.

An approach is outlined for furrow irrigation on vertisols based on the simple concept of filling of a reservoir. The applicability of this concept derives from the following conditions: infiltration is a self-regulating/self-ending process. That is, once the depleted soil moisture reservoir is replenished, the infiltration effectively stops. This condition is typical not only of vertisols, but more generally of all cracking/swelling heavy land soils. The second condition is that the furrows have an even, gentle slope and are closed at the lower end. This assures a slow, retarded recession flow which enhances the uniformity of the soil moisture replenishment along the length of the furrow. On steep slopes, the recession water will tend to accumuate at the lower end of the furrow, risking overflow from the closed ends, while much of the upper reach will not have had water present for a long enough time to attain adequate soil moisture replenishment. Most vertisols have slopes that are often as little as 0.01-0.02%, and the outlined approach covers most of furrow design cases for these soils. In the design approach outlined the rate at which the head of the stream advances in the furrow is not an explicit consideration. The volume of water applied is the main factor, the distribution of this water along the furrow being assured by the self-regulating infiltrating nature of these soils. An inlet time greater than the end advance time may apply, for example, to very short furrows where the run may reach the lower end of the furrow in less time than the set minimum inlet time while an inlet time less than the end advance time may apply to very long furrows. In general, however, inlet and end advance times will be similar. (Baker-IVI)
W85-06280

WATER USE-YIELD RELATIONS FOR COWPEA AND MAIZE,
Ife Univ. (Nigeria). Dept. of Agricultural Engineering.
H. O. Fapohunda, P. O. Aina, and M. M. Hossain.
Agricultural Water Management, Vol. 9, No. 3, p 219-224, November, 1984. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Corn, *Cowpeas, *Water use, *Crop yield, Water deficit, Irrigation, Evapotranspiration, Evaporation, Nigeria.

Three cowpea varieties and one maize variety were subjected to varying irrigation treatments, ranging from water deficits to over-irrigation, on a silty loam soil classified as an Alfisol at Ile-Ife, Nigeria. There was a strong curvilinear relation between cowpea yield and evapotranspiration (R2 = 0.86 for dry matter yield and R2 = 0.87 for dry seed yield). The values of the correlation coefficient dropped to 0.62 and 0.66 for dry matter and seed yields, respectively, when a linear relation was used. When data for over-irrigated fields were omitted from the calculation, a linear relationship yielded R2 values close to unity (R2 = 0.99). Similar results were obtained on maize dry matter and grain yields in relation to evaporation. (Author's abstract)
W85-06281

TILLAGE PRACTICE EFFECTS ON WATER CONSERVATION AND THE EFFICIENCY AND MANAGEMENT OF SURFACE IRRIGATION SYSTEMS,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
D. E. Eisenhauer.
Available from the National Technical Information Service, Sprinfield, VA 22161 as PB85 157709/AS. Nebraska Water Resources Center, Lincoln, Completion Report, Sept 1984, 90 p, 9 Fig, 26 Tab, 2 Append, Project No. OWRT B-057-NEB (1), Contract/Grant No. 14-34-0001-1242.

Descriptors: *Cultivation, *Furrow irrigation, *Irrigation efficiency, Soil management, Infiltration, Runoff, Water conservation, Conservation tillage, Reduced tillage, Furrow erosion.

A 3-year field study of reduced and conventional tillage practices was conducted under furrow irrigated conditions in south central Nebraska. The field had a 0.5 percent slope and 366 m long furrows. The soil was Hastings silt loam, a deep medium textured loessial soil, and the crop was continuous corn. Advanced, recession, and infiltration was monitored during 9 irrigations. It was found that reduced tillage practices tended to increase the soil infiltration rate and the hydraulic roughness of the furrows. This change caused an increase in the time of water advance across the field and the amount of water infiltrated. This resulted in reduced irrigation efficiency and poorer distribution of water. The energy saved in field operations with reduced tillage was partially or completely offset by increased irrigation energy requirements due to the lower irrigation efficiency. Soil and nutrient losses were monitored during 4 irrigations. While soil losses were always less than 200 kg/ha per irrigation, reduced tillage did significantly reduce these losses. Rainfall runoff was determined to be about 7.6 mm lower per year for the reduced tillage systems than the conventional practices. This is an average reduction in annual runoff of about 20 percent. Study results suggest that under these soil and slope conditions, rotary till and till plans are feasible reduced tillage systems for furrow irrigation while the slot plant system is not.
W85-06315

DEVELOPMENT OF A PREDICTIVE IRRIGATION SCHEDULING INDEX USING ELECTROPHYTOGRAMS,
Arizona Univ., Tucson. Dept. of Electrical Engineering.
W. G. Gensler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157832/AS, Price codes: A02 in paper copy, A01 in microfiche. Research Project Technical Completion Report, Sept 1984. 12 p, 4 Fig, 2 Ref, Project No. USGS G828-05, Contract/Grant No. 6-828.

Descriptors: *Irrigation efficiency, *Instrumentation, Electrochemistry, Potentiometric level, Electrodes, Irrigation scheduling, plant growth, Telemetry.

The basic objective of the research is the development of an irrigation management instrument system using electrochemical and biophysical sensors placed directly on the plant in the field. The sensors were calibrated at different water regimes in furrow and drip irrigated cotton. In addition, a telemetry system was developed to transfer the signal from the field to the grower's headquarters. The system is cost effective and amenable to large scale expansion.
W85-06326

IRRIGATED AGRICULTURAL DECISION STRATEGIES FOR VARIABLE WEATHER CONDITIONS,
New Mexico Water Resources Research Inst., Las Cruces.
For primary bibliographic entry see Field 6A.
W85-06340

LEACHING AND WATER REQUIREMENT STUDIES IN A GYPSIFEROUS DESERT SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
D. Russo.
Soil Science Society of America Journal, Vol. 49, No. 2, p 432-437, March/April, 1985. 7 Fig, 3 Tab, 14 Ref.

Descriptors: *Leaching, *Desert soils, *Water requirements, *Gypsum, Soil properties, Irrigation practices, Soil water, Saline soils, Crop yield, Evapotranspiration, Chloride, Sulfates.

This study was designed to determine the interrelations of irrigation regime, soil water content, and salinity profiles and their effect on crop yield, under field conditions. The different irrigation regimes produced different soil water profiles and different leaching fractions ranging from 0.09 to 0.53 which, in turn, affected the soil salinity profiles. Analysis of the soil solution concentrations indicated that with the higher levels of leaching, the excess chloride was essentially removed out of the root zone, whereas relatively high levels of sulfate concentration were maintained as a result of gypsum dissolution which was dominated by Ca-Na exchange. Crop yields were affected by both the irrigation amount and frequency. For a given amount of water, higher yields were obtained under the more frequent (daily) irrigation. Amounts of water equal to 1.3 and 1.5 times the pan evaporation for the daily and the every 4 d irrigation, respectively, are required to maintain yields higher than 90% of the maximum. Both the evapotranspiration and crop yield were found to be highly correlated with the soil water content and salinity profiles. This indicated that the effect of both salnity stress and water stress is to reduce crop water uptake and concurrently to reduce crop production. (Baker-IVI)
W85-06540

IRRIGATION AND AGRICULTURAL DEVELOPMENT: SOME CONCEPTUAL AND EMPIRICAL CONSIDERATIONS,
Ife Univ. (Nigeria). Dept. of Agricultural Engineering.
O. Oludimu.
Journal of Environmental Management, Vol. 19, No. 2, p 175-184, September, 1984. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Nigeria, *Developing countries, *Irrigation practices, *Water conservation, Agriculture, Smallholder irrigation, River basin, Water resources development, Boreholes, Tube wells, Canals, Lakes.

Success in agricultural production efforts calls for a carefully considered administrative procedure and adequate technical apparatus to make it possible to provide inputs, services and facilities to farmers. In most developing countries, the need to provide smallholder irrigation, as a prerequisite for a successful agrarian revolution is paramount. Aspects of irrigation development in the light of Nigeria's Green Revolution program are discussed. The Itoikin Irrigation Rice Project in Nigeria provides a community example of the whole develop-

ment process. An element of basic importance in such a project is the people's cooperation. Efforts must be made to encourage the people not only to join the scheme, but also to remain and derive greater benefits and pleasure from farming. Another difficulty arises from finance. For the rapid adoption of improved agricultural practices, credit must be extended to farmers; the extension of such credit should be linked with the distribution of facilities and with produce marketing. The development of irrigation cannot be considered in isolation without consideration of other claims on water resources such as drinking and fishing. (Baker-IVI)
W85-06604

SURFACE TEMPERATURE VARIABILITY PATTERNS WITHIN IRRIGATED FIELDS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
J. L. Hatfield, M. Vauclin, S. R. Vieira, and R. Bernard.
Agricultural Water Management, Vol. 8, No. 4, p 429-437, February, 1984. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Surface temperature, *Soil water, *Irrigation effects, Infrared thermometry, Remote sensing, Irrigation scheduling, Sampling.

Variability in surface temperature within a field has been proposed as a measure for irrigation scheduling. An experiment was conducted to examine the spatial variability of surface temperature within differentially irrigated grain sorghum fields at Davis, California in 1981. Measurements were made repeatedly throughout the season in 85 m long transects measured with an infrared thermometer reading at 1.0 m intervals. Along the transects the readings at 1 m intervals were not correlated. The lack of structure or spatial dependence within a given field suggests that a random sampling in a field would be adequate for infrared thermometer measurements. During a drying cycle from one irrigation to the next, the variance of surface temperature along a transect increased. There was no statistically significant relationship between the amount of water extracted from the upper 150 cm of the profile when more than 40% of the available water remained. When more than 60% of the available water had been removed, the variance increased above 0.5 degrees C sq but below this amount the variances did not exhibit any significant pattern. The variance of surface temperature within a field may not be a sensitive indicator of the soil water status. The number of samples needed to achieve a confidence limit of 1.0 degree C about the mean was 10 samples for a field with more than 40% available soil water and increased to 20 samples as the field dried below the 60% extraction level. This technique could possibly be used to evaluate the distribution efficiency of various irrigation methods. (Moore-IVI)
W85-06688

EVAPORATION AND DRIFT LOSSES FROM SPRINKLER IRRIGATION SYSTEMS UNDER VARIOUS OPERATING CONDITIONS,
Cukurova Univ., Adana (Turkey). Coll. of Agricultural Engineering.
A. Yazar.
Agricultural Water Management, Vol. 8, No. 4, p 439-449, February, 1984. 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Evaporation, *Drift, *Sprinkler irrigation, Wind, Vapor pressure deficit, Irrigation efficiency, Irrigation practices.

Quantitative determinations of evaporation and drift losses from sprinkler systems were carried out under different operating conditions. Evaporation losses determined by an electrical-conductivity method ranged from 1.5 to 16.8% of the total sprinkled volume. Wind velocity and vapor pressure deficit were the most significant factors affecting the evaporation losses. Exponential relationships between the evaporation losses and both wind velocity and vapor pressure deficit have been found. For the operating pressures used in this study the least effect on evaporation was found. Drift losses measured by the magnesium-oxide method varied from 1.5 to 15.1%. Drift losses increased with the second power of the wind velocity, and decreased with increasing distance in the downwind direction. Combined losses from a sprinkler system for a given set of operating conditions have been estimated by using the results obtained from the experiments. Combined losses ranged from 1.7 to 30.7% of the applied water. (Author's abstract)
W85-06689

HISTORY OF DESALTING WATER IN THE VIRGIN ISLANDS,
CH2M Hill International Corp., Gainesville, FL.
O. K. Buros.
Desalination, Vol. 50, p. 87-101, October-November, 1984. 4 Tab, 11 Ref.

Descriptors: *Desalination, *Virgin Islands, *Water supply development, Seawater, Water demand, Water resources development, Potable water, Solar distillation.

The history and economy of the US Virgin Islands have been intimately connected to its water resources. The historically recognized need and high cost of potable water in the Virgin Islands have stimulated people to propose and experiment with a variety of innovative water resource concepts in the Territory. The Virgin Islands has used dual water systems, rainwater harvesting, dams and reservoirs, wastewater reclamation, artificial recharge of groundwater and desalination to name a few. The development of desalination technology occurred almost simultaneously with the rapid growth of the population in the Islands. One of the earliest experiments took place in 1948-49. A solar humidification process was used to produce potable water from seawater. The real move to desalination started in 1958 when Congress authorized the Territory to construct, operate, and maintain saltwater distillation facilities in St. Thomas. The plant was completed in 1962. Two industrial complexes located on St. Croix were early users of distillation plants. The plants helped supply fresh water for the refineries that was independent of the government's supply. Over the years about 50 plants have been installed in the Territory. Aside from serving as a location for sales of desalination equipment, the Territory has also aided in furthering desalination technology through education and research. (Baker-IVI)
W85-06692

CHANGES IN SOUTHERN CHERNOZEMS AFTER DRIP IRRIGATION,
Leningrad State Univ. (USSR).
I. N. Panasenko, V. B. Petrov, and E. I. Gagarina.
Soviet Soil Science, Vol. 16, No. 5, p 99-108, September/October, 1984. 2 Fig, 4 Tab, 19 Ref. Translated from Pochvovedeniye, No. 4, p 61-70, 1984.

Descriptors: *Drip irrigation, *Chernozems, *Crimea, *Salts, Chemical composition, Salinization, Soil properties, Irrigation practices.

Changes in the properties of Southern Chernozems in the steppe region of the Crimea after 4 years of drip irrigation with weakly mineralized water were studied. In contrast to sprinkling, there was no compaction of the soil or destruction of its structure in the moistening contour, but there was a seasonal accumulation of toxic salts, both brought in with their irrigation water and attracted from the lower horizons. In spite of the unquestionable advantages of drip irrigation, this tendency for salts to accumulate in the soaked area, which coincides with the main zone of root development, and some dispersion of the soil particles in the middle of the profile indicate the need for soil scientists and agrochemists to make station observations on the seasonal state of the soil when this method of irrigation is used. (Baker-IVI)
W85-06750

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

PRACTICAL IMPLICATIONS IN THE USE OF STOCHASTIC DYNAMIC PROGRAMMING FOR RESERVOIR OPERATION,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter, and F.-K. Tai.
Water Resources Bulletin, Vol. 21, No. 1, p 65-74, February, 1985. 6 Fig, 3 Tab, 17 Ref.

Descriptors: *Reservoir operation, *Dynamic programming, Hydroelectric plants, Computers, Stochastic process, Probability, Water storage.

A stochastic dynamic programming model is applied to a small hydroelectric system. The variation in number of stage iterations and the computer time required to reach steady state conditions with changes in the number of storage states is investigated. The increase in computer time required to develop the storage probability distributions with increase in the number of storage states is reviewed. It is found that for an average of seven inflow states, the largest number of storage states for which it is computationally feasible to develop the storage probability distributions is nine. It is shown that use of the dynamic program results based on a small number of storage states results in unrealistically skewed storage probability distributions. These skewed distributions are attributed to 'trapping' states at the low end of the storage range. (Author's abstract)
W85-06240

STUDY OF RESIDENTIAL STORMWATER IMPOUNDMENTS: PERCEPTIONS AND POLICY IMPLICATIONS,
Petroglyph Research Associates, Chilliwack (British Columbia).
E. H. Baxter, G. Mulamoottil, and D. Gregor.
Water Resources Bulletin, Vol. 21, No. 1, p 83-88, February, 1985. 4 Tab, 4 Ref. Environment Canada, Inland Waters Directorate contract OSE80-00124.

Descriptors: *Storm runoff, *Detention reservoirs, *Public policy, *Housing, recreation, Public opinion, Stormwater, Maintenance, Mississauga, Ontario.

The traditional solution to stormwater runoff from housing developments has been stormwater sewer systems. A newer and increasingly popular solution is some sort of impoundment or 'lake' within the development, which is thought to be cheaper, to provide recreation, to improve the aesthetics of the environment, and to increase property values. Little is known of the acceptability of these to public officials, developers, or potential residents, or of their policy implications. Two such developments in Mississauga, Ontario, were studied, in terms of the perceptions and opinions of a random sample of residents and of officials who had been involved in their planning and management. The areas have attracted a relatively young group, just beginning their child-bearing years, with relatively high income and education. The lakes appear to be popular, and relatively successful, especially the one which provides more recreational opportunities, and which has had fewer maintenance problems. The major problems are visual and safety. The City, and to some extent the developers, are seen as the appropriate groups to manage and maintain the lakes. Some suggestions, based on residents' and officials' responses, are presented for future designs and policy formulation. (Author's abstract)
W85-06242

DEVELOPMENT OF A COMPREHENSIVE UPPER COLORADO RIVER BASIN MODEL

LIBRARY U. OF I. URBANA-CHAMPAIGN

FOR ANALYZING ENERGY DEVELOPMENT IMPACTS,
Utah Water Research Lab., Logan.
A. B. Bishop, R. Narayanan, M. McKee, and M. T. Nussbaum.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157808/AS, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, Sept. 1984. 116 p, 19 Tab, 6 Fig, 5 Append, Project No. USGS G872-03.

Descriptors: *Utah, *Water management, *Model studies, River basin development, Management planning, *Water allocation, Resources development, Planning.

Recent advances in detection technologies, data management and retrieval systems, and modeling capabilities have led to a large number of conceptual and applied models that are already making significant contributions to water resources management in the Colorado River Basin. The potentially useful modeling concepts and applications are inventoried from agency contacts and the literature and are assessed for usefulness in the context of the physical, hydrologic, water use, flood damage potential, recreation use, environmental, economic, social, and cultural characteristics of the Basin. Modeling potentials are also assessed in the context of the history of water resources development and management in the basin and the water laws and institutions that have evolved for their administration. Thus, model applications are reviewed in terms of both physical needs and institutional acceptability for water management decisions that affect water allocations within and among states and with Indian tribes. The literature describing scientific and engineering studies and the model development for applications in the Colorado Basin display parallels between time trends in the values and resulting policy on water resources development prevailing in the Basin and the research conducted. These relationships are then assessed and extrapolated, subject to the constraints on modeling capability documented in the literature, to project future modeling directions. The study ends with the conceptualization of an integrated modeling approach for Basin water management.
W85-06323

STORMWATER MANAGEMENT ALTERNATIVES - A COMPUTER-BASED PROGRAM FOR THE SELECTION OF TECHNIQUES TO MITIGATE THE IMPACT OF URBAN STORMWATER,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W85-06328

INVENTORY OF COURT CREEK WATERSHED CHARACTERISTICS THAT MAY RELATE TO WATER QUALITY IN THE WATERSHED,
Illinois State Water Survey Div., Peoria. Water Quality Section.
For primary bibliographic entry see Field 2A.
W85-06331

MANAGING RIVER SYSTEMS: CENTRALIZATION VERSUS DECENTALIZATION,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
P. R. Wandschneider.
Natural Resources Journal, Vol. 24, No. 4, p 1043-1066, October, 1984. 1 Fig, 148 Ref.

Descriptors: *Rivers, *Water management, *Centralization, *Decentralization, Political aspects, Economic aspects, Decision making, Planning, Columbia River.

Some positive and normative qualitites of the decentralized-negotiated approach to river management are explored. The question of whether decentralized management of such an interdependent physical system is possible was addressed. By theory and the example of the Columbia River management structure a decentralized management approach was proved viable. In the Columbia River case, however, solving problems of interdependence often required some application of such centralizing approaches as merging of firms, public provision, or government regulation. The consequences of employing a decentralized-negotiated management approach for questions of externalities and conflict resolution were also considered. Evidence presented in this case study suggests that no general recommendations for decentralized or centralized river basin management structure are justified. The choice of institutional forms cannot be reduced to a few relatively simple rules. After very careful study of the potential consequences the choice must be made. The economist contributes to the understanding of potential consequences. The ultimate choice is ethical and political. (Baker-IV)
W85-06536

STUDY AND PLANNING OF RESERVOIR DESILTING IN TAIWAN,
Taiwan Provincial Water Conservancy Bureau, Taichung City.
J. Hwang.
Water International, Vol. 10, No. 1, p 7-13, March, 1985. 7 Fig, 2 Tab, 10 Ref.

Descriptors: *Reservoirs, *Desilting, *Taiwan, Sediment transport, Flushing, Erosion control, Sedimentation, Reservoir operation.

The reservoir sedimentation rate in southern Taiwan is very high. Without any special scheme to deal with the sediment, a reservoir in this area will be silted in a short time and the project will be unfeasible economically. The special water utilization pattern and reservoir sediment control scheme which are conceived for the southern regin of Taiwan and the Ho-Ku Reservoir are first to use the available run-of-the-river water, then arrange an empty period for the Ho-Ku Reservoir to sluice the turbid water during the flood seasons and store clean water. This is mostly diverted from the upstream reaches of the Kaopin River at the end of the flood season for the supplementary uses of the region, from October through the following May. According to the flow routing, trap efficiency computation and flushing efficiency estimation, the forebay of Ho-Ku Reservoir will function as a settling basin and will contain almost no permanent deposition. The probable life of the afterbay of Ho-Ku Reservoir would be prolonged from 70 years without any silting scheme to 470 years with the special operating pattern. Although the Ho-Ku Reservoir is still being planned it has been decided to develop it according to the desilting scheme and water utilization pattern starting in 1986. In order to assure the flushing efficiency of the Ho-Ku Reservoir, it was suggested that a hydraulic model experiment be carried out to compare the results of the test with the mathematical computations. (Baker-IVI)
W85-06542

IMPACT OF ALTERNATIVE HOUSING STANDARDS ON STORMWATER MANAGEMENT,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, H. Ellis, and G. Mulamoottil.
Canadian Journal of Civil Engineering, Vol. 12, No. 1, p 192-199, March, 1985. 5 Fig, 3 Tab, 6 Ref.

Descriptors: *Drainage, *Storm runoff, *Urban hydrology, *Housing, *Ontario, *Urban runoff, Storm water, Water management, Overland flow, Drainage systems, Design criteria, Costs.

The Ontario Ministry of Housing suggested new standards for urban development for residential subdivisions. The proposed design standards include: roof discharges to the ground surface; road drainage through catch basins, with spacings adjusted to reflect gutter and inlet capacities; storm sewers only as needed; and the pipe system designed to carry a 2 year storm with the remainder of the runoff transmitted overland. The per lot proposed system costs were approximately 50-70% of those associated with the conventional design. The savings per lot associated with the proposed system are essentially all attributable to the distribution of the pipe costs along the streets over a larger number of households. The proposed system-related costs represent a per lot savings in stormwater management costs from $400 to $900, depending on the alternative conventional design practices that would otherwise be adopted. The proposed system will also have an increased nuisance arising from more frequent street flooding but, if designed correctly, these should not represent dollars of flood damage. There is a reduction in the aesthetics associated with the proposed system because of the reduced lot sizes. There is also a deterioration in the water quality runoff associated with the proposed system. (Baker-IVI)
W85-06554

PERSISTENCE AND FATE OF 2,4-D BUTOXYETHANOL ESTER IN ARTIFICIAL PONDS,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5B.
W85-06621

COMPLICATED BELGIAN SEWERAGE SYSTEM,
Liege Univ. (Belgium).
V. De Kosinsky.
European Water and Sewage, Vol. 89, No. 1067, p 8-12, January, 1985. 5 Fig.

Descriptors: *Sewer systems, *Belgium, *Liege, *Flood control, Storm runoff, Rivers, Flooding, Mining, Subsidence, Urban areas, Drainage.

A very typical example of a combined set of sewerage problems low lying urban areas can meet exists in and around Leige, one of the largest towns in Belgium. The origins of the problems are fourfold: heavy mining subsidences resulting in more and more areas settling below the level of the river; very high flood discharges in the river Meuse crossing the region; river regulating works artificially upholding the level of the river for investigation purposes; and flood-walls protecting low lying areas also impeding the flow of storm water into the river. The municipalities of the valley created a cooperative association charged with the design, construction and operation of a special sewerage system, called the Demergement. In the areas upstream of the city, most of the works are finished and there has been no inundation since 1926, the sewerage functioning perfectly even during flood conditions. Even the cellars are dry except in a few streets. In the downstream municipalities, which joined the Association only after the Second World War, there is still much to do, and not all areas are yet safe from the flooding of the river or from heavy storms. The Association has 56 years of specialized experience in urban sewerage and its works and management have been most successful in keeping the region free from flooding. In the first 50 years the actual investment amounted to 120 million US dollars, and the Demergement system discharges into the river an average of 29 cubic Mm/a of water. (Baker-IVI)
W85-06811

NEW CANAL AND IMPROVEMENTS AVERT STORMWATER RUNOFF PROBLEMS,
Stottler, Stagg and Associates, Inc., Cape Canaveral, FL.
M. E. McLouth.
Public Works, Vol. 116, No. 5, p 76-77, 106, May, 1985. 2 Fig.

Descriptors: *Canals, *Storm runoff, *Flood control, *Florida, *West Palm Beach, Planning, Water management, Detention reservoirs, Pumping.

A potential flooding problem exists in the West Palm Beach area of Florida. A plan determined that the potential flooding problem was correctable through improving existing minor canals in the project area and constucting a major 2.8 mile canal extending west to a proposed 721 acre earth detention area near the L-8 Canal. The design includes two pump stations, which allow water to be pumped north and away from the West Palm Beach Canal and west to the earth detention area.

Duuring peak wet periods, water in the detention area will be released at a controlled rate through two 54-in. corrugated metal pipe culverts, discharging into an outfall canal directed to the L-8 Canal. The allowable discharge permitted by the plan will be controlled by 21 ft high flood gates. During dry periods high water in the detention area can be used to raise the water table adjacent to the canal system wthin the M-1 acreage through the manual operation of the back flow control structures at the two pump station and at the canal plug at the Royal Palm Beach interface. (Baker-IVI)
W85-06836

NITROGEN AND ESTABLISHMENT OF A BEETLE FOR BIOLOGICAL CONTROL OF THE FLOATING WEED SALVINIA IN PAPUA NEW GUINEA,
Commonwealth Scientific and Industrial Research Organization, Indooroopilly (Australia). Long Pocket Labs.
P. M. Room, and P. A. Thomas.
Journal of Applied Ecology, Vol. 22, No. 1, p 139-156, April, 1985. 7 Fig, 2 Tab, 37 Ref.

Descriptors: *Aquatic weed control, *Beetles, *Salvinia, *Biological control, *Papua, *New Guinea, Weed control, Aquatic plants, Ferns, Insects, Nitrogen, Phosphorus, Plant growth.

A population of 570 adult Cyrtobagous sp. (Coleoptera: Curculionidae) released into two field cages containing the host fern Salvinia molesta Mitchell declined to about forty adults over nearly 7 months or about four generations. Eleven weeks after adding another 592 adults to the cages, and starting weekly application of urea fertilizer, there were approximately 3000 adults present. A field enclosure experiment in which insects were placed on unsprayed control plants, on plants sprayed with N fertilizer and on plants sprayed with N + P fertilizer produced additional evidence that the rate of insect population increase could be manipulated by application of N to the host plant. On release from cages, and in the unsprayed control treatment, populations of the insect increased exponentially despite there being very low concentrations of N in the host plant. By damaging its host, the insect can increase the quality of the host as food; there might be a 'critical' population density of the insect for particular population densities and low N-contents of the host, below which a population of the insect will decline and above which it will increase. Slow dispersal by the insect, despite its ability to fly, at several sites may be the result of selection in favor of populations remaining above 'critical' densities. The dispersal behavior contrasts markedly with that of insects suspected of responding to induced defenses in their host plants. Some practical implications of the results for biological control of weeds and management of crop pests are discussed. (Author's abstract)
W85-06891

INVENTORY AND ASSESSMENT OF AQUATIC PLANT MANAGEMENT METHODOLOGIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
E. A. Dardeau, and E. A. Hogg.
Final Report, Jan. 1983. 86 p, 3 Fig, 4 Tab, 91 Ref, 2 Append.

Descriptors: *Weed control, *Aquatic weed control, Aquatic plants, Monitoring, Surveys, Public opinion, Remote sensing, Species composition, Biomass, Herbicides, Mechanical control, Physical control, Biocontrol, Fish, Insects, Water hyacinth, Hydrilla, Alligatorweed, Pathogens, Water level fluctuation, Screens, Training, Waterways.

Available methods for aquatic weed control are reported and assessed. Information was gathered from a literature survey and a telephone survey of 14 Corps of Engineers Districts with active aquatic weed management programs. More data was obtained for treatment and monitoring than for the other subjects in the survey: reporting, public awareness, and training. Treatment programs discussed include chemical, mechanical (hand removal, barrier systems, harvesting), biological (insects, fish, pathogens, etc.), environmental (water level fluctuation, bottom screens, chemical light shades), and integrated treatments. Monitoring methods are divided into ground surveys and remote sensing surveys. Appendix A lists problem aquatic plant species. Appendix B details the telephone survey results.
W85-06898

FIELD EVALUATION OF TWO ENDOTHALL FORMULATIONS FOR MANAGING HYDRILLA IN GATUN LAKE, PANAMA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. E. Westerdahl.
Technical Report A-83-3, January 1983. Final Report. 171 p, 40 Fig, 9 Tab, 36 Ref, 5 Append.

Descriptors: *Herbicides, *Lakes, *Aquatic weed control, *Pesticide kinetics, *Pesticides, Performance evaluation, *Water pollution effects, *Pesticide residues, Aquatic weeds, Plankton, Ecological effects, Endothall, Water pollution prevention, Water quality management.

Two endothall formulations (Aquathol K and Hydout) were evaluated for their ability to control hydrilla on the Frijoles Bay area of Gatun Lake, Panama. Each formulation was applied to endothall acid equivalent rates of 27, 34, and 50 kg/ha. Aquathol K provided control of hydrilla within 24 to 72 hr posttreatment at each application rate; however, Hydout required 14 to 21 days before hydrilla control was evident at the two higher application rates. No adverse impacts were observed on selected water quality parameters after endothall treatment and only transitory shifts in the plankton community composition and vertical distribution over the 49-day study period took place. Endothall was detected in the water from the buffer zones of those plots treated with Aquathol K. Negligible endothall residues were found in the buffer zones surrounding the plots treated with Hydout throughout the 90-day posttreatment study period. Combination of Aquathol K and Hydout are recommended as a suitable alternate to copper sulfate to managing hydrilla on Gatun Lake.
W85-06900

PROCEEDINGS, 17TH ANNUAL MEETING, AQUATIC PLANT CONTROL RESEARCH PROGRAM, NOVEMBER 16-18, 1982, SACRAMENTO, CA.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
June 1983. Final Report. 169 p. Miscellaneous Paper A-83-83.

Descriptors: *Weed control, *Aquatic plants, *Herbicides, Boating, Waterways, Hydrilla, Water hyacinth, Biocontrol, Watermilfoil, 2,4-D, Fish, Grass carp, White amur, Microbiology, Insects, Fungi.

The 17th annual meeting of the Corps of Engineers Aquatic Plant Control Research Program covered the following topics: the role of boating and waterways in aquatic plant management in California's Delta; aquatic plant problems in geographical divisions of the U.S.; management of aquatic weeds by biological control, chemical control, mechanical control, 2,4-D, and white amur; research on grass carp and other herbivorous fish; biological control with microorganisms, the pyralid moth, insects, and fungi; natural hydrilla growth inhibitors; fiber formulas for controlled release of herbicides; controlled release of herbicides, effects of organic matter additions to sediment on the growth of hydrilla; and evaluating the effectiveness of aquatic plant treatment methods.
W85-06901

AQUATIC BIOTA OF BANK STABILIZATION STRUCTURE ON THE MISSOURI RIVER, NORTH DAKOTA,
National Fishery Research Lab., La Crosse, WI.
For primary bibliographic entry see Field 6G.
W85-06902

KAHOMA STREAM CHANNEL IMPROVEMENT PROJECT, MAUI, HAWAII: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. F. George.
Technical Report HL-82-19, August 1982. Final Report. 104 p, 3 Fig, 8 Tab, 30 Photos, 44 Plates.

Descriptors: *Hydraulics, *Hydraulic structures, *Channel improvement, *Flood control, Hydraulic models, Streams, Kahoma Stream, Hawaii, Model studies, Weirs, Channel morphology, Scour, Sedimentation, Erosion control, Flow control, Roughness coefficient.

A 1:30-scale model of Kahoma Stream, on Maui, Hawii, was used to determine the adequacy of proposed channel improvements consisting of a debris basin with a concrete weir (storage capacity, 55,000 cu yd), a concrete-lined trapezoidal channel from the debris basin to the ocean, and new bridges to accomodate the design flood. Wherever unsatisfactory flow conditions were observed, modifications were made to the original design so that satisfactory conditions were obtained. The weir was modified to a three-sided formation with a wedge-type transition. The wedge-shaped design of the bridge transition was changed to a warped-surface design. Slopes of the high-velocity channel were adjusted to produce a Manning's n coefficient of 0.015 rather than 0.013 in the prototype. Additional roughness placed in a downstream portion of the channel for aesthetic purposes increased water surface elevations, requiring raising the elevation of some channel walls. When a large scour hole developed offshore, the trapezoidal channel was extended and boulder concrete section was added to minimize scour and deposition.
W85-06904

PERFORMANCE OF PLASTIC CANAL LININGS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8C.
W85-06910

DETERMINATION OF CHEMICAL THRESHOLD CONCENTRATIONS USING 2,4-D TO CONTROL SELECTED AQUATIC MACROPHYTES: A PILOT STUDY TO EVALUATE A LABORATORY SYSTEM,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. E. Westerdahl, R. E. Hoeppel, E. Hummert, and L. Williams.
Technical Report A-83-4, February 1983. Final Report. 37 p, 14 Fig, 4 Tab, 17 Ref.

Descriptors: *Weed control, *Aquatic weed control, *Herbicides, Aquatic plants, 2,4-D, Macrophytes, Watermilfoil, Pondweed, Diluter system.

The objectives of this pilot study focused on the evaluation of a modified diluter system used to determine the minimum sustained (threshold) herbicide concentrations required to control nuisance aquatic macrophytes. The herbicide 2,4-dichlorophenoxy acetic acid (2,4-D) was used during this pilot study to provide data for evaluating the diluter system operation as well as to provide initial estimates of the threshold 2,4-D concentration required to control Eurasian watermilfoil (Myriophyllum spicatum L.) and Sago pondweed (Potamogeton pectinatus L.). The experimental design included three replicate aquaria containing each of the aforementioned plant species planted in beakers containing a standard hydrosoil, and one reference aquarium without plants exposed for 6 weeks to each of several 2,4-D concentrations: 0.00, 0.01, 0.04, 0.10 and 0.20 mg per liter. Results of this pilot study showed that the modified diluter system was completely satisfactory for this work. Moreover, estimates of the threshold 2,4-D concentrations needed to control the aforementioned plants were: 0.1 mg per liter for M. spicatum, and 0.2 mg per liter for P. pectinatus. These results will be verified following completion of recommended changes in the diluter system. (Author)

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W85-06917

SIMULATION FOR HARVESTING OF AQUATIC PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
E. R. Perrier, and A. C. Gibson.
Technical Report A-82-1, February 1982. Final Report. 54 p, 10 Fig, 4 Tab, 4 Ref, 1 Append.

Descriptors: *Weed control, *Aquatic weed control, *Computer programs, Model studies, Aquatic plants, Mechanical control, SHAP model, Mathematical models, Linear programming, Simulation analysis, Waterways, St. Johns River, Orange Lake, Florida.

The computer program, 'Simulation for Harvesting of Aquatic Plants (SHAP),' helps in planning for mechanical harvesting of plant-infested areas. The user-interactive model provides a stochastic simulation that evaluates the harvesting system. It uses linear programming theory for network flow analysis and queuing theory. The terrain subroutine organizes irregularly shaped plant-infested areas to be harvested into a distance-flow network. The harvesting subroutine directs the harvesting procedure. After harvesting by mowing, the plants are loaded by the transporter onto a conveyor and into a dump truck for disposal. After the harvesting process has been completed, the statistics of time and queuing operations for each component are computed. The model was verified with data from locations in Florida: Orange Lake East and Orange Lake West (hydrilla) and St. Johns River (hyacinth).
W85-06922

MICROBIOLOGICAL CONTROL OF EURASIAN WATERMILFOIL,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
H. B. Gunner.
Miscellaneous Paper A-83-4, June 1983. Final Report. U.S. Army Aquatic Plant Control Research Program, Army Engineer Waterways Experiment Station, Vicksburg, MS. 25 p, 6 Fig, 10 Tab, 25 Ref. Contract/Grant No. DACW39-80-C-0029.

Descriptors: *Watermilfoil, *Aquatic weeds, *Aquatic weed control, *Microorganisms, *Enzymes, *Microbiological studies, *Biocontrol, *Plant pathology, Cellulose, Pathogens, Bacteria, Pathogenic bacteria, Rhizosphere.

Cellulolytic and pectinolytic microorganisms were isolated from the natural microbial populations occurring on the phyllosphere of Eurasian watermilfoil, Myriophyllum spicatum and M. heterophyllum. The yield of their respective operative enzymes was maximized by growth in appropriate cellulose and pectin media. When applied to watermilfoil, these isolates accelerated plant necrosis and decline. A consortium of cyanobacteria associated with Myriophyllum was also found to accelerate necrosis. In keeping with ecosystem specificity, there should be a much higher pathogenic potential of the isolates from M. spicatum to that species than to M. heterophyllum. These results suggest that microorganisms native to the Myriophyllum ecosystem and amendments applied to the environment stimulating the growth of such populations, offer promise as biological control agents for the management of aquatic weeds.
W85-06938

BIG CREEK FLOOD-CONTROL PROJECT CLEVELAND, OHIO: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W85-06994

COMPATIBILITY AND INFECTIVITY OF A CERCOSPORA RODMANII FORMULATON WITH ENHANCING AGENTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. C. Pennington, and E. A. Theriot.
Miscellaneous Paper A-83-6, June 1983. Final Report. 23 p, 2 Fig, 5 Tab, 14 Ref.

Descriptors: *Aquatic weeds, *Aquatic weed control, *Biocontrol, *Water hyacinth, *Aquatic fungi, *Fungi, *Germination, *Plant diseases, Aquatic plants, Biocides, Plant pathology, Plant growth.

A formulation of the fungus Cercospora rodmanii Conway was produced and tested as a biocontrol agent for waterhyacinth (Eichhornia crassipes (Mart.) Solms.). Twelve germination enhancers were tested on two lots of the fungus formulation in laboratory experiments. C. rodmanii formulation was sprayed with compatible test agents on waterhyacinth pseudolaminae and damage was monitored each week for 8 weeks by assigning a disease index to each original and new pseudolaminae. Results showed that no spots characteristic of C. rodmanii infection were detected at any time during the study period. Microscopic and cultural examinations of pseudolaminae yielded no evidence of infection by the C. rodmanii formulation. Analysis of variance of mean disease indices showed no significant differences between treatments and controls. Since C. rodmanii formulation was not infective, the effects of test agents on infectivity could not be determined. It was suggested that a virulent strain of C. rodmanii be isolated from the field. Germination enhancers determined to be compatible with fungus in this study could then be reexamined for the ability to enhance the infectivity of such a C. rodmanii formulation.
W85-06997

SIMULATED MECHANICAL CONTROL OF AQUATIC PLANTS IN BUFFALO LAKE, WISCONSIN,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
B. M. Sabol.
Miscellaneous Paper A-83-8, October 1983. Final Report. 49 p, 9 Fig, 14 Tab, 15 Ref.

Descriptors: *Aquatic plants, *Computer models, *Model studies, *Aerial photography, *Aquatic weed control, *Simulation analysis, *Plant populations, *Plant growth, Aquatic productivity, Aquatic weeds, Population density, Cost analysis, Lakes, Coontail, Primary productivity, Models.

To determine the operational time required to mechanically control nuisance-level growth of aquatic plants in Buffalo Lake, Wisconsin, a computer model (HARVEST) was used which simulates all important steps in a mechanical control operation. Model inputs include plant density, distance to nearest disposal site, and mechanical and performance specifications for the harvesting system used. Plant densities were determined at two different times during the growing season by conducting a quantitative field sampling program coupled with aerial photography. A treatment area was selected which consisted of boat lanes covering approximately 20% of the area in the eastern two thirds of the lake. The Aquamarine H8-650 and H-400 harvester were selected for simulation. Mechanical control operations were simulated in the treatment area for the two summer periods using each harvester working alone and with a single Aquamarine T-650 transport unit. Surface-topped growth of aquatic plants within the harvestable portion of Buffalo Lake during early and late summer periods covered 35 and 50%, respectively, of that area. Harvestable density within the treatment area during early and late summer periods averaged 5.9 and 7.9 tons/acre, respectively. Coontail was the dominant plant species encountered. Predicted control operation times ranged from 215 to 440 hr for the early summer period and 297 to 627 hr for the late summer period. Predicted production rates were greatest for the H8-650 harvester working with a transport unit. (Author's abstract)
W85-06998

4B. Groundwater Management

IRRIGATION AND GROUNDWATER DEPLETION IN CADDO COUNTY, OKLAHOMA,
North Texas State Univ., Denton. Dept. of Geography.
J. M. Harlin, and C. Wijeyawickrema.
Water Resources Bulletin, Vol. 21, No. 1, p 15-22, February, 1985. 9 Fig, 22 Ref.

Descriptors: *Groundwater recession, *Irrigation demand, *Caddo County, *Oklahoma, Groundwater irrigation, Water use, Peanuts, Crop production, Groundwater management.

Approximately 1/2, or about 950 sq mi, of the area covered by the Rush Springs Sandstone aquifer is in Caddo County, Oklahoma. The quality of the groundwater within the aquifer is generally good for agricultural and domestic purposes. Groundwater irrigation is highly developed over portions of the aquifer, especially in Caddo County, north of the Washita River. Ninety-six percent of the groundwater resources used in Caddo County are used for irrigation. A rapid decline in the water table has been detected in Caddo County. Fifty-six persent of total groundwater withdrawn during the period 1975-1979 in Caddo County was for the irrigation of peanuts. Declining groundwater levels may seriously threaten agricultural production in Caddo County for the present generation of farmers even if groundwater use continues at present levels. Careful irrigation management and perhaps more research on optimal irrigation techniques would prolong the availability of groundwater. (Moore-IVI)
W85-06234

FRACTURE TRACE ANALYSIS TO INCREASE THE PROBABILITY OF LOCATING GROUNDWATER FOR MURRAY COUNTY, GEORGIA,
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
For primary bibliographic entry see Field 2F.
W85-06313

FY 83 PROGRAM SUMMARY REPORT OF UTAH CENTER FOR WATER RESOURCES RESEARCH,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 9D.
W85-06322

GROUNDWATER MANAGEMENT PLAN FOR STUDY AREA 1, COASTAL PLAIN FORMATIONS,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 6F.
W85-06334

SPECIAL GROUND WATER STUDY, BASIN-WIDE REPORT AND EXECUTIVE SUMMARY.
Delaware River Basin Commission, West Trenton, NJ.
For primary bibliographic entry see Field 2A.
W85-06337

SPECIAL GROUNDWATER STUDY OF THE UPPER DELAWARE RIVER BASIN, STUDY AREA III, VOLUME II.
Wright (R.E.) Associates, Middletown, PA.
For primary bibliographic entry see Field 6E.
W85-06338

MULTI-OBJECTIVE OPTIMIZATION MODEL FOR AQUIFER MANAGEMENT UNDER TRANSIENT AND STEADY-STATE CONDITIONS,
Nebraska Univ., Lincoln. Dept. of Mathematics.
J. P. Dauer, J. F. Hullett, and Y.-H. Liu.
Applied Mathematical Modelling, Vol. 9, No. 1, p 21-26, 1985. 5 Fig, 4 Tab, 6 Ref.

Descriptors: *Waste disposal, *Model studies, *Aquifer management, Groundwater management, Aquifers, Groundwater, Mathematical models.

In aquifer management one may wish to achieve a high discharge rate without lowering groundwater heads. Since these two objectives are not commensurable, the trade-offs between the objectives need to be analyzed to understand the interaction between them. A multiple objective waste-disposal model is developed and analyzed. The model is a modification of the single objective waste-disposal model of Alley, Aguado and Remson. The model has three non-commensurable objectives. The solution obtained by Alley is compared with the optimal solution, which is obtained via the multiperiod model. The numerical values of the objectives obtained by the two methods are very close. The solution structures vary substantially between the two methods. This demonstrates that the multiperiod nature of the waste-disposal field is more fully realized via the multiperiod model. A multiobjective analysis of the multi-period model is performed. This approach produces the trade-off values betwen objectives. These values are used in order to analyze the interaction between the objectives. The results demonstrate the comprehensive analysis of the objectives and their interaction which is possible using this model. (Baker-IVI)
W85-06562

EVAPOTRANSPIRATION OF FOUR MAJOR AGRICULTURAL PLANT COMMUNITIES IN THE SOUTH-WEST OF WESTERN AUSTRALIA MEASURED WITH LARGE VENTILATED CHAMBERS,
Western Australia Dept. of Agriculture, South Perth. Div. of Resource Management.
For primary bibliographic entry see Field 2D.
W85-06675

LUMPED PARAMETER MODEL: FURTHER APPLICATION IN CHALK AQUIFERS, U.K.,
Binnie and Partners, London (England).
For primary bibliographic entry see Field 2F.
W85-06827

LOWERING THE WATER TABLE WITH RADIAL DRAINS,
L. K. Ginzburg, and V. B. Shvets.
Soil Mechanics and Foundation Engineering, Vol. 21, No. 5, p 200-203, September/October, 1984. 3 Fig, 5 Ref. Translated from Osnovaniya, Fundamenty i Mekhanika Gruntov, No. 5, p 12-14, September/October, 1984.

Descriptors: *Water table, *Radial drains, Drainage, Construction, Costs, Drilling, Pumps.

A rise in the water table is frequently observed at construction sites. Because of the difficulty in the use of vertical and horizontal drains at construction sites, radial drains have recently come into use. Radial drains are drains that run horizontally off vertical main shaft drains. By drilling the vertical shafts deep enough, the horizontals go under basements and utilities. An example is given of the analysis, construction and operation of a system of radial drains at a factory. Specialized construction organizations should be called upon to perfect the method of radial drainage; they can assist in working out standard technological flow charts for dewatering with radial drains. The operating expenses incurred for radial drainage are negligible since they consist primarily in the monitoring the automatic operation of the pumps, repair of pumps, and outlays for electricity. (Cutty-IVI)
W85-06841

PILOT-SCALE INVESTIGATION OF PARTICLE RETENTION DURING ARTIFICIAL RECHARGE,
Asian Inst. of Tech., Bangkok (Thailand).
S. Vigneswaren, S. Jeyaseelan, and A. Das Gupta.
Water, Air and Soil Pollution, Vol. 25, No. 1, p 1-13, 1985. 9 Fig, 5 Ref.

Descriptors: *Artificial recharge, *Pilot plants, *Particle retention, Water supply development, Mathematical models, Model studies, Sand, Groundwater recharge.

One of the major limitations of artificial recharge is the clogging of pores by suspended solids present in recharging water. An experimental investigation was conducted using a pilot-scale artificial recharge model to study the temporal and spatial variation of particle retention in the sand pores. The experimental results were compared to a mathematical model characterizing physical clogging in artificial recharge. The particle retention within the aquifer during artificial recharge is physico-chemical in nature. Therefore a laboratory or pilot-scale experimental study, with the same media and recharging water which are used in real conditions, is essential to evaluate the parameters characterisic to the aquifer and recharging water. It was evident from this study that the proposed mathematical model along with a limited number of deep bed filter experiments can be successfully used to predict the particle retention profile during artificial recharge. (Baker-IVI)
W85-06886

4C. Effects On Water Of Man's Non-Water Activities

PORT SOLVES ENVIRONMENTAL PROBLEMS,
Port of Long Beach, CA.
For primary bibliographic entry see Field 5C.
W85-06176

EFFECTS OF FORESTRY ON WATER QUALITY AND FISH IN WELSH RIVERS AND LAKES,
Welsh Water Authority, Powys (Wales).
For primary bibliographic entry see Field 5C.
W85-06574

MODIFICATION OF BOG VEGETATION BY POWER UTILITY RIGHTS-OF-WAY,
Tufts Univ., Medford, MA. Dept. of Biology.
N. H. Nickerson, and F. R. Thibodeau.
Journal of Environmental Management, Vol. 19, No. 3, p 221-228, October, 1984. 3 Fig, 18 Ref.

Descriptors: *Bogs, *Vegetation, *Environmental effects, *Power transmission lines, Tewksbury, Massachusetts, Legal aspects, Ecosystems, Wetlands, Habitats, Wetlands management.

Wetland modification is strictly controlled by a number of state and federal statutes. This study documents the effects of construction and maintenance of power utility rights-of-way on shrub swamp-bog vegetation at Tewksburg, Massachusetts. Construction of the right-of-way created a single large-scale impact. Maintenance required a series of lesser, but repeated, perturbations. The construction and maintenance of power utility rights-of-way did not appear to be in conflict with the intent of wetlands protection laws. Neither activity created a long term or irreparable negative impact. In fact, the mosaic of habitat types which result from these practices increases the overall diversity of the landscape by encouraging equally diverse, but different, patches of vegetation. It should be noted, however, that a management program which is somewhat more conservative than the one practiced here until 1976 is likely to be equally effective from a management perspective, while causing less change to the plant association. Even the present management strategy did not appear to cause changes from which the vegetation could not recover naturally. (Baker-IVI)
W85-06606

AGRICULTURE IN CHINA - A DETERIORATING SITUATION,
Leiden Rijksuniversiteit (Netherlands). Sinological Inst.
E. B. Vermeer.
Ecologist, Vol. 14, No. 1, p 6-14, 1984. 2 Fig, 56 Ref.

Descriptors: *China (Peoples Republic), *Agriculture, Irrigation, Conservation, Erosion, Salinization, Deforestation, Water pollution, Oasis, Wetlands, Water supply.

Indications are that China's agricultural policies, in particular those pertaining to the bringing into production of marginal lands, have been environmentally disastrous. Erosion, salinization, deforestation, dessication as well as contamination of shrinking water supplies are all serious problems besetting China. The question as to whether marginal areas should be continued to be cultivated for foodgrain production or any crop at all has several angles: production, productivity, employment, capital requirement and conservation and environmental concerns. Specific areas discussed include a new oasis in Xinjiang with secondary salinization resulting, the Loess Plateau coupled with water and soil erosion, the Sanjiang Plain and accompanying drying up of marshes and pastures, the dessication of the marshes, water supply in Tainjin, reclamation of lakes, drainage of the lakes and resultant drops in fish populations, the Hainan Island and the result of slash and burn techniques. (Baker-IVI)
W85-06630

MEASUREMENT AND PREDICTION OF EVAPORATION FROM FORESTED AND AGRICULTURAL CATCHMENTS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W85-06666

PRIMARY PRODUCTIVITY AND SPATIAL STRUCTURE OF PHYTOLITHIC GROWTH IN STREAMS IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK, TENNESSEE,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W85-06793

EXAMINATION OF TIDAL FLATS, VOL. 2: IDENTIFIED VALUES REVIEW.
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W85-06895

EFFECT OF PEAT MINING ON FISH AND OTHER AQUATIC ORGANISMS IN THE UPPER MIDWEST.
Camp, Dresser and McKee, Inc., Milwaukee, WI. Environmental Sciences Div.
Available from the National Technical Information Service, Sprinfield, VA 22161 as PB83-127936. FWS/OBS-80/65, May 1981. Fish and Wildlife Service, Washington, DC. Office of Biological Services. 72 p, 6 Fig, 4 Tab, 147 Ref.

Descriptors: *Peat bogs, *Environmental effects, *Ecological effects, *Peat mining, *Fisheries, *Macroinvertebrates, *Literature reviews, *Aquatic animals, Bogs, Water resources development, Wetlands, Water quality control, Acidic water.

A review of the literature pertinent to peatlands and peat mining is given to determine the effects of peat mining on aquatic animal life. The surface waters in the Upper Midwest peatlands provide thriving and diverse fisheries. Diverse populations of macroinvertebrates are also present. Peat mining techniques involving drainage may cause additional inputs of peatland waters into downstream surface waters which decreases the pH and hardness of the receiving waters. Preliminary results from unpublished studies showed that P and N concentrations were higher in runoff from a peatland being mined by the milled method than from two undisturbed peatlands. Oxygen levels in waters receiving drainage from mined peat bogs may be lowered by increases in suspended solids. Since metals are readily adsorbed by peat, the mining of peat bogs may release high concentrations of metals into the environment. Mining may also increase the level of dissolved organics and color of waters receiving peat bog drainage. Hydraulic peat mining methods would increase turbidity and be deleterious to fish spawning areas. Measures to mitigate the effects of drainage methods of peat mining on the aquatic environment include biological surveys, site erosion control, channel protection, runoff control, water diversion, settling of

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suspended solids, and neutralization. Data gaps on peat mining impacts show the need for faunal surveys, better mine designs, hydrological data and water quality data.
W85-06936

POSSIBLE EFFECTS OF FORESTRY ON INLAND WATERS OF TASMANIA; A REVIEW,
Forest Ecology Research Fund, Launceston (Australia).
F. B. Michaelis.
Environmental Conservation, Vol. 11, No. 4, p 331-343, Winter, 1984. 5 Fig, 2 Tab, 78 Ref.

Descriptors: *Forestry, *Environmental effects, *Road construction, *Tasmania, *Australia, Water quality, Water supply, Land use, Logging, Burning, Reviews, Water yield.

Tasmania has the highest proportion of forested land of any Australian state (about 41%). The effects of road-building, logging, burning, and forest regeneraton, on water quality and aquatic flora and fauna in Tasmania are reviewed. Only brief mention is made of deforestation, or of salvage of forest associated with hydroelectric developments. In general, road construction and maintenance increase water yield, reduce water quality, and modify the physical structure of streams, particularly at bridge sites. The impact of logging depends on the harvesting method used, the proportion of trees felled, the proportion of the catchment logged, and the precautions taken. The effects of burning Australian forests are poorly understood, but there are changes in water yield and a decrease in water quality. The possible biological effects of these forest operations on Tasmania's inland waters are far-reaching. (Baker-IVI)
W85-07145

4D. Watershed Protection

SOME PROBLEMS ABOUT THE SOIL EROSION IN THE VRANCEA SUBCARPATHIANS (QUELQUES PROBLEMES SUR L'EROSION DES SOLS DANS LES SUBCARPATES DE VRANCEA),
For primary bibliographic entry see Field 2J.
W85-06420

SEDIMENT PROBLEMS AND THEIR MANAGEMENT IN PENINSULAR MALAYSIA,
Drainage and Irrigation Dept., Kuala Lumpur (Malaysia).
C. S. Fatt.
Water International, Vol. 10, No. 1, p 3-6, March, 1985. 1 Tab.

Descriptors: *Malaysia, *Rivers, *Sedimentation, *Erosion control, Watershed protection, Silting, Legislation, Soil erosion, Suspended sediments, Sediment control, Land use.

In general, soils in Peninsular Malaysia are highly susceptible to erosion if the vegetation cover is removed. Rivers in Peninsular Malaysia under natural conditions were known to have stable regimes and carried low sediment loads. As a result of rapid development during the last few decades, river sediment loads have gravely increased and problems of soil erosion and sediment discharge have emerged as matters of national concern. It has been estimated that more than 80% of the suspended sediment load is caused by human activities in the catchments. The natural processes are described and different human activities, such as mining, timber logging, urbanization and infrastructural development, and agricultural development, which contribute to sediment generation are noted. The main types of sediment problem are erosion of catchments, erosion of river courses, sedimentation in reservoirs, silting of river channels, silting of river mouths, and high sediment concentration. Current sediment control measures include the passage of several pertinent pieces of legislation including the Waters Enactment of 1920, Mining Enactment of 1923, Forest Enactment of 1934, Land Conservation Act of 1960, National Land Code of 1965, Environmental Quality Act of 1974, and the Town Planning Act in 1976. Structural measures for control include river training, sediment interception and dredging operations. Four major types of constraint constitute the main obstables to the effective control of sedimentation problems: economic, institutional, social and technical constraints. (Baker-IVI)
W85-06541

RIVER SEDIMENTATION AND REMEDIAL MEASURES IN NEPAL,
National Planning Commission, Kathmandu (Nepal).
C. L. Shrestha.
Water International, Vol. 10, No. 1, p 14-17, March, 1985. 18 Ref.

Descriptors: *Erosion control, *Sedimentation, *Soil properties, *Nepal, Himalayan Mountains, Watershed management, Land use, Legislation, Institutional constraints, Public policy.

Excessive erosion and instability are the geological characteristics in Nepal which occupies a central segment of the Himalayan Mountain System. Land use must be determined in a fitting manner within the range of its capability. The three major river systems - the Karnali, the Gandaki and the Koshi and the monsoon-fed rivers originating in the middle mountain zone form the essential part of the Ganga System. The forest area recorded in 1983 was 3.8 million hectares, of which 2.9 million were in the hills, and the remaining 0.9 million in the terai. Hydrological observations were initially begun in 1961. Legislation, institutional arrangements and remedial measures undertaken to address the problem are reviewed. Conservation, management of the watersheds and proper land use are the only means of survival. Policies have been formulated and legislation enacted. Proliferation of new institutions and availability of external finances are at times confusing and result in negative effects. There is an increase in the gap between enunciations and institutional arrangements and implementation. Political commitment is the prime need of the hour for water resources development and management of river sedimentation. For this task the nation's scientists must be nurtured to bring about the evolution of regional undertakings and international cooperation or understanding. (Baker-IVI)
W85-06543

MANAGEMENT OF RIVER AND RESERVOIR SEDIMENTATION IN PAKISTAN,
Pakistan Forest Inst., Peshawar.
S. M. Khan.
Water International, Vol. 10, No. 1, p 18-21, March, 1985. 6 Ref.

Descriptors: *Pakistan, *Sedimentation, *Reservoirs, *Rivers, Sediment transport, Erosion control, Irrigation, Agriculture, Soil conservation, Watershed management, Developing countries.

Agriculture is the mainstay in Pakistan's economy. About 70-80% of agricultural production comes from the irrigated areas. Irrigation water comes from the northern mountain watersheds of Pakistan. For centuries these watersheds have undergone excessive felling of trees, cutting and even uprooting of vegetation, overgrazing, and unproductive cultivation on marginal lands. Damage to the vegetal cover has thus occurred with resultant accelerated soil removal. According to present policy of the Government, the Forest Department must assume direct responsibility for proper soil conservation measures within the Government-owned forests, and the Soil Conservation Organization in privately owned lands. Watershed practices being carried out include construction of silt trap dams, spillways, earthern bunds, water diversion channels, water ponds, digging of contour trenches, afforestation, grass planting in watercourses and on earthen bunds, gully-plugging, check-damming, construction and maintenance of terraces, water disposal from fields, planting of fruit trees and their pruning, stabilization of landslides, reseeding of grasses and planting of fodder, water spreading, growing shelter belts, and other steps. Major management problems center around central coordination and monitoring agency, training and research, monitoring project activities, anomaly in planning and executions, and lack of cooperation. Proposals for future planning and implementation are included. (Baker-IVI)
W85-06544

REGIONAL PRIORITIES FOR ABANDONED MINE RECLAMATION IN THE BLACKLICK CREEK WATERSHED, PENNSYLVANIA,
Georgia Univ., Athens. School of Environmental Design.
For primary bibliographic entry see Field 5G.
W85-06607

STREAM-WATERSHED RELATIONS IN THE MISSOURI OZARK PLATEAU PROVINCE,
Missouri Agricultural Experiment Station, Columbia.
For primary bibliographic entry see Field 6G.
W85-06620

EROSION ON VERY STONY FOREST SOIL DURING PHENOMENAL RAIN IN WEBSTER COUNTY, WEST VIRGINIA,
Northeastern Forest Experiment Station, Broomall, PA.
For primary bibliographic entry see Field 2J.
W85-06967

EVALUATION OF MEMBRANE-TYPE MATERIALS FOR STREAMBANK EROSION PROTECTION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
D. W. White.
Miscellaneous Paper GL-81-4, August 1981. Final Report. 113 p, 2 Fig, 6 Tab, 87 Photos, 14 Plates, 1 Append.

Descriptors: *Performance evaluation, *Erosion control, *Bank erosion, *Stream stabilization, *Membranes, *Materials testing, *Materials engineering, *Bank stabilization, Stream degradation, Embankments, Slope degradation, Soil erosion, Slope protection, Slope stability, Slope stabilization.

Laboratory and field tests were conducted to test the performance of new materials and construction techniques for preventing streambank erosion. The specific materials tested were: T15, laminated vinyl-coated nylon; T16, neoprene-coated nylon; Hypalon, synthetic rubber-coated 5 X 5 and 10 X 10 polyester scrim membranes; and Bidim C-34 and C38, spunbonded, continuous polyester filament filter fabrics. The construction techniques used to install the membranes along Durden Creek and the Big Black River were: a stepped membrane encapsulated soil layer (MESL), a blanket method where the membranes were draped over the slope of the banks and anchored along the edges in ditches, and MESL sections. Results showed that all membrane materials tested performed satisfactorily and with cost effectiveness during normal streamflows as long as the banks remained stable. It is recommended that membranes should be used to prevent erosion when installed as blankets, stepped MESL, or MESL sections, and that the type of installation method should be determined by the condition of the bank where protection is needed.
W85-06979

ENGINEERING GEOLOGY AND GEOMORPHOLOGY OF STREAMBANK EROSION; REPORT 2: YAZOO RIVER BASIN UPLANDS, MISSISSIPPI,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
For primary bibliographic entry see Field 2J.
W85-06996

TRADITIONAL APPROACH TO WATER SYSTEM O AND M,
Manchester Water Works, NH.
For primary bibliographic entry see Field 5F.
W85-07060

STREAMBANK STABILITY,
Owens (F.W.) and Associates, Inc., Louisville, KY.
For primary bibliographic entry see Field 2J.
W85-07082

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

NOTE ON A MEMBRANE FILTRATION METHOD FOR THE CONCENTRATION AND ENUMERATION OF BACTERIOPHAGES FROM WATER,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
R. N. Purdy, B. N. Dancer, M. J. Day, and D. J. Stickler.
Journal of Applied Bacteriology, Vol. 58, No. 2, p 231-233, February, 1985. 2 Tab, 5 Ref.

Descriptors: *Membrane filtration, *Membrane processes, *Bacteriophage, Viruses, Water analysis, Bacteria.

A membrane filtration method is described for the recovery and enumeration of bacteriophage from water. The method is conveniently used in the field and requires no complex or expensive equipment. Nine sources of water were sampled for use in the study: Roath Park Lake, River Taff, Llanishen Reservoir, Ogmore Beach, Rest Bay, River Thaw, Cosmeston Lake, River Ely, and Penarth Beach. Subsamples of the water types were inoculated with phage. Samples were treated with chloroform to reduce the indigenous bacterial flora. They were then filtered through glass fiber to remove any suspended solids that might block the membrane filters and mask plaque formation. Any phages associated with the solid material were eluted in nutrient broth and the eluate was passed through the filter to add to the filtrate. Samples were aerated to eliminate residual chloroform. Host cells were added and absorption of bacteriophage was allowed for at least 20 min at room temperature. Samples were passed through a cellulose nitrate membrane filter which was then incubated at 30 C overnight on nutrient agar. Plaques were displayed on the membrane by treating the cells with tetrazolium violet, 2.0 mg/ml. The membrane filtration method allowed the efficient recovery and enumeration of phages RP1015, RP1033, and RP1044 from 100 ml volumes of a diversity of water types. The method is convenient to use in the field. (Baker-IVI)
W85-06180

FIELD OBSERVATIONS ON THE OCCURRENCE OF NEW INDICATORS OF DISINFECTION EFFICIENCY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, B. F. Severin, D. Roy, R. S. Engelbrecht, and A. Lalchandani.
Water Research, Vol. 19, No. 3, p 323-329, 1985. 6 Fig, 5 Tab, 12 Ref.

Descriptors: *Bioindicators, *Disinfection, *Yeasts, *Acid-fast bacteria, Wastewater analysis, Water analysis, Coliforms, Bacteria, Enteroviruses.

The conventional coliform group of bacteria may be more sensitive to disinfectants than certain human enteric viruses. Acid-fast and yeast organisms are more resistant to free chlorine and inorganic chloramines than Poliovirus Type I (Mahoney) and Escherichia coli, making them potentially better indicators of disinfection efficiency than coliforms with respect to the inactivation of the more resistant enteric viruses. The presence of acid-fast and yeast organisms in wastewater and water treatment plants and in surface water was studied. These organisms satisfy three of Bonde's criteria for indicator organisms: presence whenever pathogens are likely to be present; resistance at least equal to that of pathogens; and lack of regrowth in the post-treatment environment. This, plus prior data, indicates that these organisms are at least as acceptable as the coliform group as indicators of disinfection efficiency. The judicious use of multiple indicators, including the acid-fast and yeast groups, may permit a more thorough assessment of microbial quality in many situations. (Moore-IVI)
W85-06224

DETECTION OF GIARDIA CYSTS AT LOW CONCENTRATIONS IN WATER USING NUCLEPORE MEMBRANES,
Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
P. M. Wallis, and J. M. Buchanan-Mappin.
Water Research, Vol. 19, No. 3, p 331-334, 1984. 4 Fig, 11 Ref.

Descriptors: *Giardia, *Membrane filtration, Water analysis, Pathogenic protozoa, Protozoa, Filtration.

A filtration procedure was devised to recover Giardia cysts from water using 5 micro-m Nuclepore membranes (110 mm in dia). Cysts taken from a beaver (Castor canadensis) were added to 100 l of untreated stream water and recovered by filtration. Cysts were washed from the membrane, concentrated by centrifugation and microscopically examined. Recovery efficiencies averaged 53% at cyst concentrations between 0.5 and 45 cysts/l. Maximum cyst recovery was observed at filtration pressures of 40-60 kPa. The advantages offered by this method over cartridge filtration methods include higher recovery efficiencies at low cyst concentrations and simpler, more rapid laboratory procedures. (Author's abstract)
W85-06225

ERRORS IN GRAN FUNCTION ANALYSIS OF TITRATION DATA FOR DILUTE ACIDIFIED WATER,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
T. E. Barnard, and J. J. Bisogni, Jr.
Water Research, Vol. 19, No. 3, p 393-399, 1985. 4 Fig, 4 Tab, 15 Ref.

Descriptors: *Titration, *Water analysis, *Acidity, *Gran function, Error analysis, Chemical reactions, Carbon dioxide, Surface waters.

Errors that result from applying simple Gran function analysis to titration data from typical dilute acidified surface waters are discussed. Theoretical development and experimental verification of these errors are presented. It is concluded that for dilute acidifed surface waters of the type found in the Adirondack region of New York and in Scandinavia, simple Gran function analysis of titration data will lead to the following errors. An overestimate of strong acid acidity results at the expense of an underestimate of weak acid acidity. This is a theoretical error and its magnitude is a function of the concentration and strength of the weak acids in the sample. The error may be reduced but not eliminated by adding additional strong acid in the sample and subtracting the amount added from the final result. An overestimate of total acidity may also result. This is an analytical problem that is due to a small amount of CO3(2-) (CO2) that is present in the titrant. This contaminant cannot be removed by purging either the sample or the titrant with nitrogen. (Baker-IVI)
W85-06231

INDIRECT DETERMINATION OF TRACE PHENOL IN WATER BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY,
East China Normal Univ., Shanghai. Dept. of Chemistry.
B.-X. Xu, T.-M. Xu, M.-N. Shen, and Y.-Z. Fang.
Talanta, Vol. 32, No. 3, p 215-217, March, 1985. 3 Tab, 6 Ref.

Descriptors: *Phenols, *Atomic absorption spectrophotometry, Pollutant identification, Water analysis.

An indirect method for determination of trace phenol in water by atomic-absorption spectrophotometry (AAS) is described. The phenol is brominated in acidic solution with KBrO3-KBr solution at room temperature. The excess of bromine is reacted with KI and the I2 produced is extracted into cyclohexane and then reduced back to I(-) with ascorbic acid. The I(-) is then complexed with Cd(2+) in sulfuric acid medium and the complex extracted into MIBK. The extract is analyzed by flame AAS for Cd (and hence indirectly for phenol). The linear concentration range for determination of phenol is 6 x 10 to the -7th to 0.9 x 10 to the -5th M aqueous solution. Several foreign ions and organic substances do not interfere. (Author's abstract)
W85-06251

PARTICLE DISCRIMINATION EFFECTS IN THE DETERMINATION OF TRACE METALS IN NATURAL FRESH WATERS,
Oslo Univ. (Norway). Inst. for Kjemi.
B. Salbu, H. E. Bjornstad, N. S. Lindstrom, E. M. Brevik, and J. P. Rambaek.
Analytica Chimica Acta, Vol. 167, p 161-170, January, 1985. 5 Fig, 14 Ref.

Descriptors: *Trace metals, *Particulate matter, *Water analysis, *Natural waters, Neutron activation analysis, Atomic absorption spectrometry, Plasma atomic emission spectrometry, Filtration, Metals.

Instrumental neutron activation analysis (i.n.a.a.), atomic absorption spectrometry (a.a.s.), and inductively-coupled plasma atomic emission spectrometry (i.c.p.a.e.s.) have been applied to the determination of Na, K, Mg, Ca, Al, Mn, Fe and Zn in fresh waters containing naturally occurring particles. Scattered results were obtained for the total concentrations of trace metals which were associated to some extent with particles retainable by 0.45-micro-m filter membranes. Particle discrimination effects are indicated and the fraction of elements included in the final result depends on the method used. For the simultaneous determination of the total concentrations of Al, Mn, Fe and Zn, i.n.a.a. is preferred, as all element fractions present are included in the result. When a.a.s. or i.c.p.a.e.s. is applied, lower results are obtained when particulate matter is present, the results referring only to the acid-soluble low-molecular-weight fraction (< or = 0.45 micro-m diameter). When particles are removed prior to the quantifying step, the results obtained on the filtrates by all methods are in good agreement. However, considering the low concentrations of several elements in separated fractions, i.n.a.a. is most favorable for the determination of aluminum while graphite-furnace a.a.s. is most suitable for zinc. Both methods are applicable for manganese. For Ca, Fe, K, Mg and Na, i.c.p.a.e.s. is recommended. (Author's abstract)
W85-06252

USE OF THE L'VOV PLATFORM AND MOLYBDENUM COATING FOR THE DETERMINATION OF VOLATILE ELEMENTS IN THERMOMINERAL WATERS BY ATOMIC ABSORPTION SPECTROMETRY,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
A. Criaud, and C. Fouillac.
Analytica Chimica Acta, Vol. 67, p 257-267, January, 1985. 8 Fig, 4 Tab, 24 Ref.

Descriptors: *Mineral water, *Water analysis, *Atomic absorption spectrometry, *L'vov platform, Chemical composition, Arsenic, Antimony, Cadmium, Selenium, Germanium.

Arsenic, antimony, cadmium, selenium and germanium were determined in iron-rich spring-water samples with the use of a molybdenum-coated L'vov platform. With this method, iron spectral interference effects were eliminated without the use of Zeeman effect background correction. Analytical sensitivities of 1 micro-g/l and an r.s.d. of 2-3% were obtained. Only germanium could not be determined directly, but required the use of standard addition. Selenium concentration in the samples were below the detection limit. (Author's abstract)
W85-06253

LIBRARY U. OF I. URBANA-CHAMPAIGN

DIFFERENTIAL PULSE POLAROGRAPHIC DETERMINATION OF NITRILOTRIACETIC ACID IN NATURAL WATERS AND WASTE WATER EFFLUENTS,
Istituto Guido Danegani S.p.A., Novara (Italy).
F. Guerrieri, and G. Bucci.
Analytical Chimica Acta, Vol. 167, p 393-397, January, 1985. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Differential pulse polarography, *Nitrilotriacetic acid, Wastewater analysis, Water analysis, Iron, Aluminum, Polarography.

Optimal conditions are reported for a correct determination of nitrilotriacetic acid (NTA) with differential pulse polarography and Bi(III) in the presence of iron(III) and aluminium(III). The limit of determination of the method is improved from 20 to 2 micro-g/l NTA by ten-fold concentration of the sample. A method is proposed to obtain a reference polarogram by using the sample under test and masking NTA as its Al(III) complex. For the analysis of wastewaters, a reference polarogram is recorded directly for the sample and is used to correct for interfering organic substances. In order to determine NTA with Bi(III) in the presence of Fe(III), it is necessary to reduce Fe(III) to Fe(II). This reduction can be achieved at 20 C and pH 2 by adding hydroxylamine or ascorbic acid immediately before polarography, or only hydroxylamine at 90-100 C and pH 3.3 before polarography, or only hydroxylamine at 90-100 C and pH 3.3. (Baker-IVI)
W85-06254

GAS CHROMATOGRAPY/MASS SPECTROMETRY DETERMINATION OF WATER-SOLUBLE PRIMARY AMINES AS THEIR PENTAFLUOROBENZALDEHYDE IMINES,
Ames Lab., IA.
M. J. Avery, and G. A. Junk.
Analytical Chemistry, Vol. 57, No. 4, p 790-792, April, 1985. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Water analysis, *Amines, *Pentafluorobenzaldehyde, *Gas chromatography, *Mass spectrometry, Chemical analysis, Water quality control, Organic compounds, Aliphatic amines, Imines.

Primary aliphatic amines present in various liquids is an important problem. These compounds can be found in biological fluids, environmental samples, and industrial process streams, usually in aqueous solutions and often at trace levels. Amines are difficult to extract from water and are not easily chromatographed due to their polarity. A new procedure is described to determine trace levels of primary aliphatic amines in aqueous solutions. It involves direct derivatization of the amines present in the water sample using pentafluorobenzaldehyde to form imines of the amines. The procedure requires minimal sample manipulation and is completed within 30 min and the imine derivatives can be readily extracted into hexane. High resolution gas chromatography/mass spectrometry analysis of the hexane extract is used to ensure that all imine isomers will be measured separately, with no interferences. (Baker-IVI)
W85-06255

DETERMINATION OF CHLORINATED BENZENES IN BOTTOM SEDIMENT SAMPLES BY WCOT COLUMN GAS CHROMATOGRAPHY,
National Water Research Inst., Burlington (Ontario).
F. I. Onuska, and K. A. Terry.
Analytical Chemistry, Vol. 57, No. 4, p 801-805, April, 1985. 3 Fig, 8 Tab, 13 Ref.

Descriptors: *Gas chromatography, *Chlorinated benzenes, *Sediments, Benzenes, Chlorinated hydrocarbons, Pollutant identification.

An integrated analytical procedure for determining chlorinated benzene contaminants that enables quantitation of individual isomers as low as 0.4 micro-g/kg in sediment samples has been developed. Preparation of the sample can be performed by using one of three techniques, namely, Soxhlet extraction and ultrasonic extraction or steam distillation. Chlorinated benzenes are then characterized and quantified by open tubular column gas chromatography with electron capture detection. Recoveries of individual chlorinated benzene isomers at three different levels from two different types of sediment, one low and one high in organic matter, were evaluated. Although all three methods are quantitative, the steam distillation method was found to be the most efficient for the determination, insofar as time and simplicity are concerned. Data presented indicate that detection limits of this method are 0.4 to 10 micro-g/kg of individual chlorobenzene isomers. Chlorobenzene recovery from bottom sediment samples at concentration levels between 1 and 100 micro-g/kg is 86 +/- 14%. (Author's abstract)
W85-06256

INDUSTRIAL WASTEWATER ANALYSIS BY LIQUID CHROMATOGRAPHY WITH PRECOLUMN TECHNOLOGY AND DIODE-ARRAY DETECTION,
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
M. W. F. Nielen, U. A. Th. Brinkman, and R. W. Frei.
Analytical Chemistry, Vol. 57, No. 4, p 806-810, April, 1985. 7 Fig, 4 Tab, 14 Ref.

Descriptors: *Wastewater analysis, *Liquid chromatography, *Industrial wastewater, Diode-array detection, Pollutant identification, Precolumns.

Small precolumns packed with C18, PRP1, and cation-exchange materials have been used for the on-line group separation and trace enrichment of industrial wastewater samples. The sample is divided into three main groups: a fraction containing nonpolar compounds, a second fraction containing medium polarity compounds and certain polar substituted aromatics, and a third fraction containing polar anilines and other polar bases. Each precolumn fraction is subsequently chromatographed on a C18 analytical column with a methanol gradient and detected by a diode-array UV-Vis detector. Multisignal plots and three-dimensional spectrochromatograms are used to get information about the identity of the pollutants present. The completely automated system is optimized for 29 selected chemicals of particular interest. Some of these compounds were found in the wastewater samples tested and were quantitated. (Author's abstract)
W85-06257

METHOD OF ANALYSIS BY THIN-LAYER CHROMATOGRAPHY FOR ACTIVE COMPONENTS OF TRIAZINE HERBICIDES IN WATER (DUNNSCHICHTCHROMATOGRAPHISCHE ANALYSENMETHODE FUR HERBIZIDE TRIAZIN-WIRKSTOFFE IM WASSER),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
A. Lawrenz.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 347-350, 1983. 2 Tab.

Descriptors: *Thin-layer chromatography, *Herbicides, *Triazines, *Pollutant identification, Water analysis, Simazine, Atrazine, Propazine, Desmetryn, Ametryn, Prometryn.

An analytical method for the semiquantitative determination in groundwater and lightly polluted surface waters of simazine, atrazine, propazine, desmetryn, ametryn, and prometryn is described. After extraction of the substances from the water sample, qualitative determination is performed by means of thin-layer chromatography. Chromatography is achieved with paraffin/glacial acetic acid/benzol/cyclohexane (10 + 20 + 30 + 200) in a saturated atmosphere in the chamber. Development is complete after a 12-cm run length, whereupon the slide is placed in a chlorinating atmosphere. The slide is then left in air for 10 min to remove excess chlorine, after which it is sprayed with o-tolodine reagent. The investigated substances appear as blue patches on a white background and must be evaluated immediately. Additional separation media may be used to confirm the identity of a substance. If silver nitrate is applied and the chromatogram irradiated by UV light for 10 min, chlorine-containing triazines appear as brown or black patches, while triazines containing sulfur appear white. p-Dimethylaminobenzaldehyde may be used as a negative test. Semiquantative determination is performed by visual comparison of patches (size and color intensity) with known concentrations of comparison substances. (Gish-IVI)
W85-06265

PROBLEMS IN WATER CONTAMINATION AND ITS ANALYTICAL UNDERSTANDING (PROBLEME DER WASSERKONTAMINATION UND IHRER ANALYTISCHEN ERFASSUNG),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
R. Koch, H. J. Dobberkau, D. Lienig, A. Lawerenz, and E. Stottmeister.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 391-399, 1983. 1 Tab, 22 Ref.

Descriptors: *Pollutant identification, *Raw water, Organic compounds, Water analysis, Chemical composition, Water treatment, Water quality standards.

The increasing loading of raw water for the drinking water supply with trace substances results in an increasing exposure of the population to toxicologically suspect substances. At present, the quality of such raw waters is evaluated mainly by cumulative parameters or individual substances with low ecotoxicological or human toxicological relevance. Now, about 500,000 environment-relevant organic substances must be taken into account; the number of individual compounds for a loaded receiving water is estimated to be 1000. Secondary contaminations are caused by oxidative processes of water treatment. In the trace substance analysis so far only about 40% of the organic substances are identifiable by comparatively simple methods. From this derives the demand for developing standardized methods for determining cumulative and group parameters with a high value of information and indication, as e.g. organically bonded chlorine or halogens. (Author's abstract)
W85-06267

ACUTE TOXICITY OF PHENOL, PENTACHLOROPHENOL AND SODIUM PENTACHLOROPHENATE TO A FRESHWATER OSTRACOD CYPRIS SUBGLOBOSA (SOWERBY),
Udaipur Univ. (India). Dept. of Limnology and Fisheries.
For primary bibliographic entry see Field 5C.
W85-06271

TOXICITY AND TRACE ANALYSIS OF TENSIDES IN WATER (ZUR TOXIZITAT UND SPURENANALYSE VON TENSIDEN IN WASSER),
Akademie der Wissenschaften der DDR, Leipzig. Forschungsstelle fuer Chemische Toxikologie.
G. Hanschmann, and H. Sohr.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 5, p 497-509, 1983. 4 Fig, 1 Tab, 53 Ref.

Descriptors: *Tensides, *Toxicity, *Water analysis, Bioaccumulation, Infrared spectroscopy, Thin-layer chromatography, Sediments, Pollutant identification, Water pollution effects, Surfactants.

Judging the behavior of tensides in water requires not only the results of the conventional methods of determining their biochemical degradability and toxicity, but also their distribution in the sediment as well as in animal and vegetable products. Properties such as adsorbability, persistence, sequence of stations in the nutrient chain (bioaccumulation), relations of structure and actions and dose-effect relations are very important. In these investigations, changes in the effects of combinations of substances with tensides have to be taken into account; a power plant water and a Baltic Sea sediment are used as examples. Of the variety of tested possibilities of analyzing very small amounts of tensides, mainly infrared spectroscopy and thin-layer chromatography have proved to be success-

ful. By means of special procedures, the detection and the quantitative determinability can be shifted into the nano- and picogram-ranges. (Author's abstract)
W85-06272

OPTIMAL SAMPLING STRATEGIES FOR SOURCE IDENTIFICATION IN ENVIRONMENTAL EPISODES,
Iowa Univ., Iowa City. Dept. of Geography.
R. Rajagopal.
Environmental Monitoring and Assessment, Vol. 4, No. 1, p 1-14, March, 1984. 4 Fig, 7 Tab, 14 Ref.

Descriptors: *Sampling, *Water analysis, *Optimization, *Water pollution sources, Streams, Toxicity, Mathematical studies.

A mathematical framework for the design of optimal sampling strategies for episode detection in a stream network is developed. The methodology is readily applicable to conservative contaminants that do not undergo significant changes. It can be extended to cases of non-conservative contaminants, if one is able to model the behavior of such contaminants in stream networks and incorporate such knowledge in interpreting sample results. The methodology can be extended to cases where there are a large number of sources on a stream network. The cost effective nature of such sampling plans depends on the ability to accurately estimate certain values. The application of some of the sampling strategies developed to the case of a toxic contaminant release in a sewerage system is briefly explored. (Baker-IVI)
W85-06283

TOXIC SUBSTANCES MONITORING PROGRAM, 1982,
California State Water Resources Control Board, Sacramento.
F. La Caro, and D. Watkins.
Water Quality Monitoring Report No. 83-7TS. December 1983, 124 p, 10 Fig, 14 Tab, 10 Ref, 6 Append.

Descriptors: *Toxicity, *Heavy metals, *Water pollution sources, *Water pollution effects, Water sampling, On-site data collections, Dieldrin, Mercury, Cadmium, Copper, Lead, Poisons, Water pollution, *Toxaphene, Guadalupe River, Lake Nacimiento, Feather River, Stanislaus River, Alamo River, New River, PCB.

The results are presented of the the 1982 sampling of the occurrence and levels of toxic substrates in the fresh water of California. The analysis of 2,580 samples showed that in 482 instances concentrations of toxic substances were detected, identified and measured. In 39 instances, the concentrations measured exceeded the National Academy of Science (NAS) guidelines. Twenty-two of these instances involved mercury. Mercury concentrations exceeded the Food and Drug Administration action level at the Guadalupe River in Region 2 and Lake Nacimiento in Region 3. The rest of the NAS guideline violations involved chlordane, DDT, dieldrin, hexacholorcyclohexane (HCH) and toxaphene. Other substances found in elevated concentrations were copper, cadmium, lead, silver, zinc, hexachlorobenzene, and PCBs. Toxaphene was detected at levels exceeding the NAS guideline in five rivers, including the Feather and the Stanislaus, marking the first time detectable levels of toxaphene were noted in these rivers. Levels in the Alamo River fish surpassed NAS guidelines for DDT, Dieldrin and toxaphene. Levels in New River fish exceeded the NAS guidelines for DDT, hexachlorocyclohexande (HCH-Beta) and toxaphene. At present, adsorbent column water sampling may not yield sufficient cost-effective data to be helpful in determining a potential water quality problem area. This type of analysis should be stopped until such techniques improve. (Hawkins-Omniplan)
W85-06329

USING A BIOTIC INDEX TO EVALUATE WATER QUALITY IN STREAMS,
Wisconsin Dept. of Natural Resources, Madison.
W. L. Hilsenhoff.
Technical Bulletin No. 132, 1982, 22 p, 15 Fig, 6 Tab, 27 Ref.

Descriptors: *Stream biota, *Bioindicators, *Water quality, *Stream pollution, *Aquatic Life, *Water sampling, *Biological samples, *Pollutant identification, Species composition, Streams, Mathematical equations, Biotic index.

A biotic index proposed in 1977 has been used widely in Wisconsin and elsewhere to evaluate the water quality of streams. More than 1,000 streams have been evaluated in Wisconsin. Recent improvements in the index and keys for identification of species in certain important insect genera are included in this report. For the purpose of calculating a biotic index, species are assigned pollution tolerance values of 0 to 5 on the basis of previous field studies. Intermediate values are assigned to species that occur in streams with intermediate degrees of pollution or disturbance. When species cannot be identified, genera are assigned values instead. The biotic index is calulated from a formula which includes the number of individuals of each species or genus, the tolerance value assigned to that species or genus, and the total number of individuals in the sample. Several studies were carried out to determine the efficiency and reliability of this procedure, the importance of species identification, and the relative merit of alternative sampling and sorting procedures. The time required to collect a sample, sort it, identify the arthropods to genus, label the vials, and calculate a biotic index was only slightly more than one hour for each stream. Only 21 more minutes were needed to calculate a biotic index at the species level. A recommended sampling procedure along with alternative methods are given. (Hawkins-Omniplan)
W85-06339

SPONGE SENTINEL OF HEAVY METALS,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
B. Patel, M. C. Balani, and S. Patel.
Science of the Total Environment, Vol. 41, No. 2, p 143-152, February, 1985. 2 Fig, 2 Tab, 30 Ref.

Descriptors: *Heavy metals, *Monitoring, *Water quality control, *Sponges, Bioindicators, Trace metals, Organic compounds, Halogens, Manganese, Nickel, Zinc, Cobalt, Selenium, Tin, Strontium, Iodine, Cesium.

The possibility of monitoring siliceous sponges as an ideal bioindicator of 17 trace metals and halogens was investigated. Of the two species of Demosponge from the Indian coastal waters receiving stable and radioactive nuclides (54-Mn, 63-Ni, 65-Zn, 60-Co, 75-Se, 113-Sn, 90-Sr, 131-I, 137-Cs), Spirastrella cuspidifera was found to accumulate Cd, Cr, and Sn in a range of 15-2000 microg/g dry tissue, some 5-7 orders of magnitude higher than in the ambient waters. Prostylyssa foetida, from the same microecological niche, was found to be totally free of these three metal ions. The bioaccumulation of Ni was also significantly higher in S. cuspidifera (400-2250 microg/g) than in P. foetida (7-15 microg/g). The former species was also an ideal sentinel for detecting levels of Co, Zn, and Ti; levels of Cu, Mn, Pb, Fe and Sr were higher in P. foetida, but those of the halogens I and Br were practically identical in both species. Furthermore, bioaccumulation of metal ions was found to be a function of sponge tissue itself, rather than that of either obligate or facultative symbiont microflora. In view of the high degree of species specificity which sponges exhibit while accumulating many trace metal ions, a sponge watch program is proposed on a global scale for monitoring the health of coastal ecosystems against a variety of potentially toxic pollutants. (Author's abstract)
W85-06431

ALGAL ASSAY EVALUATION OF TRACE CONTAMINANTS IN SURFACE WATER USING THE NONIONIC SURFACTANT, TRITON X-100,
Ontario Ministry of the Environment, Rexdale. Water Resources Branch.
S. L. Wong.
Aquatic Toxicology, Vol. 6, No. 2, p 115-131, March, 1985. 7 Fig, 2 Tab, 43 Ref.

Descriptors: *Algal growth, *Organic compounds, *Toxicity, *Triton X-100, Surfactants, Water quality control, Pollutant identification.

Triton X-100, a nonionic surfactant, has been found to be capable of neutralizing the toxic effect of selected organic compounds in algal assays using 10% Bristol's medium. This nonionic surfactant does not seem to affect specific growth rates of Chlorella cultures when it is added alone to the medium but it accelerates growth inhibition when coupled with metals. By administering a series of increasing Triton concentrations in assays with natural waters, Chlorella growth that was once arrested in the test waters became revitalized and growth was more profuse as the concentration of Triton increased. The results indicate that Triton has the ability to alleviate the toxic stresses of organic mixtures that are contaminating many southern Ontario lakes. The bioavailability of these trace organics such as PCB, DDT, chlordane and dieldrin was confirmed in the study lake waters from bioaccumulation in fish tissues. (Author's abstract)
W85-06438

USE OF FISH CELL CULTURES AS AN INDICATION OF CONTAMINANT TOXICITY TO FISH,
Waterloo Univ. (Ontario). Dept. of Biology.
N. C. Bols, S. A. Boliska, D. G. Dixon, P. V. Hodson, and K. L. E. Kaiser.
Aquatic Toxicology, Vol. 6, No. 2, p 147-155, March, 1985. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Toxicity, *Fish, *Organic compounds, *Phenols, Water quality control, Bioindicators.

The cytotoxicity of 12 chemicals to rainbow trout cells (RTG-2) was determined in culture. The indicator of cytotoxicity was the inability of cells to attach to a growth surface after chemical exposure. From most toxic to least toxic, these chemicals were pentachlorophenol, p-methylaminophenol, 2,4-dichlorophenol, p-chlorophenol, p-cyanophenol, p-nitrophenol, benzene, p-methylphenol, aniline, phenol, p-methoxyphenol, and 1,2,4-trichlorobenzene. The cytotoxicity of these compounds was found to be significantly correlated to their water-born toxicity to rainbow trout. (Author's abstract)
W85-06440

ION-SCANNING POTENTIOMETRY-A METHOD FOR DETERMINATION OF ZINC, CADMIUM, LEAD AND COPPER TRACES IN MARINE AND INTERSTITIAL WATER (ION-SKANIRUYUSHCHAYA POTENTSIOMETRIYA - METOD OPREDELENIYA MALYKH KOLICHESTV TSINKA, KADMIYA, SVINTSA I MEDI V MORSKOII ILOVOI VODE),
A. E. Kosov, and G. I. Sychkova.
Okeanologiya, Vol. 24, No. 1, p 88-94, January/February, 1984. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Metals, *Water analysis, *Interstitial water, *Seawater, Potentiometers, Zinc, Cadmium, Copper, Lead.

Use of an ion-scanning potentiometry method to study marine and interstitial water is demonstrated. The optimum conditions for the measurements are noted. The lower limit of detection for cadmium, lead and copper determinations are as low as 0.05 microg/l. The thickness of the mercuric film formed at the working electride surface on zinc and copper and its possible effect on the results of the determinations is studied, and simple methods are proposed to measure concentrations of these metals when they appear together in solution. (Author's abstract)
W85-06454

FORMS OF COPPER MIGRATION IN FRESH AND BRACKISH WATER BODIES (FORMY

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MIGRATSII MEDI V PRESNYKH I SOLONOVATOVODNYKH VODOEMAKH),
V. M. Timchenko, and P. V. Sipchenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 69-75, 1984. 2 Fig, 1 Tab, 21 Ref.

Descriptors: *Copper, *Water analysis, *Membrane filters, Chromatography, Chemoluminescence, Brackish water, Natural waters.

The kinetic chemoluminescent method and techniques of membrane filtration and gel chromatography have been employed to study the state of copper in fresh and brakish water bodies. Copper complexing was very high, 70-90% Cu(solv). The distribution of copper between its complexed compounds is featured by a rather great variety, with compounds having a molecular mass of 0.25-5 thou. being the most abundant among the complex forms. (Author's abstract)
W85-06463

UTILIZATION OF CRUSTACEA ZOOPLANKTON FOR ESTIMATING HEAVY METAL POLLUTION OF LAKE BALATON (ISPOL'ZOVANIE RACHKOVOGO ZOOPLANKTONA (CRUSTACEA) DLYA OTSENKI ZAGRYAZNENIYA OZ. BALATON TYAZHELYMI METALLAI),
K. V. Balogh, and J. Salanki.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 56-64, 1984. 11 Fig, 1 Tab, 19 Ref.

Descriptors: *Lake Balaton, *Heavy metals, *Bioindicators, *Zooplankton, Mercury, Cadmium, Lead, Copper, Iron, Manganese, Zinc, Crustaceans, Seasonal variation.

Lake Balaton was sampled at 15 sites for concentrations of various heavy metals (mercury, cadmium, lead, copper, iron, manganese and zinc) in Crustacea zooplankton. The north-western part of the lake is more polluted than other areas. Heavy metals are more likely to enter the lake in summer. (Author's abstract)
W85-06469

APPLICATION OF ANALYZER A PHI-1 TO QUANTITATIVE DETERMINATION OF BLUE-GREEN ALGAL TOXINS (ISPOL'ZOVANIE PRIBORA AF-1 DLYA KOLICHESTOVENNOGO OPREDELENIYA TOKSINOV SINEZELENYKH VODOROSLEI),
N. I. Kirpenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 81-83, 1984. 2 Fig.

Descriptors: *Enzymatic activity analyzer, *Toxins, *Cyanophyta, Water analysis, Water quality control, Eutrophication, Pollutant identification, Public health.

The enzymatic activity analyzer A Phi-1 is described for application in quantitative determination of toxins from blue-green algae. The procedure can be used by hydrobiological specialists, hygienists, and sanitary and epidemiologic stations for controlling water quality during blue-green algal blooms in bodies of water. (Author's abstract)
W85-06472

METHODOLOGICAL PRINCIPLES FOR ECOLOGICAL CLASSIFICATION OF SURFACE WATER QUALITY (O METODOLOGICHESKIKH OSNOVAKH EKOLOGICHESKOI KLASSIFIKATSII KACHESTVA POVERKHNOSTNYKH VOD SUSHI),
V. R. Lozansky.
Gidrobiologischeski Zhurnal, Vol. 20, No. 3, p 39-42, 1984. 13 Ref.

Descriptors: *Water quality, *Surface waters, Ecology, Water quality standards, Ecosystems.

The paper is open to discussion. A disagreement is expressed with the interpretation of the notion of 'water quality' and criteria for estimation of the surface water quality by V. N. Zhukinsky and O. P. Oksiyuk, the authors of ecological classification of the land surface water quality (see Gidrobiologischeski Zhurnal, No. 2, 1981; No. 2, 1983). It is affirmed that water quality criteria correctly formulated in ecological sense and ecological norms of water quality constructed on their basis must be used for preservation and formation of ecosystems useful for the society. Neglecting this, it is impossible to make a single complex ecosystem classification for estimating quality of the surface waters. (Author's abstract)
W85-06473

NECESSITY OF CREATION OF UNIVERSAL WATER QUALITY CLASSIFICATION (O NEOBKHODIMOSTI SOZDANIYA UNIVERSAL'NOI KLASSIFIKATSII KACHESTVA VOD),
A. V. Dyachkov.
Gidrobiologischeski Zhurnal, Vol. 20, No. 3, p 43-45, 1984. 9 Ref.

Descriptors: *Water quality standards, Water resources development, Surface waters, Ecosystems.

Any national-economic utilization of water resources should provide either conservation or restoration of biological value of water bodies. A system of standards directed to the priority of hydrobiological classification of all the waters promotes this cause. (Author's abstract)
W85-06474

TECHNIQUE FOR PHOSPHORORGANIC INSECTICIDE DETECTION IN WATER AND HYDROBIONTS (METOD OBNARUZHENIYA FOSFORORGANICHESKIKH INSEKTITSIDOV V VODE I GIDROBIONTAKH),
V. V. Metelev.
Gidrobiologischeski Zhurnal, Vol. 20, No. 6, p 77-80, 1984. 3 Ref.

Descriptors: *Insecticides, *Organophosphorus compounds, *Aquatic animals, Enzyme methods, Pollutant identification, Water analysis.

A simple high-sensitive method is developed for detecting organophosphoric compounds in water and in aquatic animals. The method is based on the enzymic paper determination with the preliminary activation of phionic phosphates in hydrogen peroxide vapors and on development by an enzymic developer. (Author's abstract)
W85-06485

SURROGATE PARAMETERS FOR MONITORING ORGANIC MATTER AND THM PRECURSORS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W85-06491

ORGANIC HALOGEN MEASUREMENTS: CURRENT USES AND FUTURE PROSPECTS,
Environmental Protection Agency, Cincinnati, OH.
A. A. Stevens, R. C. Dressman, R. K. Sorrell, and H. J. Brass.
Journal of the American Water Works Association, Vol. 77, No. 4, p 146-154, April, 1985. 3 Fig, 8 Tab, 39 Refs.

Descriptors: *Water analysis, *Halogenated hydrocarbons, *Water quality control, *Drinking water, Water treatment, Wastewater treatment, Disinfection, Pollutant identification.

Currently, the most popular method of analyzing total organic halide in water involves carbon adsorption, oxidative combustion, and measurement of the hydrogen halide by microcoulometry. Total organic halide (TOX) can be used as an indicator of water quality, providing a direct measure of disinfection by-product formation and, in some circumstances, a surrogate measure of individual organic pollutants. An important application of organic halide (OX) measurements is in unit process design, control, and monitoring. Measurements of OX in wastewater primarily discern compounds of industrial origin, whereas analysis of OX in finished drinking water primarily discern disinfection by-products. Trihalomethanes and nonpurgeable organic halide (NPOX) data generated under carefully controlled treatment conditions can lead to a plant design that minimizes the formation of halogenated disinfection by-products in the treated water. In spite of several shortcomings, the TOX method has a unique advantage in that it can verify the absence of OX contamination without the need to resort to a variety of specific methods to eliminate all the possibilities. Costs can be saved by using a single method to monitor a situation in which two or more methods might otherwise be required. (Baker-IVI)
W85-06494

EFFECT OF ENVIRONMENTAL PARAMETERS ON LYSOSOMAL MARKER ENZYMES IN THE TROPICAL BLOOD CLAM ANADARA GRANOSA,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
For primary bibliographic entry see Field 5C.
W85-06522

CRYPTOGAMS OF FLOWING WATERS - BIOINDICATORS OF WATER QUALITY (FLIESSGEWASSERKRYPTOGAMEN - BIOINDIKATOREN DER WASSERQUALITAT),
Martin-Luther-Univ. Halle-Wittenberg, Halle (German D.R.).
U. V. Kock.
Wissenschaftliche Zeitschrift, Vol. 34, No. 1, p 95-104, 1985. 1 Fig, 1 Tab, 77 Ref.

Descriptors: *Aquatic plants, *Bioindicators, *Cryptogams, *Water quality, Algae, Mosses, Lichens, Streams, Ecological distribution.

The paper deals with investigations for using aquatic cryptogams as bioindicators of water quality. This is necessary especially for such rills and small rivers in which only a few species of higher water plants in small quantities can occur because of the special abiotic factors. The investigations were carried out on two softwater rills flowing to the Saidenbach-water reservoir (Ore mountains; Karl-Marx-Stadt district; Germany Democratic Republic). This organism group (green and red algae, mosses, lichens) can be used for ranking such waters in so-called 'floristic-ecological zones' of distinct water quality. (Author's abstract)
W85-06525

RECOVERY AND REPRODUCIBILITY IN DETERMINATION OF VOLATILE HALOCARBONS IN WATER AND BLOOD,
Turku Univ. (Finland). Dept. of Public Health.
R. Kroneld.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 4, p 486-496, April, 1985. 6 Tab, 9 Ref.

Descriptors: *Chemical analysis, *Blood, *Water analysis, *Halogenated hydrocarbons, *Volatile compounds, Pollutant identification, Organic compounds.

The recovery or extraction efficiency of volatile halocarbons from water and both plasma and blood cells was analyzed. The recovery in water is described as a function of amount of n-pentane used as an extraction solvent. There was a highly significant increase in the eluation process to 5 and 10 ml, but the increase was not significant from 5 to 10 ml. Evidently a water:pentane ratio lower than 20 means a dilution of the extract. The recovery as a function of extraction time in water was also analyzed. There was a significant increase in the eluation process to 5 and 10 minutes. Continued extraction or shaking of the test tubes for more than 5 minutes did not evidently increase the recovery in a significant way. The recovery as a function of extractions from plasma and cells was also analyzed. There was a significant increase in eluation to an extraction number of 80, 100, and 150, both in plasma and cells. Turning the test tube until the phase had been passed through the tube did not significantly increase the recovery. (Baker-IVI)

W85-06526

SIMULTANEOUS DETERMINATION OF ARSENIC, SELENIUM, TIN AND MERCURY BY NON-DISPERSIVE ATOMIC FLUORESCENCE SPECTROMETRY,
Consiglio Nazionale delle Richerche, Pisa (Italy). Ist. di Chimica Analitica Strumentale.
A. D'Ulivo, R. Fuoco, and P. Papoff.
Talanta, Vol. 32, No. 2, p 103-109, February, 1985. 6 Fig, 5 Tab, 28 Ref.

Descriptors: *Arsenic, *Tin, *Mercury, *Selenium, *Atomic fluorescence spectrometry, Chemical analysis, Heavy metals, Pollutant identification, Spectrometry.

A non-dispersive atomic-fluorescence spectrometry procedure is described for simultaneous determination of arsenic, selenium, tin and mercury in aqueous solution. Radiofrequency-excited electrodeless discharge lamps 100% modulated in the kHz region, were used for atom excitation. Sodium tetrahydroborate was used as reductant and a hydrogen-argon miniflame as atomizer. Sample volumes from 0.2 to 5 ml can be used. The lowest detection limit is obtained with 5 ml of sample for selenium and arsenic and either 1 or 5 ml of sample for mercury and tin. Except for determination of selenium and arsenic at concentrations near the detection limit, 1 ml of sample is to be preferred because the interferences are then minimal. The relative standard deviation is then less than 7% for each of the four analytes within their dynamic ranges and down to 1 ng/ml, regardless of the presence of high concentrations of the other three analytes. The linear dynamic ranges cover more than three orders of magnitude for all four analytes. (Baker-IVI)
W85-06570

SPECTROPHOTOMETRIC DETERMINATION OF NITRATE AND NITRITE IN NATURAL WATER AND SEA-WATER,
Loyola Univ. of Chicago, IL. Dept. of Chemistry.
S. J. Bajic, and B. Jaselskis.
Talanta, Vol. 32, No. 2, p 115-118, February, 1985. 1 Fig, 2 Tab, 33 Ref.

Descriptors: *Nitrates, *Nitrites, *Spectrophotometry, Water analysis, Sea water, Natural water, Pollutant identification.

Nitrate and nitrite in natural waters are determined spectrophotometrically by passage through an amalgamated zinc reductor at pH 3.4 into iron(III)-Ferrozine solution. Interference by high levels of nitrite is eliminated by treatment with azide. The method is based on hydroxylamine (resulting from initial reduction of nitrate or nitrite) reducing iron(III)to give the intensely colored iron(II)-Ferrozine complex, the absorbance of which is proportional to the original amount of nitrate (or nitrite). The pH must be kept between 3.2 and 3.5, and sodium chloride should be added to provide a higher ionic strength and give more reproducible results. This method is particularly suitable for the determination of nitrate in the presence of large amounts of nitrite and of chloride, at levels as low as 0.1 ppm with a relative precision of better than 3%. Synthetic sea water samples used in this study yielded consistently high blank values, which were primarily due to the nitrate impurities in the reagent grade sodium and potassium chlorides used for preparing the samples. (Baker-IVI)
W85-06571

EFFECT OF ORGANIC COLLOIDS ON ASV SIGNALS OF CD, PB AND CU,
Newcastle Univ. (Australia). Dept. of Chemistry.
T. Ugapo, and W. F. Pickering.
Talanta, Vol. 32, No. 2, p 131-138, February, 1985. 4 Fig, 2 Tab, 40 Ref.

Descriptors: *Cadmium, *Lead, *Copper, *Anodic-stripping voltammetry, *Colloids, *Water analysis, Organic compounds, Humic acids, Fulvic acids, Chemical analysis, Pollutant identification.

The effect of both humic and fulvic acids on the anodic-stripping voltammetry (ASV) signals of Cd, Pb and Cu has been reexamined in an attempt to provide additional basic information. The presence of organic acids caused the magnitude of the signal peaks to decrease, owing to their ability to adsorb metal ions, or form complexes. This effect was seen to increase with increasing organic acid: metal ion ratios and pH from 5 to 8. Most of the Cd retained was labile. In the Pb and Cu system less than half of the sorbed metal ion was labile, though a further fraction was displaced in the presence of Chelex 100 resin. The molarity of the medium and the presence of diverse anions in the system both affected the magnitude of the interference. (Baker-IVI)
W85-06572

VIRUSES AND DRINKING WATER,
Thames Water Authority (England). Northern Div.
For primary bibliographic entry see Field 5F.
W85-06577

DETERMINATION OF FENTHION RESIDUES IN SAMPLES OF MARINE BIOTA AND SEA-WATER FROM LABORATORY EXPOSURES AND FIELD APPLICATIONS,
Environmental Research Lab., Gulf Breeze, FL.
E. M. Lores, J. C. Moore, J. Knight, J. Forrester, and J. Clark.
Journal of Chromatographic Science, Vol. 23, No. 3, p 124-127, March, 1985. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Fenthion, *Insecticides, *Seawater, *Marine life, Pesticide residues, Pollutant identification, Water analysis, Organic compounds, Chemical analysis.

Fenthion, an organophosphate insecticide used extensively in the state of Florida, was selected for a field study to examine the applicability of laboratory toxicity data in predicting environmental effects of a pesticide under actual-use conditions. A method for measuring fenthion in samples from the estuarine environment is described. The method was applied to samples from the field applications of fenthion to control salt-marsh mosquitos. The method described is sensitive and efficient for extraction and cleanup of fenthion residues in seawater, marine biota, and sediments. The detection limits for fenthion in seawater and biota are 0.010 microg/liter and 0.010 microg/g, respectively. The cleanup method has been successfully tested on a variety of substrates. It required relatively little time, eliminated co-extractives, and provided adequate sensitivity. Average recovery from tissue is 95%, much better than with previous methods. (Baker-IVI)
W85-06581

TASTES AND ODORS: THE FLAVOR PROFILE METHOD,
Southern California Metropolitan Water District, La Verne.
For primary bibliographic entry see Field 5F.
W85-06582

RECOVERY OF HEXACHLOROCYCLOHEXANE ISOMERS IN FORTIFIED WATER SAMPLES,
Environmental Health Directorate, Ottawa (Ontario).
M. Malaiyandi, E. Junkins, P. L. Bowron, and M. Bowron.
Journal of Environmental Sciences and Health, Vol. A20, No. 2, p 219-237, February, 1985. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Hexachlorocyclohexane, *Chemical analysis, *Isomers, Pesticides, Pollutant identification, Water analysis, Chlorinated hydrocarbons, Statistical analysis.

Recovery studies using water samples fortified with 30-350 ng/L of alpha-, beta-, gamma-, and delta-hexachlorocyclohexane (HCH) isomers using the Kuderna-Danish evaporators and modified Synder column were carried out. These studies consisted of extraction, concentration and analysis by two operators on five different mixed concentrations of the four isomers with five replicates on three different days. The mean % recoveries (+/- standard deviation) of 98.02 +/- 7.27 for the alpha-, 96.61 +/- 4.88 for the beta-, 96.59 +/- 5.72 for the gamma- and 73.89 +/- 11.20 for the delta-isomers were observed. The analysis of variance between concentrations for operator 1 shows that the F ratio is significant for the isomers alpha-, gamma- ($p < 0.05$). However, in the case of operator 2, there were significant differences between concentrations only in the case of the alpha-isomer. It has also been shown that there were significant differences in operator variability for the alpha-, gamma-, and delta-isomers and that operator 2 with minimum experience could obtain consistent recoveries with beta-, gamma- and delta-HCH isomers with greater than 95% confidence. Further, a method has been described for purifying recovered hexane solvent. (Author's abstract)
W85-06601

SOME PROBLEMS IN THE APPLICATION OF THE MPN METHOD FOR THE QUANTITATIVE DETERMINATION OF SALMONELLA (EINIGE PROBLEME BEI DER ANWENDUNG DES MPN-VERFAHRENS ZUR QUANTITATIVEN SALMONELLENBESTIMMUNG),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
M. Nagel, W. Stelzer, and E. Schulze.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 23-35, 1983. 8 Fig, 3 Tab, 9 Ref.

Descriptors: *Most probable number test, *Salmonella, Bacterial analysis, Pathogenic bacteria, Water analysis, Poisson ratio.

So far, the MPN technique has been the method chosen for detecting pathogenic bacteria in waters, since it allows the use of larger volumes. In the evaluation, however, comparatively frequently (10-15%) nontypical codes occur. The validity of the Poisson model is confirmed for pure cultures by extensive laboratory experiments with pure cultures and controlled mixed cultures. In mixed cultures, however, a comparatively large number of atypical codes occur, since obviously a single organism is not sufficient for the formation of a growth-cover on the test tube, so that the true number of organisms may be considerably underestimated. Obviously, the accompanying flora has an inhibiting effect on the salmonella detection. (Author's abstract)
W85-06650

AUTOMATIC DETERMINATION OF CARBON DIOXIDE AND CARBONATE IN WATER ACCORDING TO THE FLOW-STREAM PRINCIPLE (AUTOMATISCHE BESTIMMUNG VON KOHLENDIOXID UND CARBONAT IN WASSER NACH DEM FLOW-STREAM-PRINZIP),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
G. Proft.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 2, p 235-239, 1983. 1 Fig, 4 Ref.

Descriptors: *Carbon dioxide, *Carbonate, *Water analysis, *Flow-stream principle, Ultrared technology, Extraction, Chemical analysis.

A method is presented for determining carbon dioxide and carbonate in water using ultrared (UR) technology and automatic flow-system analysis. Water samples are placed in receptacles in a storage tank, whence a hose pump drives them via samplers to a gas extractor, where acid can be continuously fed into them. Pressurized air is fed by means of a peristaltic pump through two gas-washing bottles with potash lye in order to absorb carbon dioxide. This almost carbon-dioxide-free mixture is used to blow the carbon-dioxide content of the sample in the gas extractor out into the UR analyzer, where its concentration is determined and registered on a graphic recorder. Reproducibility is strongly dependent on gas-flow constancy, while the correctness of data depends highly on preparation of calibration values. The calibration solution is 208.4 mg KHC03 in 250 ml H20

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(C02 free); 1 ml approximately equals 100 micro g C. Both this solution and distilled water required for dilution take up carbon dioxide from the air, so that calibration curves are too high and analysis values too low; fresh calibration solution with carbon-dioxide-free distilled water should be used for each new calibration. For total-carbonate (DIC) analysis, sample receptacles are rinsed with test water and filled with as little turbulence as possible. The high frequency of automatic analysis makes it possible to make multiple determinations from each sample and to obtain a calibration value for each block of samples. Since samples may not be filtered (to avoid carbon-dioxide loss), the determination includes all inorganically dissolved and bound carbonate compounds. For free-carbon-dioxide (FC) analysis, the procedure is similar, but after calibration, the gas extractor is rinsed without acid before sample analysis. Only carbon dioxide that can be blown out by air is measured. The procedure leads to a continuous cycle of shifting of carbonate balance and release of carbon dioxide. (Gish-IVI)
W85-06665

EFFECT OF SOME COAL GASIFICATION AND TAR SAND PROCESS WATERS ON THE VIABILITY OF INDICATOR BACTERIA OF FECAL CONTAMINATION,
Wyoming Univ., Laramie. Div. of Microbiology and Veterinary Medicine.
For primary bibliographic entry see Field 5C.
W85-06725

MODIFICATIONS TO ELECTROLYTIC RESPIROMETER SYSTEMS FOR PRECISE DETERMINATION OF BOD EXERTION KINETICS IN RECEIVING WATERS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 7B.
W85-06734

VALIDATION OF AN AUTOMATED FLUORESCEIN METHOD FOR DETERMINING BROMIDE IN WATER,
Geological Survey, Denver, CO.
M. J. Fishman, L. J. Schroder, L. C. Friedman, C. E. Arozarena, and A. G. Hedley.
Water Research, Vol. 19, No. 4, p 497-501, 1985. 2 Tab, 8 Ref.

Descriptors: *Bromide, *Water analysis, *Ion chromatography, Water quality control, Fluorescein, Chemistry of precipitation, Surface water, Automation.

Surface, atmospheric precipitation and deionized water samples were spiked with micro-g/l concentrations of bromide, and the solutions stored in polyethylene and polytetrafluoroethylene bottles. Bromide was determined periodically for 30 days. Results obtained from the automated fluorescein method are equivalent to results obtained by ion chromatography for the matrices investigated. The estimated variance for the fluorescein method is nearly 70% less than the estimated variance for the ion chromatography method. The fluorescein method is more rapid than the ion chromatography method. In laboratories where a large number of samples are processed, the fluorescein method would be the method of choice. No loss of bromide ion occurred with time in natural water samples stored in polyethylene of PTFE bottles. (Baker-IVI)
W85-06737

SIMULTANEOUS MULTIELEMENT DETERMINATION OF TRACE METALS IN LAKE WATERS BY ICP EMISSION SPECTROMETRY WITH PRECONCENTRATION AND THEIR BACKGROUND LEVELS IN JAPAN,
National Inst. for Environmental Studies, Tsukuba (Japan).
Y. Nojiri, T. Kawai, A. Otsuki, and K. Fuwa.
Water Research, Vol. 19, No. 4, p 503-509, 1985. 1 Fig, 5 Tab, 22 Ref.

Descriptors: *Trace metals, *Lakes, *Spectrometry, *Water analysis, Aluminum, Titanium, Vanadium, Manganese, Iron, Cobalt, Nickle, Copper, Zinc, Cadmium, Lead.

A method combining a preconcentration and determination with inductively coupled plasma emission spectrometry (ICPES) was modified to become suitable for the analysis of trace levels of metals in lake water samples. Preconcentration with evaporation before the separation procedure facilitated obtaining a high concentration factor. Column preparation is not necessary with the use of Sep-Pak C18 disposable plastic column. The adsorption pH is slightly lowered when a high removal rate of magnesium and calcium to avoid severe background shift in ICPES is required. Simultaneous multielement preconcentration and analysis of eleven elements was possible for the lake water sample of the Japanese background level area. This new procedure has the following advantages: few sample manipulations, low analytical blanks and simultaneous multielement preconcentration ability at a single set of treatment conditions. (Baker-IVI)
W85-06738

USE OF THE BIVALVE MYTILUS EDULIS AS A TEST ORGANISM FOR BIOCONCENTRATION STUDIES. 1. DESIGNING A CONTINUOUS-FLOW SYSTEM AND ITS APPLICATION TO SOME ORGANOCHLORINE COMPOUNDS,
National Swedish Environment Protection Board, Stockholm. Special Analytical Lab.
For primary bibliographic entry see Field 5C.
W85-06743

ANIONS IN WATER OF ENERGY GENERATING PLANTS. IMPORTANCE AND ANALYSIS (REVIEW) (ANIONEN IN WASSERN VON ENERGIEERZEUGUNGSANLAGEN - BEDEUTUNG UND ANALYSE (UBERSICHTSBERICHT)),
Vereinigte Elektrizitaetswerke Westfalen A.G., Dortmund (Germany, F.R.).
G. Resch.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 463-469, March, 1985. 14 Fig, 3 Tab, 20 Ref.

Descriptors: *Anions, *Cooling water, *Process water, *Power plants, Clorides, Sulfates, Corrosion, Scaling.

Metallic structural materials are in interaction with the water used in the generation of electricity, steam and remote heat as well as the dissipation of industrial process heat by cooling systems. Durability, availability and efficiency of such operational plants decisively depend on water preparation and treatment for limiting deposits of dissolved materials and corrosion. Analyses of the water that comply with the technical requirements has come to be an indispensable component of all strategies to prevent damage. Anion analysis has a special importance in that regard, as some anions (e.g. chloride and sulfate) promote the corrosion and others lead to sparingly soluble deposits if certain cations are present. (Author's abstract)
W85-06754

ION-CHROMATOGRAPHIC DETERMINATION OF THE ANIONS CL-, NO3- AND SO42- IN RAIN WATER (IONEN-CHROMATOGRAPHISCHE BESTIMMUNG DER ANIONEN CL-, NO3- UND SO42- IN REGENWASSER),
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
F. Wagner, P. Valenta, and H. W. Nurnberg.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 470-476, March, 1985. 10 Fig, 2 Tab, 31 Ref.

Descriptors: *Ion chromatography, *Anions, *Chemical analysis, *Chlorides, *Rain, *Nitrates, *Sulfates, Acid rain, Hydrogen ion concentration, Acids, Chromatography, Sample preservation, Sampling, Water sampling.

Wet deposition of acid onto the vegetation blanket and the surface of fresh waters is of increasing importance for the estimation of environmental damages. Ion-chromatography has been evaluated as a suitable tool for the determination of the most important anions present in rain water. These anions are partly present as anionic components of the totally dissociated strong acids, H2SO4, HNO3, and HCl, responsible for the acidity of the rain. The advantages of the method are sufficient sensitivity, automation, the possibility of a direct simultaneous determination of the three anions and small sample volume. The most frequent sources of error can occur in the sampling step, during sample storage and due to insufficient cleaning of the sampling bottles and the components of the rain water sampler. As a practical application of ion-chromatography the concentrations of the three most important anions were determined in rain water samples taken in 1983. Sampling was performed at four sampling sites of the Stolberg-Juelich region: Juelich-Hambach, Stolberg-Werth, Stolberg-Gressenich or Stolberg-Muensterbusch und Stolberg-Binsfeldhammer. The anion concentrations varied in the ranges 0.2-7 mg/l Cl(-), 0.5-10 mg/l NO3(-) and 2-20 mg/l SO4(-2) and had a standard deviation up to 15%. (Author's abstract)
W85-06755

DETERMINATION OF CL-, NO3- AND SO42- IN PORE WATERS OF SEDIMENTS,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofftechnologie und Chemie.
For primary bibliographic entry see Field 2K.
W85-06756

ANION CHROMATOGRAPHY OF HYDROGEN CARBONATE, CHLORIDE AND SULPHATE IN MINERAL WATERS WITH COMPARISONS OF METHODS (ANIONEN-CHROMATOGRAPHIE VON HYDROGENCARBONAT, CHLORID UND SULFAT IN MINERALWASSERN MIT METHODENVERGLEICHEN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Lebensmittelchemie.
A. Schweizer, and G. Schwedt.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 480-484, March, 1985. 6 Fig, 4 Tab, 4 Ref.

Descriptors: *Hydrogen carbonate, *Chlorides, *Sulfates, *Ion chromatography, *Chemical analysis, *Mineral water, Chromatography, Carbon dioxide, Anion exchangers, Calcium, Hardness.

An ion-chromatographic HPLC analytical system was utilized for quantitative analysis of hydrogen carbonate, chloride and sulfate in mineral waters. Separation is performed within 8 min on the HPLC anion-exchanger Nucleosil 10-Anion with an aqueous solution of 0.01 mol/l potassium hydrogen phthalate at pH 7.0 as mobile phase. An RI-detector is used for quantitative analysis. The relation of the peak area to the anion concentration was investigated up to 4000 mg/l for hydrogen carbonate, to 4200 mg/l for chloride and to 1500 mg/l for sulfate, respectively, and linearity was proved in these regions. The free carbon dioxide is removed by degassing, and interfering calcium ions are previously precipitated as oxalate. Comparison with reference methods for the determination of single anions shows in each case corresponding results with deviation of less than 5% in most cases. (Author's abstract)
W85-06757

DETERMINATION OF NITRATE IN WATERS BY MEANS OF CHROMOTROPIC ACID (BESTIMMUNG VON NITRAT IN GEWASSERN MIT HILFE VON CHROMOTROPSAURE),
Gesamthochschule Wuppertal (Germany, F.R.). Fachbereich 9 - Analytische Chemie.
P. Bachhausen, N. Buchholz, and H. Hartkamp.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 490-493, March, 1985. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Nitrates, *Water analysis, *Spectrophotometry, Nitrites, Chloride, Iron, Interference.

The growing contamination of natural waters with nitrate requires constant monitoring of nitrate levels. A spectrophotometric method is described for the determination of nitrate in waters with the aid of chromotropic acid. The method differs from the procedures reported so far in the large work-range, the small sample required, the high long-term stability of the reagent solution and in the small amount of work. The interferences from nitrite, chloride and iron(III) in the chromotropic acid method were investigated. Chloride concentrations up to 200 mg/l and nitrite concentrations up to 10 mg/l did not substantially interfere with this method. Iron(III) concentrations up to 10 mg/l did not interfere with nitrate measurement. (Moore-IVI)
W85-06758

SIMULTANEOUS DETERMINATION OF CL-, BR- AND I- IN WATER SAMPLES BY ISOTOPE DILUTION MASS SPECTROMETRY (GLEICHZEITIGE BESTIMMUNG VON CL-, BR- UND I- IN WASSERN DURCH MASSENSPEKTROMETRISCHE ISOTOPENVERDUNNUNGSANALYSE),
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
K. G. Heumann, and H. Seewald.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 493-497, March, 1985. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Chemical analysis, *Chlorides, *Bromides, *Iodides, *Isotope dilution mass spectrometry, *Mass spectrometry, Spectrometry, Ion chromatography, Chlorine, Bromine, Iodine, Halogens.

An analytical procedure was developed which allows the trace determination of Cl(-), Br(-) and I(-) in different water samples by isotope dilution mass spectrometry within a single reprocessing of the sample. This definitive method has the advantage that the analytical results are relatively accurate and is thus especially suitable as a calibration method. The method was utilized for analysis of water samples from a drinking water reservoir, different springs, river and a mineral water. The relative standard deviation for the chloride determination in the lower ppm-range is 0.2-1.6%, for the bromide and iodide analysis in the lower ppb-range it is 0.5-5%. The detection limits of this method - which could be improved by a more precise isotope ratio measurement - are 13 ppb for Cl(-), 0.4 ppb for Br(-) and 0.1 ppb for I(-). An analytical comparison for the chloride determination showed good agreement between the mass spectrometric method and ion chromatography. An analysis procedure was presented which allows the determination of the inorganic iodine species iodide and iodate in water samples by isotope dilution mass spectrometry. (Author's abstract)
W85-06759

DETERMINATION OF TRACE ELEMENTS IN RIVER WATER BY MEANS OF VOLTAMMETRY (BESTIMMUNG VON SPURENELEMENTEN IN FLUSSWASSER MIT HILFE DER VOLTAMMETRIE),
Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Maschinenbau.
M. Weidenauer, and K. H. Lieser.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 550-555, March, 1985. 2 Fig, 6 Tab, 22 Ref.

Descriptors: *Trace elements, *Chemical analysis, *River water, *Voltammetry, *Detection limits, Zinc, Cadmium, Lead, Copper, Nickel, Cobalt, Thallium, Manganese, Bismuth, Selenium, Ultraviolet radiation, Chemical reactions, Metals, Trace metals.

The determination of trace elements in river water by voltammetry is disturbed by the presence of organic substances. The influence of these substances can be eliminated by oxidative UV-photolysis. After UV irradiation the following elements were determined in Rhine water by voltammetry: Zn, Cd, Pb, Cu, Ni, Co, Tl and, with reservations, Mn. The concentrations of Bi and Se were below the detection limits. The detection limits in river water for the elements mentioned were determined and found to be between 0.1 and 1 micro-g/l. Comparative determinations by AAS (graphite tube) showed good agreement for Cu, Zn and Mn, whereas the concentrations of the other elements were below the detection limits of AAS. The complexing capacity of Rhine water for Zn, Cd, Pb and Cu was determined by voltammetric titration. It decreased in the order Cu > Zn > Pb > Cd and was between 5.0 and 0.7 micro-g/l. (Author's abstract)
W85-06760

DETERMINATION OF DISSOLVED HEXAVALENT CHROMIUM IN RIVER WATER, SEA WATER AND WASTE WATER,
Rijks-Kwaliteitsinstituut voor Land-en Tuinbouwprodukten, Wageningen (Netherlands).
G. Vos.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 556-561, March, 1985. 3 Fig, 4 Tab, 14 Ref.

Descriptors: *Chromium, *Wastewater analysis, *Seawater, *Water analysis, Coprecipitation, Atomic absorption spectrometry, Pollutant identification, Sulfates, Chlorides.

A lead sulfate coprecipitation procedure was developed for determination of chromium (VI) in water. The procedure was modified from the Martin and Riley procedure, and had an appreciably lower limit of detection. Chromium (VI) was quantitatively coprecipitated with lead sulfate from weakly acidic (pH 3.5) sample solutions. Determination was made by graphite furnace atomic absorption spectroscopy at 357.9 nanometer. In a series of 226 determinations with samples of laboratory mixtures, waste water effluents, river waters, and sea water, the detection limit was 0.3 microgram/liter at a 95% confidence level. Relatively high concentrations of chromium (III) did not interfere with the determination of hexavalent chromium, but high chloride (> 6 g/l) or sulfate (> 800 mg/l) resulted in a significant reduction in chromium (VI) recoveries. The sulfate interference was reduced, but not eliminated, in the presence of high chloride concentrations, whereas chloride interferences were eliminated by the presence of sufficient sulfate in the original sample. Chromium (VI) was recovered quantitatively from water and effluents, but recovery from seawater was incomplete (83%) as a result of sulfate interference during coprecipitation. Effects of centrifuging speed, the procedure for withdrawing of supernatant, and changes of chromium content and speciation during storage are discussed. (Rochester-IVI)
W85-06761

SIMULTANEOUS GLC DETERMINATION OF FENITROTHION, AMINOCARB AND THEIR CORRESPONDING HYDROLYSIS PRODUCTS IN WATER,
Moncton Univ. (New Brunswick). Dept. of Chemistry.
A. Cassista, and V. N. Mallet.
Chromatographia, Vol. 18, No. 6, p 305-308, June, 1984. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Gas-liquid chromatography, *Fenitrothion, *Aminocarb, Hydrolysis, Phenols, Insecticides, Thermionic detectors, Pesticide residues.

A Tracor Model 560 gas-liquid chromatograph (GLC) equipped with a thermionic nitrogen-phosphorous detector was used for simultaneous detection of fenitrothion, aminocarb, and their hydrolysis products (3-methyl-4-nitrophenol and 4-dimethylamino-3-methylphenol, respectively) in natural water. In a series of three experiments in which environmental water was spiked with known amounts of fenitrothion, aminocarb, and their corresponding phenols in the same sample, aminocarb and fenitrothion were recovered at 97% and 99%, respectively, and the corresponding phenols were recovered at 100%. Chromatograms exhibited some interfering peaks, and resolution was not ideal, but detection and quantitation of aminocarb and the two phenols at 0.1 ppb was possible, and the limit of detection of fenitrothion was at least 0.01 ppb. Comparison of the present method with high performance liquid chromotography showed very good agreement for detection of the two insecticides and their phenols in environmental water as part of a monitoring program. (Rochester-IVI)
W85-06762

DETERMINATION OF CHLOROPHENOLS IN WASTE WATER USING C18 REVERSE-PHASE ENRICHMENT PRIOR TO HIGH RESOLUTION GASCHROMATOGRAPHY - MASS SPECTROMETRY,
State Chemical Supervision Service, Soeborg (Denmark).
P. G. Nielsen.
Chromatographia, Vol. 18, No. 6, p 323-325, June, 1984. 1 Fig, 5 Tab, 7 Ref.

Descriptors: *Chlorophenols, *Wastewater analysis, *Gas chromatography, *Mass spectrometry, Chlorocresols, Herbicides, Halogenated hydrocarbons, Phenoxy compounds, Industrial wastes.

Reverse-phase enrichment employing Sep-pak C18 cartridges, followed by gas chromatography using fused-silica capillary columns in combination with mass spectrometry was tested and subsequently employed in studies of municipal waste water samples containing chlorophenols and chlorocresols. The effects of the presence of a mixture of substances on the results were assessed by recovery studies involving eight chlorophenols at levels of 5-20 ppb added to pure water, water samples containing phenoxy herbicides MCPA, dichloroprop, and mecoprop at levels of 400 ppb, and waste water samples from a municipal purifying plant receiving phenoxy herbicides and chlorophenols from a chemical plant. With a 100 ml sample, monochlorinated phenols were recovered at 30-50%; higher substituted phenols were recovered at near quantitative yield. For higher halogenated phenols recovery was quantitative even with a 1,000 ml sample. Phenol itself was recovered at only 5-8% from a 100 ml sample. Twenty-five waste water samples were obtained regularly from a municipal treatment plant and analyzed. The identity of phenols was unambigous from the ion chromatogram and retention time. The peak shape of underivatized phenols was extremely sensitive to the presence of heavy contamination with high molecular mass substances, which resulted in rapid decrease in column efficiency. With capillary columns with crosslinked stationary phases, performance could be restored easily by washing the stationary film with organic solvent. (Rochester-IVI)
W85-06763

SEPARATION OF MOLYBDOHETEROPOLY ACIDS OF PHOSPHORUS, ARSENIC, SILICON AND GERMANIUM AS ION-ASSOCIATES BY HPLC. APPLICATION TO QUANTITATIVE DETERMINATION IN WATER,
Tieraerztliche Hochschule Hannover (Germany, F.R.). Chemisches Inst.
M. Braungart, and H. Russel.
Chromatographia, Vol. 19, p 185-187, 1984. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *High-performance liquid chromatography, *Phosphorus, *Arsenic, *Silicon, *Germanium, Water analysis, Chromatography, Molybdoheteropoly acids.

A high-performance liquid chromatography (HPLC) method was perfected for detection of phosphorus, arsenic, silicon, and germanium as molybdoheteropoly acids (HPAs) stabilized by amine. A Knauer Model 87.00 UV-detector (310 nanometer) was employed; best retention and separation were obtained with NUCLEOSIL CN as the stationary phase. In a 20 microliter sample containing 200 ng each of HPA ion associates, As-HPA associate, P-HPA associate, alpha-Si-HPA associates, Ge-HPA associate, isopoly compound, and beta-Si-HPA were clearly separated. Dissolved inorganic phosphorus in water could be determined in the presence of silica at levels limited only by the level of laboratory contamination. HPLC of molybdoheteropoly compounds allows study of the structure and constitution of HPAs, especially inversion rates and mechanisms. The technique is useful for

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multielement determinations of P, As, Si, and Ge in natural waters, and it provides information on speciation of the various compounds. (Rochester-IVI)
W85-06764

TOXINS FROM FRESHWATER CYANOBACTERIA,
Wright State Univ., Dayton, OH. Dept. of Biological Sciences.
W. W. Carmichael, and K. A. Mahmood.
ACS Symposium Series, Vol. 262, p 377-389, 1984. 5 Fig, 1 Tab, 39 Ref.

Descriptors: *Toxins, *Cyanophyta, Cyanobacteria, Eutrophication, Water pollution, Anatoxins, Alkaloids, Peptides, Aphantoxins.

Toxins are produced by several planktonic bloom forming genera of freshwater cyanobacteria. The main genera responsible for freshwater toxic blooms are Microcystic, Anabaena, Apanixomenon and Oscillatoria. Cyanobacterial toxins (both marine and freshwater) are functionally and chemically a diverse group of secondary chemicals. Toxins include: anatoxins, alkaloids and peptides; the peptide microcystin and related peptides; aphantoxins, compounds with properties similar to some paralytic shellfish poisons (PSP). Of particular importance is the production of toxins which appear to be identical with saxitoxin and neosaxitoxin. Since they are the primary toxins involved in cases of PSP, these aphantoxins could be a source of PSP standards. The study of their production by Aphanizomenon can provide information on the biosynthesis of PSP's. The cyanobacteria toxins have not received extensive attention since they have fewer vectors by which they come in contact with humans. As freshwater supplies become more eutrophicated and as cyanobacteria are increasingly used as a source of single cell protein, toxic cyanobacteria will have increased importance. The study of these cyanobacterial toxins can contribute to a better understanding of seafood poisons. (Baker-IVI)
W85-06779

DISTRIBUTION OF OLIGOCHAETES IN LAKE MICHIGAN AND COMMENTS ON THEIR USE AS INDICES OF POLLUTION,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
D. D. Lauritsen, S. C. Mozley, and D. S. White.
Journal of Great Lakes Research, Vol. 11, No. 1, p 67-76, 1985. 7 Fig, 2 Tab, 33 Ref. EPA grant R-805333010.

Descriptors: *Lake Michigan, *Great Lakes, *Oligochaetes, *Tubificids, *Sediments, *Bioindicators, Annelids, Benthos, Infauna, Eutrophication, Organic matter, Water pollution effects.

Benthic samples were taken from 286 stations covering all areas of Lake Michigan in 1975 as part of a sedimentological survey of the Great Lakes. From these samples a total of twenty-seven oligochaete species were identified. Stylodrilus heringianus was the most abundant species in the lake and densities were inversely related to organic content of the sediments. Tubificids exhibited localized concentrations in Green Bay and in the northern and southern basins. Comparison of several methods using oligochaete data to assess water quality showed similar patterns, indicating that Southern Green Bay and parts of the southern and northern basins of the lake are organically enriched environments. With the exception of the northern basin, which had not previously been surveyed, these conclusions are consistent with earlier regional oligochaete surveys of the lake. The northern basin of Lake Michigan warrants further study to generate and test hypotheses concerning tubificid species distributions observed there. (Author's abstract)
W85-06866

USE OF VOLATILE CHLOROORGANICS AS A MEASURE OF THE REHABILITATION OF THE ST. LOUIS RIVER AND BAY,
Minnesota Univ., Minneapolis. Dept. of Chemistry.
W. J. Doucette, P. K. Johnson, and R. Caple.
Journal of Great Lakes Research, Vol. 11, No. 1, p 77-81, 1985. 4 Fig, 14 Ref. NOAA Office of Sea Grant Program grant NA79AA-D-00139.

Descriptors: *Pulp and paper industry, *Fate of pollutants, *Chlorinated hydrocarbons, *St. Louis River, *Lake Superior, *Cloquet, *Minnesota, *Wastewater treatment, Industrial wastewater, Indicators, Chloroform, Bleaching wastes.

One of the major sources of chloroorganic discharge into the St. Louis River system had been the Potlatch Paper Mill located at Cloquet, Minnesota, about 33 km upstream from Lake Superior. The Potlatch Paper Mill effluent receives primary treatment at the mill and is now treated at the new (winter 1978-79 startup) Western Lake Superior Sanitary District (WLSSSD) advanced secondary sewage treatment plant rather than being discharged directly into the St. Louis River. The effect of diverting the pulp mill effluent to the treatment plant, located 33 km downstream, was examined using a 'chloroform monitoring technique.' Chloroform, formed during the bleaching of pulp, was used as a tracer substance to follow the movement of the chloroorganic effluent plume originating from the pulp mill. The treatment plant was shown to be only partially effective in removing chloroorganics, indicating that the point source of chloroorganic discharge into the St. Louis River system has only been relocated. In addition, the WLSSD plant itself uses large quantities of chlorine in its disinfection process and no doubt causes the production of additional chloroorganics, although the main source of chloroorganics in the WLSSD effluent is the Potlatch Paper Mill. (Collier-IVI)
W85-06867

MINERAL CONTENT OF CANADA GOOSE EGGS AND IMPLICATIONS FOR ENVIRONMENTAL SURVEILLANCE ALONG THE COLUMBIA RIVER,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
W. H. Rickard, and R. E. Fitzner.
Northwest Science, Vol. 59, No. 1, p 28-32, 1985. 1 Fig, 1 Tab, 16 Ref. DOE contract DE-AC06-76RLO 1830.

Descriptors: *Minerals, *Eggs, *Geese, *Columbia River, *Washington, Water pollution effects, Phosphorus, Sulfur, Sodium, Calcium, Potassium, Magnesium, Zinc, Selenium, Lead, Nickel, Barium, Strontium, Manganese, Iron, Aluminum.

Nesting geese provide a natural population that can be used as an indicator of biologically available metal contamination in their foraging environment. Eggs are particularly useful because killing of birds is not required and eggs are available year after year. Eggs were taken from deserted goose nests on islands in the Hanford Reach of the Columbia River, Washington, one month before the eruption of Mount St Helens. Phosphorus, sulfur and sodium were the most abundant elements in goose eggs followed by calcium, potassium, and magnesium. Calcium concentrations were higher in eggs from certain clutches with values ranging from 4400-6600 ppm as compared to values ranging from 2200 to 4000 for upstream islands. Eggs collected from island 17 had about the same levels of trace element Cu, Zn, Mn, and Se as compared to eggs taken from islands 11, 12, 15, and 19. Eggs from two of three clutches from island 17 had enhanced levels of Al, Ni, and Cr but Pb levels were only marginally elevated. Island 17 is located within 1 km of a uranium fuel fabrication facility located on the western bank of the river, and island 19 is located several km downstream. (Baker-IVI)
W85-06873

FACTORS AFFECTING TRACE METAL ACCUMULATION BY ESTUARINE OYSTER CRASSOSTREA VIRGINICA,
District of Columbia Univ., Washington. Dept. of Biology.
H. L. Phelps, D. A. Wright, and J. A. Mihursky.
Marine Ecology, Vol. 22, No. 2, p 187-197, 1985. 9 Fig, 5 Tab, 41 Ref. NASA grant NGR 09-050-019.

Descriptors: *Trace metals, *Estuarine environment, *Oysters, *Bioaccumulation, *Water pollution effects, Copper, Zinc, Cadmium, Silver, Mollusks, Salinity, Animal physiology, Bioindicators, Indicators.

Copper, zinc, cadmium and silver analyses were made of groups of ca 34 individual oysters taken from 13 oyster bars in the mid-Chesapeake Bay region on the east coast of the United States. Data are described for the years 1978, 1979 and 1981. Sampling stations were chosen to represent high and low salinity regimens as well as sites of potentially differing metal input. Metal concentrations were determined on a wet-weight basis and were found to be largely negatively correlated with body weight and with salinity. Data were entered in a multiple regression program which included body weight and salinity as independent variables, and regression equations were used to normalize the metal concentrations. Data indicated localized copper concentration in oysters close to 2 electricity generating stations, although at 1 of these sites the high values could be explained in terms of the body weight/salinity model. High metal concentrations were also indicated at an oyster bar having stunted animals. Results indicated that the use of oysters to map trace metal input to an estuary can be complicated by extraneous factors such as salinity, but that useful information may still be obtained after normalization to size and salinity. Year-to-year comparison between these data and earlier data indicate that correction for salinity may have to be reset from year to year. (Author's abstract)
W85-06878

DETERMINATION OF HALOGENATED CHEMICALS IN WATER BY THE PURGE AND TRAP METHOD, METHOD 502.1,
Environmental Protection Agency, Environmental Monitoring and Support Lab., Cincinnati, OH.
T. A. Bellar, and J. J. Lichtenberg.
EPA Report No. 600/4-81-059, 1981. 50 p, 7 Fig, 4 Tab, 3 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Halogenated compounds, *Chlorinated hydrocarbons, *Chemical analysis, Organic compounds, Trihalomethanes, Gas chromatography, Chromatography, Drinking water.

A method for determining organohalides in water uses an extraction/concentration technique to enhance the quantities of analyte injected into the gas chromatograph by a factor of 1000 compared with direct injection gas chromatography. An inert gas is bubbled through the sample. Those organohalides and other organic constituents which boil at less than 200 degrees C, are removed from the aqueous phase and trapped in a short column containing a sorbant combination. After a predetermined time, the trapped components are thermally desorbed, backflushed onto the head of a gas chromatograph and separated under programmed conditions. Measurement is done with a halogen-specific detector. The method is useful for determination of carbon tetrachloride, 1,2-dichloroethane, tetrachloroethylene, 1,1,1-trichloroethane, trichloroethylene, vinyl chloride, and 44 additional halogenated compounds listed in a table. The method, useful for detection and measurement of multicomponent mixtures spiked into carbon filtered finished water and raw source water at concentrations of 0.20-0.40 micrograms per liter, has detection limits of $<$ 0.01 micrograms per liter. The compounds listed in the table can be accurately measured over a concentration range of 0.10-5.0 micrograms per liter. Individual organohalides can be determined at concentrations up to 1500 micrograms per liter.
W85-06915

DETERMINATION OF CHEMICAL THRESHOLD CONCENTRATIONS USING 2,4-D TO CONTROL SELECTED AQUATIC MACROPHYTES: A PILOT STUDY TO EVALUATE A LABORATORY SYSTEM,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 4A.
W85-06917

Group 5A—Identification Of Pollutants

HANDBOOK FOR SAMPLING AND SAMPLE PRESERVATION OF WATER AND WASTEWATER.
Environmental Monitoring and Support Lab.-Cincinnati, OH.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124503. EPA-600/4-82-029, September 1982. Edward L. Berg, editor. 402 p, 122 Fig, 64 Tab, 219 Ref, 2 Append.

Descriptors: *Pollutant identification, *Water analysis, *Wastewater analysis, *Sampling, Water sampling, Biological samples, Bottom sampling, Sample preparation, Sample preservation, Microbiology, Statistical analysis, Flow measurement, Quality control, Industrial wastewater, Municipal wastewater, Agricultural wastes, Surface water, Aquatic life, Bottom sediments, Sediments, Groundwater, Drinking water, Sludge, Suspended solids, Organic compounds, Trace levels, Radioactive wastes, Bacterial analysis, Chemical analysis.

Guidelines for sample collection and preservation were derived from a literature review and a survey of field practices. This handbook covers general considerations for a sampling program, flow measurments (in closed conduits, from pipes, in open channels, etc.), statistics, and sampling of the following: municipal wastewater, industrial wastewater, agricultural discharges, surface waters, aquatic organisms, bottom sediments, groundwater, drinking water, sludges, suspended solids, radioactive materials, trace organics, and microbiological samples. Sample control and chain of custody are discussed. Quality assurance programs and sample preservation are also included. This material does not supersede procedures already specified by enforcement, compliance monitoring, or program offices of the EPA.
W85-06919

CALCIUM OXIDE AND HYDROXIDE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario). Environmental Protection Programs Directorate.
EN-48-10/3-1984E, March 1984. 57 p, 9 Fig, 4 Tab, 118 Ref.

Descriptors: *Pollutant identification, *Water pollution effects, *Toxicity, *Calcium hydroxide, *Water pollution prevention, *Calcium oxide, *Lime, *Cleanup operations, Alkalinity, Fish, Ecological effects, Environmental effects, Aquatic life.

Calcium oxide (CaO) when spilled is corrosive and harmful to humans by all exposure routes at elevated levels and harmful to aquatic life if pH is raised significantly. The aquatic toxicity of CaO is a function of alkalinity. CaO has shown no food chain concentration or bioaccumulation toxicity potential. CaO spills should be confined as soon as possible and be kept from entering sewers or watercourses. If it enters soil, CaO should be removed by manual or mechanical means. If it enters water, damming, water diversion and natural barriers should be used to contain CaO. Calcium hydroxide (Ca(OH)2) can decompose to produce CaO. It is mildly corrosive to humans by all routes and harmful to aquatic life. The aquatic toxicity of Ca(OH)2 is a function of alkalinity and it has shown no food chain concentration or bioaccumulation toxicity potential. Remedial actions to Ca(OH)2 spills are similar to those for CaO spills. CaO is detected quantitatively in water by atomic absorption spectroscopy or qualitatively by a flame test.
W85-06935

MICROWAVE SYSTEMS FOR DETECTING OIL SLICKS IN ICE-INFESTED WATERS: PHASE 1, LITERATURE REVIEW AND FEASIBILITY STUDY.
Memorial Univ. of Newfoundland, St. John's. Centre for Cold Ocean Resources Engineering. EPS 3-EC-81-3, September 1981. Department of the Environment, Ottawa (Ontario). 356 p, 4 Fig, 16 Ref, 6 Append.

Descriptors: *Oil spills, *Pollutant identification, *Oil slicks, *Microwaves, *Radar, *Oily water, *Sea ice, *Remote sensing, Ice cover, Arctic zone, Radiation, Aerial photography, Sensors, Spectrophotometry.

The feasibility of using microwave techniques for detecting oil pollution in ice environments was studied. Ku- or X-band active measurements and L-band measurements proved suitable for detecting oil when it is present on and in the top surface of the ice. Both VV and HH polarizations were also successful, and cross-polarization provided additional useful data. Active and passive systems operating in the frequency range of 100-300 MHz may be able to detect oil when it is present under ice or contained within the lower regions of sea ice. However, only a qualitative assessment of a limited nature can be made on the performance of active and passive microwave systems in detecting oil slicks in the ice environment due to the limited data available on microwave emission and scattering from sea ice, oil on water, and the ocean. The presence of oil in the ice environment may often be detected through subtle changes in texture and tone induced by oil such as increased metling in comparison with oil free areas. Possible radar data processing and analysis methods are considered. It is suggested that theoretical and laboratory studies, as well as field experiments under controlled conditions, are likely to produce quantitative data on the microwave emission and scattering from oil in the ice environment.
W85-06942

PARASITES AND THE LAND APPLICATIONS OF SEWAGE SLUDGE,
Ontario Ministry of the Environment, Toronto. Pollution Control Branch.
For primary bibliographic entry see Field 5D.
W85-06978

APPLICATION OF 'HEAD-SPACE' ANALYSIS TO DETERMINING READILY VOLATILE CHLORINATED HYDROCARBONS IN SURFACE WATERS (ANWENDUNG DES 'HEAD-SPACE' - VERFAHRENS AUF DIE BESTIMMUNG LEICHTFLUCHTIGER CHLORIERTER KOHLENWASSERSTOFFE IN OBERFLACHENGEWASSERN),
Bundesanstalt fuer Gewaesserkunde, Coblenz (Germany, F.R.).
H. Hellmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 2, p 92-98, April, 1985. 9 Fig, 7 Tab, 9 Ref.

Descriptors: *Head-space analysis, *Volatile organics, *Chlorinated hydrocarbons, *Chemical analysis, Water analysis, Trichloroethane, Trichloromethane, Perchloroethane, Trichloroethane, Ionization, Fluid extraction.

Head-space analysis is especially applicable for volatile substances that pass at higher water sample temperatures into the gas phase; there is a temperature dependent equilibrium between the concentration in water and in the gas phase. Using head-space analysis in conjunction with an automatic sampling valve, different chlorinated hydrocarbons of high and higher volatility can be determined at a minimum expenditure of work and time. With separation of unwanted pollutants not required the analytical procedure is simplified. Detection of volatiles is carried out by ionization or electron absorption detectors. Reproducibility, influence of variable device parameters, and detection limits were systematically investigated; surface water samples including rain and spring water were used. Compared with fluid extraction with pentane, the precision of the results and detection limits are favorable. Compounds such as trichloromethane, tetrachloromethane, trichloroethane, and perchloroethane can be determined very easily in rain, spring, and river water. (Collier-IVI)
W85-07027

EVALUATION OF A COMMUNITY-BASED INDEX USING BENTHIC INDICATOR-ORGANISMS FOR CLASSIFYING STREAM QUALITY,
Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
D. J. Schaeffer, W. H. Ettinger, W. J. Tucker, and H. W. Kerster.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 167-171, February, 1985. 3 Tab, 16 Ref.

Descriptors: *Streams, *Water quality control, *Bioindicators, *Benthos, Benthic environment, Indexes, Statistical analysis.

The question of whether benthic classification of stream quality accurately represents the chemical classification of stream quality is addressed. More effective ways of using benthic data to assess water quality are not considered. The classification system as considered gives consistent results. Organisms specified as intolerant are generally not found in association with organisms in other categories. The demonstration of independence of this class of organisms from all other classes of organisms is critical, because it is this class that determines the index value. The results strongly suggest that organisms sharing similar habitat preferences have the same specification. Therefore, the index value calculated as the percentage of intolerant species should usefully discriminate between various water quality classes. This implies that if Schiffman's original validation study were thorough, classifications made today using his system will be correct most of the time. Although the system is robust to incorrect specification of organisms, it could be improved by omission of those species that are not discriminating and consequently add little but noise to classification. (Baker-IVI)
W85-07046

BIOMONITORING FOR TOXICS CONTROL IN NPDES PERMITTING,
Oak Ridge National Lab., TN. Energy Div.
R. D. Roop, and C. T. Hunsaker.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 271-277, April, 1985. 2 Fig, 2 Tab, 24 Ref.

Descriptors: *Water quality control, *Biomonitoring, *Permits, Toxicity, Monitoring, Species variability, Testing.

Major topics discussed at the WPCF Ecology Committee sponsored workshop entitled Biomonitoring For NPDES Compliance are reviewed, including EPA's proposed approach to biomonitoring and the important issues that surround the use of biomonitoring techniques. Specific topics discussed include an overview of biomonitoring, the rationale for using biomonitoring in permitting, EPA's assessment methodology with emphasis on initial scoping and effluent characterization plus exposure assessment and wasteload allocation with permitting, issues in the water quality based toxics control process such as correlation of effluent toxicity measurements to actual instream impact and the variabiity within toxicity test methods. Also considered are effluent variability, exposure variability and species variability, the acute to chronic ratio and behavior of toxicants after discharge. (Baker-IVI)
W85-07048

APPLICATION OF REVERSED-PHASE LIQUID CHROMATOGRAPHY TO DISSOLVED ORGANIC MATTER IN ESTUARINE SEAWATER,
Hiroshima Univ. (Japan). Faculty of Integrated Arts and Sciences.
K. Hayase, K. Shitashima, and H. Tsubota.
Journal of Chromatography, Vol. 322, No. 2, p 358-362, April, 1985. 2 Fig, 14 Ref. Japanese Ministry of Education, Science and Culture grant 57490010.

Descriptors: *Reversed phase liquid chromatography, *Organic matter, *Dissolved solids, *Estuaries, Water analysis, Water quality control, Monitoring, Seawater, Chromatography.

Preliminary results on the application of reversed phase liquid chromatography with double detectors (fluorescence and absorption) to the analysis of dissolved organic matter (DOM) in estuarine

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seawater are reported. From seawater, the DOM with elution volumes in the range between 2.70 and 4.28 could be isolated. The three fractions of the DOM extracted from the seawater sample were less hydrophilic than the sedimentary fulvic acid. Fractions with elution volumes larger than the fraction 2-Z and smaller than the fraction X were not observed in the chromatograms. It is not known whether such fractions do not exist in seawater or that they cannot be extracted into chloroform. Further study should be concerned with developing methods for concentrating DOM to a maximum degree. Here, the hydrophilic-hydrophobic balance and aromatic character of the DOM in seawater were actually represented on the chromatograms. The application of reversed phase liquid chromatography with double detectors appeared to be effective in the characterization of DOM in seawater. (Baker-IVI)
W85-07065

INFLUENCE OF THE TIME OF ACIDIFICATION AFTER SAMPLE COLLECTION ON THE PRESERVATION OF DRINKING WATER FOR LEAD DETERMINATION,
Health Effects Research Lab., Cincinnati, OH.
R. G. Miller, J. U. Doerger, F. C. Kopfler, J. Stober, and P. Roberson.
Analytical Chemistry, Vol. 57, No. 6, p 1020-1023, May, 1985. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Acidification, *Sample preservation, *Drinking water, *Lead, Water analysis, Sample preparation, Water sampling.

It has been suggested that to obtain accurate data for trace metal analysis of drinking water, immediate acidification at the time of collection is necessary. However, because of problems encountered by EPA in field operations and epidemiology studies, further investigation into this requirement was pursued. Drinking water samples containing known concentrations of lead were acidified at different time intervals after collection. The water samples were then stored at room temperature for varying time intervals before being analyzed for lead. For each time period there were seven samples with three aliquots from each taken for analysis in duplicate by flameless atomic absorption spectrophotometry (AAS). All acidified samples that were spiked with lead gave a higher lead value than the unacidified samples having comparable lead concentrations. Lead recovery varied among the time periods studied: however, the results indicated that acidification of water samples after collection could be delayed up to 14 days without any adverse effect on lead concentration data. This would allow acidification after samples are received in the laboratory and thus facilitate field studies. (Author's abstract)
W85-07088

TOXICITY OF NITRITE AND ITS DETERMINATION IN POLLUTED WATERS USING A NEW REAGENT,
Ravishankar Univ., Raipur (India). Dept. of Chemistry.
A. K. Baveja, and V. K. Gupta.
Asian Environment, Vol. 6, No. 4, p 4-8, 1984. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Water analysis, *Nitrites, Diazonium salts, Chemical reactions, Water quality control, Potable water, Pollutant identification.

A new method is described for the determination of nitrite in potable and polluted water, based on the reaction of nitrite with p-nitroaniline to form diazonium salt and its subsequent coupling with N-(1-naphthyl) ethylene diamine dihydrochloride in acidic medium. The purple color dye obeys Beer's law in the range 0.08 to 0.48 ppm in the aqueous phase and gamma-max = 545 nm. The molar absorptivity and Sandell's sensitivity being 78200 l/mole/cm and 0.00058 micro-g/sq cm, respectively. The optimum reaction conditions and other analytical parameters have been studied. The proposed method is simple, rapid and far more sensitive than the standard method. The solvent extraction of the dye in iso-amyl alcohol is advantageous because it enhances the sensitivity of the method although other parameters remain the same. In aqueous media, the range of determination of nitrite is 0.08 ppm to 0.48 ppm in a 25 ml sample, whereas in the extraction procedure, the range of determination of nitrite is considerably lowered and it is possible to determine 0.02 to 0.12 ppm of nitrite in a 100 ml sample. A large number of common ions normally present in polluted waters cause no interference. (Baker-IVI)
W85-07106

WATER ANALYSIS,
Geological Survey, Denver, CO.
J. R. Garbarino, T. R. Steinheimer, and H. E. Taylor.
Analytical Chemistry, Vol. 57, No. 5, p 46R-88R, 1985. 874 Ref.

Descriptors: *Water analysis, *Water chemistry, *Chemical analysis, Inorganic compounds, Organic compounds, Water quality control, Sampling, Metals, Pesticides, Detergents.

Recent research in the areas of inorganic and organic analytical chemistry of water is reviewed. In the area of inorganic analysis topics covered include alkali and alkaline-earth metals (barium, beryllium, calcium, cesium, and magnesium), transition metals (scandium, titanium, vanadium, chromium, manganese, iron, nickel, copper, multimetal analysis, molybdenum, ruthenium, palladium, silver, osmium, and gold), group 12 metals (zinc, cadmium, and mercury), group 13 elements (aluminum, and thalium), group 14 elements (lead, and tin), group 15 elements (bismuth), metalloids (boron, germanium, arsenic, antimony, and tellurium), nonmetals (carbon, nitrogen and phosphorus, selenium, and sulfur), radionuclides (radium and thorium), and actinide elements. Multielement techniques considered include electrochemistry, spectrophotometry, atomic absorption spectrometry, atomic emission spectrometry, mass spectrometry, x-ray fluorescence spectrometry, neutron activation analysis, preconcentration and separation. Also considered are anions and, in particular, nitrogen anions, phosphorus anions and halides. Gases discussed include ammonia, chlorine, ozone, oxygen, and carbon dioxide. Miscellaneous inorganic analyses topics briefly considered include alkalinity-acidity, pH, hardness and sampling techniques. Under organic analysis specific attention is devoted to gas chromatography, gas chromatography/mass spectrometry, liquid chromatography and high-performance liquid chromatography, extraction and concentration techniques, photometry and spectrophotometry. Specific methods for pesticides and detergents are noted. Other topics included are total elemental analysis and oxygen demand, and sampling methods. (Baker-IVI)
W85-07112

COLIPHAGES AS INDICATORS OF ENTERIC VIRUSES IN ACTIVATED SLUDGE,
Texas Univ. at Austin. Dept. of Civil Engineering.
S. W. Funderburg, and C. A. Sorber.
Water Research, Vol. 19, No. 5, p 547-555, 1985. 6 Tab, 13 Ref.

Descriptors: *Sludge, *Viruses, *Bioindicators, *Coliphages, Indicators, Sludge treatment, Phages, Coliforms, Activated sludge process.

Indigenous Escherichia coli bacteriophages in sewage are composed of a heterogeneous population of large and small viruses. These coliphages plaque in different proportions on different E. coli strains. Total indigenous coliphages and fecal coliforms are not suitable indicators of enteric viruses in either primary or secondary activated sludge effluent. Coliphage forming plaques greater than 3 mm in diameter may serve as indicators of the effectiveness of enterovirus removal during activated sludge treatment. The volatile suspended solids concentration in secondary effluent may also be a means by which the effectiveness of activated sludge treatment on enteric viruses can be assessed. The proportion of influent enteroviruses found viable in settled activated sludge exceeded 150% whereas the proportion of influent total coliphages recovered from the sludge never exceeded 90% and was usually much less. This difference suggests that the activated sludge process is less antagonistic towards enteric viruses than it is towards the coliphages studied. If inactivation of coliphages continued to be rapid in the settled sludge, then these viruses would not be suitable indicators of enteric viruses in this residual. Before this coliphage can be used as an indicator of enteric viruses in wastewater treatment processes, the relationship between the two viral types in other unit processes and under varying environmental conditions must be known. (Baker-IVI)
W85-07113

CG-MS IDENTIFICATION OF ODOROUS VOLATILES IN WASTEWATER,
Ghent Rijksuniversiteit (Belgium). Lab. voor Organische Chemie.
H. Van Langenhove, K. Roelstraete, N. Schamp, and J. Houtmeyers.
Water Research, Vol. 19, No. 5, p 597-603, 1985. 4 Fig, 5 Tab, 16 Ref.

Descriptors: *Odor control, *Wastewater treatment, *Volatile acids, *Volatile solids, Wastewater analysis, Chromatography, Mass spectroscopy, Hydrocarbons, Oxygen, Nitrogen, Sulfur compounds, Organic compounds.

GC-MS analyses were made of water samples taken from all unit processes of a wastewater treatment plant receiving municipal as well as industrial wastewater. A wide variety of organic volatiles were identified in the samples. Aliphatic, aromatic and chlorinated hydrocarbons were the most widely dispersed species. These compounds do not seem to be very important with respect to the odor problem existing in the neighborhood of the wastewater treatment plant in question. Sulfides, polysulfides, alkylthiophenes, alkylthiothiophenes, organic acids, phenol and p-cresol were identified and selected as the most powerful organic odor stimuli present in the wastewater. Large variations in character and amounts of volatiles were observed. Some of these could be explained as a result of different oxidation reduction potentials present in different parts of the plant. Others could be explained as a result of anaerobic fermentation. The main reason for the existence of the odor problem was the mixing of two types of industrial wastewater and the long retention of this water in a sewer. (Baker-IVI)
W85-07119

SILVER COMPLEXATION IN RIVER WATERS OF CENTRAL NEW YORK,
State Univ. of New York at Binghamton. Dept. of Geological Sciences.
S. I. Whitlow, and D. L. Rice.
Water Research, Vol. 19, No. 5, p 619-626, 1985. 4 Fig, 4 Tab, 33 Ref. NOAA grant NA81AA-D-00089.

Descriptors: *Silver, *Complexation, *New York, *Susquehanna River, *Chenango River, Chemical speciation, Rivers, Metals, Water chemistry.

The dissolved component of the apparent silver complexation capacity was determined for Susquehanna and Chenango River water samples collected over a 3-month period in the vicinity of Binghamton, New York. The study predicts that AgCl(0) and additional undetermined species are the major dissolved species of Ag in the two rivers. Little of the Ag(r) is present as Ag(+). The importance of long term studies in characterizing river water chemistry is emphasized by the variability in the apparent complexation capacity due to natural fluctuations in the concentration of the ligands complexing Ag, over the three-month period. The usefulness of ion-selective electrodes in determining the dissolved component of the apparent complexation capacity (if it is possible to work at low total metal concentrations and avoid precipitation of the metal) has been demonstrated. (Baker-IVI)
W85-07120

SOIL AMOEBAS AS BIOLOGICAL MARKERS TO ESTIMATE THE QUALITY OF SWIMMING POOL WATERS,

Dakar Univ. (Senegal). Dept. de Parasitologie.
A. N'Diaye, P. Georges, A. N'Go, and B. Festy.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1072-1075, May, 1985. 6 Tab, 19 Ref.

Descriptors: *Water quality, *Amoeba, *Protozoa, *Swimming pools, Recreational facilities, Epidemiology, Public health, Seasonal variation, Pathogenic protozoa.

A 12-month survey of 54 swimming pools was performed between March 1978 and March 1979 in Paris, France, and 765 superficial pool and tap water samples were collected. Because of the importance of swimming waters in the etiology of primary amoebic meningoencephalitis, the samples were filtered and cultured for amoebas. Important differences in the quality of the tap waters supplying the pools were observed. These differences depended on the origins of the tap water and also on the season. Differences in tap water sources affected the quality of the swimming pool waters as well. For each swimming pool, tap and pool water samples were collected simultaneously. Seasonal variations indicated that tap water was significantly more contaminated during the summer. The data suggest that filters were not always protective against a high concentration of amoebas. The disinfection procedures were not equally efficient according to estimates based on biological criteria. The numeration of soil amoebas is useful as an additional biological marker to estimate the quality of swimming pool water. (Baker-IVI)
W85-07126

USE OF BITUMINOUS COAL AS AN ALTERNATIVE TECHNIQUE FOR FIELD CONCENTRATION OF WATERBORNE VIRUSES,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Virology Section.
D. R. Dahling, P. M. Phirke, B. A. Wright, and R. S. Safferman.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1222-1225, May 1985. 4 Tab, 21 Ref.

Descriptors: *Viruses, *Pollutant identification, *Coal filters, Drinking water, Public health, Filters, Water analysis, Bituminous coal, Costs, Developing countries.

A filter system that sandwiches a bituminous coal preparation between two prefilters was compared to those presently in use to recover human viruses from large volumes of water. An initial series of studies with the coal filters prepared between 47-mm AP20 prefilters showed that good virus recoveries in water conditioned with MgCl2 occurred from pH 3.0 through 7.0, with the greatest recoveries from pH 3.5 through 6.0. Within this range, all values showed about the same rate of recovery, which led to the selection of the high and low pH values, pH 3.5 and 6.0, to condition water in subsequent tests. In the same series of studies, use of unconditioned tap water (no MgCl2) resulted in lower virus recovery, which ranged from 5% at pH 8 to 26% at pH 5. The coal filter proved a viable alternative to the other types of filters tested. In tap water studies no significant differences in virus recovery were observed between the bituminous coal and Filterite cartridge filter. Flow rates were comparable in this study. If either sample turbidity or volume is increased appreciably, disk filters such as the bituminous coal system do not compare favorably to the cartridge filter in either volume processed or flow rate. The effectiveness of the coal filter for sewage effluent is evident from the data presented. A major advantage of the coal filter is that elution requires only 4 ml of eluent and, as opposed to cartridge filters, no secondary reconcentration steps are needed. Another advantage is the low cost of the coal filter, making it applicable to developing countries. (Baker-IVI)
W85-07129

INSTRUMENT FOR THE IMMEDIATE QUANTIFICATION OF BACTERIA IN POTABLE WATERS,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
C. Wallis, and J. L. Melnick.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1251-1253, May, 1985. 3 Fig, 14 Ref.

Descriptors: *Bacteria, *Measuring instruments, *Potable water, Water analysis, Colorimetry, Bacterial analysis.

A new semiautomated instrument is described which quantifies the number of bacteria in potable waters within 3 min, providing a permanent colorimetric record of the results. The bacteria detection device can measure as few as 100 CFU/ml in potable waters. The sample is siphoned through the bacteria-concentrating filter. The filter, which is impacted with bacteria, rust, and organic compounds indigenous to natural waters, is treated with the reducing agent to remove those contaminants without affecting the bacteria. The filter is inverted, the bacteria thereon are backflushed with eluent, and the eluate is recovered in the eluate holder within the device. The eluate is then passed through a 7 mm diameter reconcentrating filter. The bacteria on the filter are stained, the filter fibers are decolorized, and the color intensity of the filter surface is compared with that of the standardized color guide imprinted on the test card. The color guide is calibrated to indicate the number of bacteria per milliliter of the original water sample when a 100-ml sample is processed through the apparatus. If a 1,000 ml sample is used, the result should be recorded as 10-fold less than that indicated on the color guide. (Baker-IVI)
W85-07130

EFFECTS OF HUMIC MATERIALS ON VIRUS RECOVERY FROM WATER,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
N. Guttman-Bass, and J. Catalano-Sherman.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1260-1264, May, 1985. 3 Fig, 3 Tab, 21 Ref. EPA grant CR-806588-03-2.

Descriptors: *Water analysis, *Viruses, *Humic acids, *Fulvic acid, *Filters, Microporous filter, Filtration, Zeta Plus Filters, Seitz S Filters.

The effects of humic materials on virus recovery by four types of microporous filter were investigated. Humic acid interfered with virus recovery by all four filter types, whereas fulvic acid had no effect on recovery by the two types of filter (Balston and Zeta Plus) which were tested. The negatively charged filters were more sensitive to interference by humic acid than were the positively charged filters at all concentrations of humic acid tested. Recovery by Balston filters was inhibited at concentrations as low as 10 mg of humic acid per liter, whereas the Zeta Plan filters recovered essentially all of the virus at humic acid concentrations of up to 50 mg/liter. At higher humic acid concentrations, less than 10% of the virus was recovered by the Balston filters, whereas the positively charged filters continued to recover 30% or more of the virus. In both cases, the primary level of interference was prevention of virus adsorption, since the virus not found in the eluate could generally be accounted for by the amount of virus in the filtrate. The results obtained with electronegatively charged filters suggests a relatively simple mechanism of interference, in which the humic acid, which bound to the Balston filters, prevented virus adsorption by occupying virus attachment sites. The virus and humic acid sites of attachment to the filter would be the same, and interference would be due to direct competition for available sites. (Baker-IVI)
W85-07131

INTERACTIONS BETWEEN HETEROTROPHIC PLATE COUNT BACTERIA AND COLIFORM ORGANISMS,
Montana State Univ., Bozeman. Dept. of Microbiology.
M. W. LeChevallier, and G. A. McFeters.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1338-1341, May, 1985. 3 Fig, 1 Tab, 22 Ref. EPA grant R807092.

Descriptors: *Coliforms, *Heterotrophic plate count bacteria, *Bacteria, Drinking water, Potable water, Bacterial analysis, Nutrients.

Some species and strains of bacteria have been shown to suppress coliform detection. The role of heterotrophic plate count (HPC) bacteria in causing injury to coliform bacteria was examined and the mechanism of coliform antagonism was investigated. Experiments were first designed to demonstrate coliform antagonism of injury in drinking water. Depending on the HPC, coliforms either died or became injured. As HPC densities approached 10,000 to 100,000 CFU/ml, coliform counts decreased at a rate of 0.5 log per day. Coliforms in pure culture remained constant over the 8 day period. No significant injury was detected in either the mixed- or the pure-culture coliform populations. Statistical analysis of 10 replicate experiments demonstrated a significant correlation between the initial HPC level and the rate of coliform decline. A laboratory controlled system for studing the interactions of HPCs with coliforms was developed. The results indicated that HPCs grew at low nutrient levels (0 to 2 mg of yeast extract per liter), whereas coliforms required 4 to 6 mg of yeast extract per liter to grow. Since coliforms have higher growth requirements than HPCs, they are particularly susceptible to competition for nutrients in oligotrophic environments such as drinking water. Similar results were obtained with experiments designed to determine the limiting glucose concentration necessary for the growth of coliforms and HPCs. (Baker-IVI)
W85-07133

APPLICATION OF A SIMPLIFIED METHOD FOR RECOVERY OF YERSINIA ENTEROCOLITICA FROM SURFACE WATERS,
Aquila Univ. (Italy). Ist. d'Igiene.
G. Marinelli, C. D'Innocenzo, L. Fabiani, and V. Leoni.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1348-1349, May, 1985. 2 Tab, 19 Ref.

Descriptors: *Surface waters, *Yersinia, *Bacterial analysis, *Aterno River, *L'Aquila, *Italy, Public health, Water analysis, Sampling.

Yersinia enterocolitica was recovered from surface water by a simplified method: samples were taken by means of the Moore tampon and, after a short, warm preincubation in peptone-sorbitol-bile salts broth, were quickly passed to an alkali solution. Immediately after this, samples were directly plated on MacConkey agar. Y. enterocolitica was isolated from 60% of the water samples, and the identification confirmation of the strains chosen was 100%. The greatest number of Yersinia strains was isolated from the surface water taken at sampling station A, a point before the town effluent joins the river. When this is compared with other sampling stations, it might suggest that there are life-competition phenomena, chemical toxicity, dilution in the river, or all of these after the urban drain discharges. These phenomena probably adversely influence Yersinia survival, but this hypothesis requires further examination. The substantial presence of Yersinia strains in the Aterno River may be attributed to the cold climate and the local economy based on agriculture and animal husbandry. (Baker-IVI)
W85-07135

NEW METHOD FOR MONITORING TEMPORAL TRENDS IN THE ACIDITY OF FRESH WATERS,
Lamont-Doherty Geological Observatory, Palisades, NY.
A. L. Herczeg, W. S. Broecker, R. F. Anderson, S. L. Schiff, and D. W. Schindler.
Nature, Vol. 315, No. 6015, p 133-135, May, 1985. 3 Fig, 16 Ref. NSF grant DEB 80 17639.

Descriptors: *Acidity, *Acid rain, *Monitoring, *Chemical properties, Acid precipitation, Lakes, Inorganic carbon, Dissolved solids, Carbon dioxide, Acidification.

Acid precipitation and the consequent increased acidity of fresh waters are subjects of widespread concern. Several organizations in the United States, Canada and Europe have established extensive monitoring programs in an attempt to determine the relationship between the acidity of pre-

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cipitation and the change in acidity of fresh waters. It is contended that the present strategies for monitoring temporal trends in the acidity of fresh waters will not yield results sensitive enough to detect trends in acidity even on a 10-year timescale. An alternative scheme is proposed, based on calculations using precise measurements of dissolved inorganic carbon (DIC) and partial pressure of CO2 (P CO2). This scheme eliminates biases inherent in pH electrode determinations and minimizes the perturbations in acidity caused by changes in the P CO2 of lake waters associated with biological cycles. (Author's abstract)
W85-07143

ISOLATION OF ORGANIC MATERIAL FROM WATER,
Mainz Univ. (Germany, F.R.). Hygiene Inst.
H. Kunte, and E. H. Pfeiffer.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 650-655, May, 1985. 2 Tab, 13 Ref.

Descriptors: *Organic matter, *Water analysis, Dissolved solids, Adsorption, Water quality, Water chemistry, Organic matter.

Various methods for concentrating or isolating organics from water samples are compared with respect to recovery of total organic matter from water using dissolved organic carbon as a criterion of effectivity. UV absorbance, gas chromatography and recovery of added chemicals were used for additional information. Recovery rates of added chemicals are given for four different sorption procedures: a combination of XAD 2 and XAD 7 and neutral pH of the sample; the same, followed, after acidification to pH 2 to 3, by a second column of the same material; followed after acidification, by a column with Amberlite IRA 401S; and a mixture of XAD 4 + XAD 8 at neutral and acid pH. An additional adsorption step does not significantly improve the recovery rates. About 35% of the organic carbon in water can be recovered by a simple XAD resin adsorption procedure. This is comparable to the recovery rates obtained with freeze concentration at a concentration factor of 50, and with lyophilization, if the organic material is extracted. (Baker-IVI)
W85-07150

TOXICITY OF EIGHT WATER-SOLUBLE ORGANIC CHEMICALS TO SELENASTRUM CAPRICORNUTUM: A STUDY OF METHODS OF CALCULATING TOXIC VALUES USING DIFFERENT GROWTH PARAMETERS,
Building Research Establishment, Princes Risborough (England). Princes Risborough Lab.
N. Adams, K. H. Goulding, and A. J. Dobbs.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 333-345, May, 1985. 6 Fig, 5 Tab, 23 Ref, 1 Append.

Descriptors: *Phytotoxicity, *Selenastrum, *Algal growth, Toxicity, Organic compounds, Algae, Monitoring.

The need for a reliable algal toxicity test to support environmental monitoring programs is well established, but the effect of differences in methods for calculating quantitative toxic values of test chemicals is not known. Standard toxicity experiments were carried out using Selenastrum capricornutum and eight water-soluble organic chemicals in order to evaluate different methods of quantifying toxic response. There are two types of toxic values. The EC50 type are values interpolated from data from a range of chemical concentrations. The reported value is an estimate of the concentration that would cause the effect reported. The 'significant effect' type values (such as lowest concentration tested with a significant effect or algistatic concentration) are concentrations of chemical actually tested in an experiment with no extrapolation or interpolation. A multiple comparison method which gives 'no effect concentrations' and 'lowest concentrations with an observable effect' is chosen as a preferable method to those which involve interpolation, as would be the case for EC50 determinations. The area under the growth curve is more sensitive than either cell counts from a single point or growth rates for the detection of toxic effect. (Moore-IVI)
W85-07159

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY WITH HYDRIDE GENERATION/ATOMIC ABSORPTION SPECTROMETRY FOR THE DETERMINATION OF ARSENIC SPECIES WITH APPLICATION TO SOME WATER SAMPLES,
Plymouth Polytechnic (England). John Graymore Chemical Lab.
C. T. Tye, S. J. Haswell, P. O'Neill, and K. C. C. Bancroft.
Analytica Chimica Acta, Vol. 169, p 195-200, March, 1985. 3 Fig, 26 Ref.

Descriptors: *Pollutant identification, *High-performance liquid chromatography, *Atomic absorption spectrometry, *Arsenic, Chromatography, Spectrometry, Pesticides, Water analysis, Bottled water, Drinking water, Soil water.

High performance liquid chromatography is used for separation of arsenite, arsenate, monomethylarsinate and dimethylarsonate followed by continuous sodium tetrahydroborate reduction and atomic absorption spectrometric detection. Preconcentration is done on Zipax, a pellicular anion-exchange material, and the separation on a column packed with h.p.l.c.-grade strong anion-exchange resin. The Zipax column has the added advantage of acting as a guard column for the following column. The detection limits, based on the concentration of arsenic corresponding to twice the standard deviation of replicate analyses of known, low standards were 2 ng As for aresnite, arsenate and MMA, and 1 ng for DMA. The sensitivity of the method was dependent on the design of the gas-liquid separator. Small changes in the dimensions and geometry of the separator could make changes in peak height sensitivity of up to an order of magnitude. Soil waters and commercial bottled waters were analyzed for arsenic species by the method described. The concentrations of the arsenic species found for the water logged soil sample were 15 micro-g As/l as arsenite, 5 micro-g As/l as MMA, and 30 micro-g As/l as arsenate. Typical values for a similar but drier soil were 2 micro-g As/l as arsenite and 35 micro-g As/l as arsenate. Results of ten commercial bottled water analyzes showed that almost all the waters contained < 1 micro-g/liter total arsenic. Vichy water contained an average of 180 micro-g/l total arsenic. For the Vichy waters, > 90% of the total reducible arsenic was present as arsenate with the remainder being arsenite. (Baker-IVI)
W85-07162

VOLTAMMETRIC MEASUREMENT OF COPPER(II)/ORGANIC INTERACTIONS IN ESTUARINE WATERS,
Institute for Marine Environmental Research, Plymouth (England).
A. Nelson.
Analytical Chimica Acta, Vol. 169, p 287-298, March, 1985. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Copper, *Voltammetry, *Estuaries, *Organic compounds, Trace metals, Surface waters, Water analysis, Pollutant identification.

The voltammetry of copper in organic ligand/chloride media is dominated by the formation of CuCl2(-) species and by induced adsorption of Cu(I) in organic coatings on the electrodes. The method is based on the induced adsorption of CuCl2(-) from Cu(II) species in solution on an organically-coated positively-charged hanging mercury drop electrode (HMDE). The approach as described takes advantage of the anomalies of copper interfacial electrochemistry. The method provides meaningful response when tested on pure ligands in surfactant/chloride media and on estuarine waters. The technique gives both a diagnostic criterion on the nature of the Cu(II)-binding ligands and also an estimate of the complexation capacity and binding constants. Estuarine waters appear to contain two populations of Cu(II)-binding ligands: a high concentration of humic material with polyelectrolyte-type binding, and a lower level of discrete ligands forming copper complexes with stability constants around 10 to the 9th power. The extent of Cu(II) binding by the humic material decreased down the estuary because of dilution and increased competition from metal ions. (Baker-IVI)
W85-07163

DETERMINATION OF ALIPHATIC ALDEHYDES IN WATERS BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Studiesyndicaat voor Water, Antwerp (Belgium).
F. Van Hoof, A. Wittocx, E. Van Buggenhout, and J. Janssens.
Analytica Chimica Acta, Vol. 169, p 419-424, March, 1985. 2 Tab, 14 Ref.

Descriptors: *Water analysis, *Chromatography, *Aldehydes, *High-performance liquid chromatography, Organic compounds, Pollutant identification, Surface waters, Drinking water, Humic acids, Ozone.

A method is described for the determination of linear aldehydes in water. In this method the aldehydes are derivatized with 2,4-dinitrophenylhydrazine and extracted with n-pentane. The determination is completed by reversed-phase high-performance liquid chromatography with detection at 365 nm. The method was assessed for different aldehydes and applied to surface waters, treated water and humic acid solutions after ozonization. With a 250 ml sample, the limit of detection is 1 micro-g/l for the C1-C3 aldehydes. Analysis of different surface waters, treated water and a humic acid solution after ozonization showed that C1-C3 aldehydes predominated, their concentration increasing with increasing ozone dosage. (Baker-IVI)
W85-07164

5B. Sources Of Pollution

NOTE ON YERSINIA ENTEROCOLITICA IN A SWINE FARM WATERSHED,
P. J. Walker, and D. J. Grimes.
Journal of Applied Bacteriology, Vol. 58, No. 2, p 139-143, February, 1985. 1 Tab, 27 Ref.

Descriptors: *Animal wastes, *Yersinia, *Agricultural watersheds, *La Cross River, *Wisconsin, Water pollution sources, Public health, Runoff, Path of pollutants, Pigs.

Swine feces from three pig farms in the La Crosse River watershed near La Crosse, Wisconsin, were sampled for Yersinia enterocolitica; 19 presumptive isolates were recovered and biochemically confirmed as Y. enterocolitica. Simultaneously, during a 2.2 cm rainfall, the confluences of runoff water flowing from the swine holding pens and of nearby streams were also sampled; a single isolate was obtained from one holding pen runoff-stream confluence. Biochemical analysis showed that the water isolate was a biotype identical with that of a swine isolate from the adjacent farm. These results demonstrate one possible mechanism for the introduction of Y. enterocolitica into water supplies; fecal material from swine, a suspected natural reservoir of the bacterium, is transported via runoff water to streams. (Author's abstract)
W85-06179

POTENTIAL SITES OF GEOSMIN PRODUCTION BY STREPTOMYCETES IN AND AROUND RESERVOIRS,
Macaulay Inst. for Soil Research, Aberdeen (Scotland). Dept. of Microbiology.
S. Wood, S. T. Williams, and W. R. White.
Journal of Applied Bacteriology, Vol. 58, No. 3, p 319-326, March, 1985. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Geosmin, *Streptomycetes, *Reservoirs, *Longridge, *England, Odor, Water pollution sources, Water quality, Nutrients, Sediments, Soil, Vegetation, Detritus.

Water from several oligotrophic reservoirs of the North West Water Authority at Longridge, Lancashire (England), supported only sparse growth of

streptomycetes isolated from the reservoirs. Growth was enhance by nutrient-amendment of the water and one common isolate, identified as Streptomyces albidoflavus, produced geosmin in water which was supplemented with sufficient concentrations of available carbon, nitrogen and phosphorus. The minimum concentrations required for geosmin production were higher than those recorded in natural reservoir water. Synthesis of geosmin in water also required a minimum temperature about 15 C. Sterilized samples of reservoir sediment, sediment extract, plant debris from banks and surrounding soil also supported geosmin production by S. albidoflavus. Both bank debris and exposed sediment developed earthy odors without inoculation. The structure of reservoir banks influenced the quantity of plant growth and accumulation of litter, and there also the potential for contamination of reservoir water by geosmin. The potential of these various sites of geosimin production to contaminate reservoir water is assessed. (Author's abstract)
W85-06181

DRAINAGE LOSSES OF POTASSIUM FROM A YELLOW-GREY EARTH SOIL,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 2K.
W85-06183

EFFECTS OF SEDIMENT SORPTION AND ABIOTIC HYDROLYSES. 1. ORGANOPHOSPHOROTHIOATE ESTERS,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
D. L. Macalady, and N. L. Wolfe.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 1, p 167-173, 1985. 5 Fig, 6 Tab, 17 Ref.

Descriptors: *Fate of pollutants, *Hydrolysis, *Sediments, *Sorption, *Organophosphorothioate esters, Organic compounds, Sediment-water interfaces, Chlorpyrifos, Diazinon, Ronnel, Chemical kinetics.

In sediment-water systems it is generally assumed that organic compounds do not hydrolyze in the sediment-sorbed state but that the compound is in rapid equilibrium between the sediment and aqueous phases and hydrolysis occurs only through the aqueous phase. The kinetics of hydrolysis of selected organophosphorothioate insecticides were determined in sediment-water samples to define the role of hydrolysis in the sediment-sorbed state. Investigations with well-characterized sediments showed that the rates of neutral hydrolysis of chlorpyrifos, diazinon, and Ronnel are unaltered when the compounds are sorbed to sediments. For chlorpyrifos, the observed rate constants were the same in the sediment and aqueous phases and similar in magnitude to those found for natural water samples. Limited data for diazinon and Ronnel indicated similar kinetic behavior for these related compounds. Alkaline hydrolysis rates in the sediment-sorbed phase for chlorpyrifos, on the other hand, were slowed considerably relative to those in aqueous phase. The rate of alkaline hydrolysis in the sorbed state is approximately 10 times slower than in the bulk solution. In pollutant fate modeling, the neutral hydrolysis process can be simulated by assuming equilibrium between the aqueous and sediment phase with hydrolysis occurring in both phases with the same disappearance rate constant. For describing the fate of organophosphorothioate in sediments, a model with partitioning of the ester to the sediment with reaction in the aqueous phase only is adequate. (Moore-IVI)
W85-06249

OCCURRENCE AND ASSESSMENT OF POLYCYCLIC AROMATIC HYDROCARBONS IN A RIVER LOADED WITH MUNICIPAL AND INDUSTRIAL WASTEWATER (VORKOMMEN UND BEWERTUNG POLYZYKLISCHER AROMATISCHER KOHLENWASSERSTOFFE IN EINEM MIT KOMMUNALEN UND INDUSTRIELLEN ABWASSERN BELASTETEN FLIESSGEWASSER),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
A. Lawerenz.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 259-268, 1983. 5 Fig, 3 Tab, 21 Ref.

Descriptors: *Polycyclic aromatic hydrocarbons, *Carcinogens, *Fate of pollutants, *Water pollution sources, Industrial wastewater, Municipal wastes, Pollution load.

A river with a catchment of 5,400 sq km was investigated over a length of 230 km at seven stations for the total concentration of six polycyclic aromatic hydrocarbons (PAH) and the total of three carcinogenic polycyclic substances (CPS) in the water by mean of thin-layer chromatography. The maximum load occurs in the lower course downstream of large industrial wastewater introduction points with 5.1 micro-g/l polycyclic aromatic hydrocarbons, whereas in the upper course the maxima are at 2 to 3 micro-g/l polycyclic aromatic hydrocarbons mainly from municipal pollution. The average daily load increases from 0.146 kg/d PAH and 0.048 kg/d CPS to 4.168 and 1.401 kg/d, respectively. In the flowing water there cannot be observed any self-purification concerning these substances; an interconnected storage reservoir reduces seston and thus also the PAC-concentrations are reduced by 50 to 60%. The PAH-concentration shows a significant positive correlation with the COD-Mn and the ammonium concentration. There is also a good agreement between the concentrations measured and the concentrations calculated from the wastewater load in the longitudinal section of the river. (Author's abstract)
W85-06258

LEACHING OF SEVERAL INSECTICIDES FROM AN AGRICULTURALLY USED SOIL IN LYSIMETER STUDIES (AUSWASCHUNG EINIGER INSEKTIZIDE AUS LANDWIRTSCHAFTLICH GENUTZTEN BODEN IM LYSIMETERVERSUCH),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
G. Schmaland.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 269-278, 1983. 3 Fig, 7 Tab, 4 Ref.

Descriptors: *Leachates, *Insecticides, *Toxicity, *Soil types, Lysimeters, Degradation, Pesticide residues, Toxaphene, Lindane, Butonate, Trichlorphon, Methylparathion, Dimethoate.

Six lysimeters filled with loam and seven lysimeters filled with sand, having an area of 1 sq m and a depth of 1 m, were agriculturally used and in July of 1976, 1977, and 1979, they were treated with the following agents (g/sq m): toxaphene (0.75, 0.36), lindane (0.05), butonate (0.09), trichlorphon (0.07), methylparathion (0.045, 0.03) and dimethoate (0.17). The percolates accumulated on the lysimeter bottom were drained off monthly and investigated in toxicological tests with Poecilia and Daphnia. The lasting precipitation in 1978 and 1977 resulted in 1978 in percolates with a toxic effect for several months. The July insecticide applications of 1979 resulted in toxic percolates from December 1979 to May 1980. Compared with sand, loamy soils have shown only a time delay of toxicity, but no decrease of it. To assess the results, the theoretical average maximum concentration (quantity used:annual runoff) is compared with LC50 of the substances, solved in percolates of untreated lysimeters. For the organophosphorus insecticides, either other substances contained in the percolates act synergistically or toxicity is increased by degradation products such as Paraoxon. In general, a toxipotent penetration of the insecticides into the ground water is possible. (Author's abstract)
W85-06259

CONCENTRATIONS OF CADMIUM, LEAD AND COPPER IN FILTRATED BALTIC SEA WATER SAMPLES COLLECTED AT TWO SEASONS IN 1969,
Uppsala Univ. (Sweden). Dept. of Analytical Chemistry.
I. Gustavsson.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 309-317, 1983. 2 Fig, 2 Tab, 21 Ref.

Descriptors: *Baltic Sea, *Cadmium, *Lead, *Copper, *Seawater, Atomic absorption spectrophotometry, Voltammetry, Heavy metals, Seasonal variation, Water pollution.

Two research cruises on the Baltic Sea, in July and November of 1979, were made for investigating the Baltic Sea water for its contents of dissolved cadmium, lead and copper. Atomic absorption spectrophotometry and voltammetry were used as methods of investigation, the latter method having supplied slightly lower results. In the water layer of 0-50 m the cadmium concentrations were 0.03-0.05 micro-g/l and the lead concentrations were 0.1-0.2 micro-g/l, seasonal changes did not have any effect on them. The copper concentrations, on the other hand, were 0.4-1.2 micro-g/l in summer and 0.1-0.7 micro-g/l in autumm. Compared with ocean waters, the lead content is remarkably high. In anoxic deep waters of the Baltic Sea the concentrations of the three metals, especially that of cadmium, are very low (< 0.01 micro-g/l). (Author's abstract)
W85-06261

ESTIMATION OF THE MERCURY CONTENT IN THE WATERS OF THE POMERANIAN BALTIC-SHORE-AREA,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Physics.
H. Z. Wrembel.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 5, p 523-538, 1983. 7 Fig, 7 Tab, 68 Ref.

Descriptors: *Pomeranian Bay, *Baltic Sea, *Coastal waters, *Mercury, Heavy metals, Water pollution sources, Seasonal variation, Rivers, Precipitation, Marine environment, Estuarine environment, Particulate matter.

In the catchment area of the Pomeranian Bay an average mercury concentration of 178 ng/l in precipitation was determined. Eight different flowing waters showed mean concentrations between 105 ng/l (Lupawa) and 500 ng/l (Odra), a pronounced annual cycle having been demonstrated for the concentrations and for the loads with the minimum in February/March and the maximum in August/September. The total load of the eight rivers amounts to 19.5 t/a, the share of the Wisla being 11 t/a. The ratio between the mercury in precipitation (335 to 410 micro-g Hg/sq m/a) and in the run-off (30-75 micro-g Hg/sq m/a) for the individual river basins varies between 0.08 and 0.21. In the Baltic Sea, the mercury concentrations are 40 ng/l in the open sea, 50 ng/l in the coastal region and 290-390 ng/l near the estuaries. Through the eight investigated rivers about 48 cu km/a water runs off into the Baltic Sea with about 20 t/a Hg. The total introduction of Hg into the Baltic Sea is estimated at 100 t/a with the river water, 35 t/a with precipitation and 35 t/a with dust. (Author's abstract)
W85-06273

NUTRIENT INPUTS AND OUTPUTS IN A FORESTED AND GRASSLAND CATCHMENT AT PLYNLIMON, MID WALES,
Institute of Hydrology, Wallingford (England).
G. Roberts, J. A. Hudson, and J. R. Blackie.
Agricultural Water Management, Vol. 9, No. 3, p 177-191, November, 1984. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Nutrients, *Forest watersheds, *Plynlimon, *Wales, Water analysis, Drainage, Agriculture, Seasonal variations, Water quality control, Water pollution sources, Nitrogen, Phosphorus, Potassium, Runoff, Leaching,.

Daily water samples, extracted over a 4 year period from streams draining rough pasture and forest in an upland area of Wales were analyzed for nitrogen, phosphorus, and potassium. A seasonal variation in nitrate-N concentration was formed in both streams - low in summer and high in winter. This was thought to be due to the hydrological response of the catchments and to the growth cycle of plants. In the growing season, any available nutrients within the rooting zone are rapidly

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taken up by plants before thay can contribute to baseflow loads. In the winter, rapid runoff ensures that the concentrations in the streamflows are similar to those in the rainfall. Higher nitrate-N concentrations were found in the stream draining the forested catchment especially during 1976 and 1977. Two further studies were initiated to try to explain this difference. Throughfall samples were collected below the forest canopy and an areal sampling survey was made of both catchments. The results of these studies suggested that the difference could not be attributed to increased concentrations in throughfall but was due in part at least to the artificial surface drainage installed in parts of the forest to aid sampling development. This drainage aids nitrogen release to the stream while the mires in the grassland catchment act as nitrogen sinks. Enhanced organic N concentrations in the Wye catchment in 1977 were thought to be due to the leaching and erosion of dessicated peat. A comparison of nutrient inputs and outputs in rainfall and runoff from both catchments showed a net input of nutrients in the months April to October and a net output in November to March. An annual nutrient balance showed a net input of 7 kg/ha of nitrogen to both catchments, parity for potassium in the grassland and a small net input to the forested catchment. (Baker-IVI)
W85-06278

ACID RAIN AND DRINKING WATER DEGRADATION,
National Center for Atmospheric Research, Boulder, CO.
P. Middleton, and S. L. Rhodes.
Environmental Monitoring and Assessment, Vol. 4, No. 1, p 99-103, March, 1984. 15 Ref.

Descriptors: *Acid rain, *Drinking water, *Water pollution effects, *United States, *Sweden, Water treatment, Geography, Water quality control, Metals, Leaching, Water treatment, Water pollution control.

Acid deposition induced drinking water degradation is discussed with respect to the geographical extent of and the potential for dealing with possibly adverse human health impacts. Qualitative evidence from the northeastern United States and Sweden strongly suggests a cause-and-effect link between acid deposition, metal leaching due to acid water, contamination of drinking water, and human effects, but quantitative evidence is not yet available. Standard responses to water quality problems are water treatment and/or regulation of the sources of contaminants. Proposed responses to acid deposition impacts are similar including the treatment of the affected areas and/or control of the atmospheric emissions causing the problems. Clearly the reduction of acid deposition is more comprehensive and has positive benefits for more than just drinking water. The second general solution, water treatment, at least appears to be more viable. The existence of appropriate water treatment practices does not mean that treatment is necessarily desirable on a large scale. Economic costs, time scales of implementing the controls, and side effects associated with particular treatment practice require investigation before water treatment is embraced as an accepted solution to any acid rain-drinking water problem. (Baker-IVI)
W85-06286

STATISTICAL COMPARISON OF HEAVY METAL CONCENTRATIONS IN VARIOUS LOUISIANA SEDIMENTS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
K. D. White, and M. E. Tittlebaum.
Environmental Monitoring and Assessment, Vol. 4, No. 2, p 163-170, June, 1984. 7 Tab, 7 Ref.

Descriptors: *Heavy metals, *Sediments, *Louisiana, Mississippi River, Lead, Zinc, Cadmium, Statistical analysis, Fate of pollutants.

Statistical 't' tests were used to determined lead, zinc, and cadmium enrichment in various Louisiana sediments. Both absolute metal concentrations and trace metal/conservative metal concentration ratios were used in comparing sampled sites to a 110 m deep background core taken just off the mouth of the Mississippi River. Concentration ratios were used to reduce the effects of certain chemical and physical sediment characteristics on the quantity of metal contained in a given sediment. Results from the comparison of sample sites to the background reveal metal enrichment at several sites. The University Lake sampling sites exhibit both lead and zinc enrichment when using both the concentration alone and ratio methods of comparison. Additionally, cadmium enrichment is indicated in the sediments of University Lake when using only the ratio method of comparisons. Several samples sediments in and around the New Orleans metropolitan area exhibited lead and cadmium enrichment. (Author's abstract)
W85-06289

MIGRATION OF POLLUTANTS IN GROUNDWATER. II. ADSORBABLE POLLUTANTS AND NUMERICAL DISPERSION REDUCTION,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
K. N. Carter, Jr., M. Saenz, D. J. Wilson, and P. W. Rosten, Jr.
Environmental Monitoring and Assessment, Vol. 4, No. 2, p 171-202, June, 1984. 22 Fig, 2 Tab, 14 Ref.

Descriptors: *Path of pollutants, *Groundwater pollution *Adsorption, *Dispersion, Mathematical equations, Advection, Aquifers, Decomposition, Solute transport, Velocity.

The partial differential equations governing the migration of decomposing pollutant adsorbing according to a Langmuir isotherm and undergoing 2-dimensional flow in a saturated aquifer are discussed. The equation governing the mass transfer of the pollutant to the surfaces within the aquifer are solved in closed form, permitting the use of larger values of the time increment Delta t in the numerical integration of the dispersion-advection equation governing the behavior of the dissolved pollutant. In this numerical integration transverse numerical dispersion is eliminated by using conformal coordinates (velocity potential and stream function), and longitudinal numerical dispersion is very substantially reduced by use of an asymmetrical 4-point formula to represent the advection term. Some representative results are given as contour maps. The mass transfer rate coefficient is estimated as the least positive eigenvalue of a diffusion problem. (Author's abstract)
W85-06290

ALKALINITY AND CHEMICAL OXYGEN DEMAND IN SOME FINNISH RIVERS DURING THE PERIODS 1911-1931 AND 1962-1979,
Water District Office of Oulu (Finland).
E. Alasaarela, and P. Heinonen.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 3-13, 1984. 5 Fig, 1 Tab, 19 Ref, 2 Append.

Descriptors: *Alkalinity, *Chemical oxygen demand, *Rivers, *Finland, Water quality, Water pollution, Acid rain, Effluents, Acidification, Acidic sulfate lands, Drainage, Dam effects.

Water quality in the important Finnish rivers discharging into the Gulf of Bothnia was investigated by the Hydrographical Bureau over the years 1911-1931. Observations were made at monthly intervals at the river mouths. In the present report a comparison is made between this old data and more recent water quality data collected during the period 1962-1979 as part of a national survey of the quality of river waters carried out by the National Board of Waters. Of the different quality variables, only alkalinity and chemical oxygen demand (COD) are discussed in this context because the analysis methods used during the two data collection periods are directly comparable. Alkalinity was found to have decreased at all the sites investigated, the least change being observed in areas in which effluent or non-point loading had increased. From the point of view of the deleterious effects of acidity, the situation has reached a serious level in a watercourse with an input from acidic sulfate lands. The least disturbing acidity levels were measured in the larger rivers of northern Finland, although even in these rivers the effects of acid rain are already discernable. Material flows of COD have decreased in the larger rivers. Due to the effects of drainage, COD values have in most cases increased during the time of the spring flood, whereas in summer and in many rivers also in winter the COD of the waters has decreased during the twentieth century. Increase in COD has only occurred in watercourses in which loading has increased due to effluents or to the construction of reservoirs. (Author's abstract)
W85-06291

CONTRIBUTION OF AGRICULTURAL LOADING TO THE DETERIORATION OF SURFACE WATERS IN FINLAND,
L. Kauppi.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 24-30, 1984. 6 Fig, 1 Tab, 18 Ref.

Descriptors: *Water pollution sources, *Agriculture, *Finland, Nonpoint-pollution sources, Fertilizers, Phosphorus, Nitrogen, Surface waters, Nitrates, Agricultural runoff, Algal growth.

Agriculture accounts for 9% of the total land area of Finland, and use of fertilizers in agriculture has more than doubled since 1960, thus increasing potential pollution. A move towards larger and more specialized production units in agriculture may also cause water pollution problems. Point source phosphorus loading of lakes and rivers has decreased during the nineteen-seventies, increasing the relative importance of non-point loading. The contribution of agricultural phosphorus and nitrogen loading to the deterioration of Finnish lakes was studied. Agriculture comprises the greatest single source of nutrients released into Finnish watercourses. Approximately 31,000 t of nitrogen and 1,400 t of phosphorus enter the watercourses annually due to agricultural activity. These estimates were based on the specific loads of 12 kg/ha/a nitrogen and 0.57 kg/ha/a phosphorus for cultivated land. Although most of the nitrogen coming from agricultural fields was in the form of nitrate, the amounts were so low that the concentrations remained well below the harmful level. A major fraction of the phosphorus in agricultural runoff enters the watercourses adsorbed to soil particles. Experimental results indicated that 60-70% of the total phosphorus was available for algae growth. The concentrations of available P remained so low that they could be achieved in Finnish lakes of low ionic concentration through chemical desorption without the assistance of the metabolic activities of algae. (Moore-IVI)
W85-06292

NITRATE IN RUNOFF AND RIVER WATERS IN FINLAND IN THE 1960'S AND 1970'S,
L. Kauppi.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 31-40, 1984. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Nitrates, *Runoff, *Rivers, *Finland, Water pollution sources, Agriculture, Fertilizers, Atmospheric deposition, Nitrogen, Agricultural runoff.

Nitrate concentrations and their changes in runoff waters from 31 small hydrological basins and in 19 rivers were studied. Average concentrations varied from 21 to 1800 micro-g/l in runoff waters and from 53 to 2100 micro-g/l in rivers. In general, the concentrations were well below the drinking water standards. Agriculture was an important contributor to the nitrogen budget of the basins. Atmospheric deposition played a minor role, except that it might have caused the differences in NO3-concentrations observed between southern and northern non-cultivated areas. Nitrate concentrations increased statistically significantly in 15 small hydrological basins during the period 1966-1980. Most of the increases were observed in basins influenced by agriculture. The use of nitrogenous fertilizers increased strongly until 1976, but not subsequently. Trends were therefore also calculated separately for the periods 1966-1975 and 1976-1980. It was found that most of the increases during the period

1966-1980 occurred in fact during the first 10 years, indicating that the use of fertilizers was an important contributor to NO3-concentrations in waters. Nitrate concentrations increased during the monitoring period in only one river, the river Kymijoki. The absence of trends in rivers may be due to the short observation period, which started in most cases in the middle of the 1970's. (Author's abstract)
W85-06293

ROLE OF RUNOFF WATER PHOSPHORUS IN EUTROPHICATION,
L. Kauppi, and M. Niemi.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 41-51, 1984. 3 Fig, 6 Tab, 24 Ref.

Descriptors: *Runoff, *Eutrophication, *Algal growth, *Phosphorus, Agricultural runoff, Forest watersheds, Bioavailability, Nutrients, Wastewater pollution, Water temperature.

Spring and autumn runoff waters were sampled from five drainage basins ranging from forested to totally cultivated. The algal growth potentials (AGP) of the samples with and without filtering were measured using Selenastrum capricornutum as test organism. The effects of the runoff waters on the AGP of the water of an oligotrophic lake were studied by mixing 10% and 50% of runoff water into the lake water and measuring the AGP values of the mixtures. Sewage was used as a comparison. The AGP of the runoff water from the forested basin was about the same as that of the lake water. In spring samples, the AGP of the runoff water increased with increasing proportion of cultivated land in the basin. In autumn the AGP values were lower and the differences between the basins were smaller. The algal utilization of runoff water P was most efficient in the tests with 10% runoff water addition to the lake water. In spring the proportion of available P was on average 64% of the added total P and varied from 27 to 100%. In autumn all the runoff water P became available in the 10% mixture of 4 samples, but only 27% of total P in one case. In sewage tests the availability of P was 59-83% in the tests in which density of the algal population did not limit the utilization. The effect of the time delay between the maximum loading and the optimal algal growth temperature on the utilization of runoff water P was discussed. It was concluded that, if desorption can account for the solubilization of P the delay is not of great significance. (Author's abstract)
W85-06294

MODELING PHYSICS AND CHEMISTRY OF CONTAMINANT TRANSPORT IN THREE-DIMENSIONAL UNSATURATED GROUNDWATER FLOW,
Simons, Li and Associates, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 2F.
W85-06301

EFFECT OF RESERVOIR INDUCED CIRCULATION ON THE WATER QUALITY OF RECREATIONAL FRESHWATER EMBAYMENTS,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
L. Johnstone, and A. F. Babb.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157733/AS, Price codes: A07 in paper copy, A01 in microfiche. Washington Water Research Center, Pullman, Report 58, Jan 1984. 133 p, 39 Fig, 21 Tab, 31 Ref, 5 Append, Project No. OWRT B-087-WASH (1), Contract/Grant No. 14-34-0001-1276.

Descriptors: *Water pollution sources, *Recreation, *Swimming, Exchange, Mixing, Embayments, Flushing, Fecal coliforms, Water quality, Intestinal bacteria, Turbidity, Temperature, Freshwater, Reservoir, Nutrients, Algae.

A combined field and laboratory investigation was conducted to determine the relationship between water quality and exchange characteristics in freshwater recreational swim embayments in reservoirs. The quality of water in the swim embayment will be no better than that of the exchange water from the main channel. Numbers of fecal coliforms will increase to unacceptable concentrations under light swimmer loads when exchange is less than 23 percent of volume (24-hour period). 1 Exchange rates of 93 percent (24-hour period) produced acceptable water with peak swimmer loads of 100. At peak swimmer loads of 100 to 150, a minimum surface area of 225 square feet per swimmer is suggested for embayments of less than five acres with an exchange rate of 93 percent or greater. To optimize design for water quality enhancement, a historical bacteriological perspective must be established for the exchange water. Concentrations of intestinal bacteria, turbidity and temperature are the most useful water quality parameters when relating exchange rates to water quality in freshwater swim embayments. Both laboratory and field studies indicated that adequate exchange must be achieved by using the effect of reservoir flow-by velocity to produce circulation in the embayment. Water surface fluctuations in the reservoir are inadequate to create the desired exchange. Either large single or double openings are needed for adequate exchange.
W85-06317

REVIEW OF THE MUNICIPAL POLLUTION ABATEMENT PROGRAMS IN THE GREAT LAKES BASIN.
International Joint Commission-United States and Canada, Windsor (Ontario). Municipal Abatement Programs Task Force.
Report to the Great Lakes Water Quality Board, November 1983, 184 p and 43 p, 4 Fig, 26 Tab, 42 Ref, 6 Append. (in separate volume).

Descriptors: *Toxicity, *Sludge disposal, *Poisons, *Chemical wastes, *Municipal wastewater, *Phosphorus, Wastewater treatment, Wastewater facilities, Treatment plants, Suspended solids, Jurisdiction, Interagency cooperation, Great Lakes.

In 1978, Canada and the U.S. renewed their commitment to control phosphorus inputs. This signed agreement also focused attention on the toxic chemical contamination of the Great Lakes. A task force established by the International Joint Commission examined this problem in terms of municipal wastewater treatment, facilities, phosphorus measurements and controls, sludge disposal, and combined sewer overflows. The task force found there is relatively little quantitative data on the levels of toxic organic contaminants in municipal sludge. Moreover, there is a lack of information on the fate of and environmental effect of toxic organics applied to the land with municipal sludges. Over 95% of the major municipal wastewater treatment works in the Great Lakes basin provide the equivalent of secondary treatment. Phosphorus removal facilities are provided at 85% of the major sewage treatment works. These works provide 76% of the total design flow capacity in the Great Lakes basin. The equivalent of secondary treatment in Ontario currently means achieving BOD and suspended solids concentrations of 20 mg/l each and a total phosphorus concentration of 1.0 mg/l on an annual average basis. There is considerable variation in the effluent limits established for specific wastewater treatment dischargers. Of the 390 major municipal wastewater treatment facilities in the basin, 215 met all their effluent requirements in 1981, while 175 facilities did not. (Hawkins-Omniplan)
W85-06330

CALIFORNIA STATE MUSSEL WATCH, 1981-1983, BIENNIAL REPORT,
California State Water Resources Control Board, Sacramento, CA. Div. of Surveillance and Monitoring.
For primary bibliographic entry see Field 5C.
W85-06333

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
For primary bibliographic entry see Field 5G.
W85-06349

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, APPENDIX--DELAWARE RIVER BASIN,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
For primary bibliographic entry see Field 5G.
W85-06350

MICROSYSTEM SEDIMENT-WATER SIMULATION: A PRACTICAL TECHNIQUE FOR PREDICTING RESERVOIR WATER QUALITY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
D. Craft.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-83-12, October 1983. 7 p, 6 Fig, 6 Ref.

Descriptors: *Simulation, *Sedimentation, *Sediment-water interfaces, *Reservoirs, *Lake sediments, Hypolimnion, Water quality, Water chemistry.

Water quality at the bottom of a lake or reservoir may be conveniently simulated in a controlled laboratory environment using the technique of microsystem sediment-water simulation. The technique provides predictive data on planned or existing reservoirs and lakes by duplicating conditions expected at the sediment-water interface including anaerobic (chemically reducing) conditions which may occur in the hypolimnion during summer and winter stratification. Using many small sediment-water 'microsystems' allows for replication and the estimation of experimental error, as well as application of a variety of analytical chemical techniques for characterizing the simulation water. The relatively small size of microsystems offers economies of scale advantages compared to some previously suggested simulation techniques. Because all the microsystem water is prepared for chemical analyses, the problem of microstratification seen in larger sediment-water systems is reduced. Microsystems are easier to seal, which minimizes the chance of oxygen contamination. Data obtained using this technique represent worst case rather than actual water quality conditions.
W85-06358

WATER QUALITY ANALYSIS OF THE PASSAIC RIVER AT THE DIVERSION INTAKE OF THE PASSAIC VALLEY WATER COMMISSION.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
October 20, 1982. 16 p. 7 Fig, 4 Ref.

Descriptors: *Water pollution sources, *Rivers, *Streamflow, *Nonpoint pollution sources, *Biochemical oxygen demand, *Diversion, Water quality, Ammonia, Streams, Hydrocarbons, Carcenogens, Aquatic environment, Chlorination.

Water quality data were analyzed to determine specific pollution sources in the upstream drainage basin of the Passaic River in New Jersey. The Passaic Valley Water Commission (PVWC) currently diverts approximately 50 mgd of water from the Passaic River at Little Falls for water supply purposes. Because of the significant amount of point source loading in the river upstream of the PVWC intake, water quality varies with stream flow and temperature. According to PVWC records, the ammonia concentration at the PVWC intake was reported as high as 9.7 mg/l during the 1981 winter drought. Additions of chlorine to oxidize the excessive ammonia causes a significant increase in the formation of halogenated hydrocarbons, which are suspected carcinogens. The domestic dischargers upstream of Little Falls are estimated to generate more than 20 times the annual nonpoint BOD load, 27 times more phosphate, and 15 times more nitrogen than the nonpoint sources of pollution. When the long-term water quality trends of BOD5 and NH3-N are compared with the corresponding stream flow (on a 12-month average) measured at the same location, it is found that the stream flow has a direct effect on the water quality. The trend shows that the PVOC will intake water with a BOD5 greater than 6 mg/l and NH3-N greater than 3.5 mg/l,

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under summer low flow periods. Nonpoint sources were found to be the major contributing source of nitrate to the Passaic River at Little Falls. Biological data showed the organic pollutants stressed the aquatic community in the vicinity of the PVWC intake. (Hawkins-Omniplan)
W85-06364

ACID DEPOSITION NEAR A SOUR GAS PLANT IN SOUTHWESTERN ALBERTA,
McKinnon, Allen and Associates Ltd., Calgary (Alberta).
C. M. L. Dufour, B. Chapman, J. A. Lore, and M. Nosal.
Water, Air, and Soil Pollution, Vol. 24, No. 4, p 361-373, April, 1985. 2 Fig, 7 Tab, 28 Ref.

Descriptors: *Water pollution sources, *Acid rain, *Alberta, *Natural gas, Hydrogen ion concentration, Sulfates, Rainfall.

Analysis of rainfall data collected at 9 sites within a 20 km radius of a sour gas plant during June, July and August of 1972, 1973, and 1982 indicates that acidic deposition could not be attributed to local plant emissions. Despite a significant increase in the magnitude of S emissions from the plant from 1972-1973 to 1982, the only significantly different results between these time periods are for precipitation pH. Site differences for total atmospheric sulfation did exist, with those sites downwind of the plant having higher exposure levels. The variations in precipitation results at all sites were similar and do not correspond to the variations in sulfation exposure levels. Deposition of H(+) ion is higher for 1972 and much lower in 1973 and 1982 than predictions and reports in the literature for the Canadian prairie provinces. Deposition of sulfate ion is on the low end of the range of values previously reported. There is no significant correlation between H(+) and SO4(2-) concentration in the samples. (Baker-IVI)
W85-06373

FATE OF RIVERINE NITRATE ENTERING AN ESTUARY: I. DENITRIFICATION AND NITROGEN BURIAL,
Louisiana State Univ., Baton Rouge. Lab. for Weland Soils and Sediments.
C. J. Smith, R. D. DeLaune, and W. H. Patrick, Jr.
Estuaries, Vol. 8, No. 1, p 15-21, March, 1985. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Estuaries, *Fate of pollutants, *Nitrates, *Atchafalaya River, Seasonal distribution, Denitrification, Nitrification, Sediments, Wetlands, Marshes.

Fate of riverine nitrate entering a well defined turbid estuary receiving discharges from the Atchafalaya River, a distributary of the Mississippi River, was determined. Seasonal distribution of NO3 and its transformations were measured in Four League Bay (9,300 ha). Denitrification was estimated by incubating wet samples in the presence of acetylene and monitoring N2O production. The annual sediment accumulation of N was also determined within the bay and within the adjacent marshes. Nitrogen accumulation ranged from 6.0 to 23 g N per sq m per yr on the marsh and 6.1 to 11.2 g N per sq m per yr in the bay. Denitrification in this system was controlled by the availability of NO3(-) with fluxes ranging from 2 to 70 ng N per g per hr. The annual (N2O + N2)-N emission was equivalent to 142 and 120 microg per g or 2.1 and 1.7 g N per sq m from the 5 bay and 5 marsh stations, respectively. Approximately 195000 kg N, predominantly as N2, is being returned to the atmosphere via denitrification. This is estimated to be equivalent to 50% of the riverine NO3(-) entering this estuary. A significant amount was also assimulated within the estuary. (Author's abstract)
W85-06412

PARTICULATES AND THE CYCLING OF LEAD IN ULLSWATER, CUMBRIA,
Westfield Coll., London (England). Dept. of Botany.
M. Everard, and P. Denny.
Freshwater Biology, Vol. 15, No. 2, p 215-226, April, 1985. 2 Fig, 9 Tab, 28 Ref.

Descriptors: *Lead, *Ullswater, *England, *Particulates, *Fate of pollutants, Sediments, Phytoplankton, Seston, Turbulence, Littoral zone, Heavy metals, Particle size.

The manner in which lead is redistributed within the littoral zones of a lake, Ullswater (England), having entered the lake from lead mining the catchment area, is considered. A proportion of the lead in the lake is still mobile even though the mines closed some 20 years ago. Most lead in the water seems to occur in particulate form. Sequential filtration of water samples revealed a range of particle sizes in suspension and particles are often a major component of the Aufwuchs, ecton and seston. Particles are subject to the antagonistic influences of turbuent suspension and gravitational settling. During periods of high turbulence, suspension predominates over settlement. In periods of calm the various component particulates of the homogenate separate out according to size- and density-related gravitational settlement rates. Although Aufwuchs and ecton have a degree of similarity, the Aufwuchs has an attached algal component, is more compact and is relatively immobile. The intimate contact between the two provides the mechanism for metal transfer to the Aufwuchs. Concentrations of lead in epilithic and epixylic Aufwuchs decrease from the inflow to the outflow. The ooze is a young, gelatinous deposit not yet incorporated into the firmer sediment but is in sufficiently intimate contact for mixing and metal exchange. The concentrations of lead in the ooze and interstitial water overlying contaminated sediments corroborates this and gives some indication of the quantities of lead that may enter the water column during turbulence. (Baker-IVI)
W85-06417

SORPTION AND LEACHING OF THREE NONFUMIGANT NEMATICIDES IN SOILS,
Florida Univ., Gainesville. Dept. of Soil Science.
J. N. Bilkert, and P. S. C. Rao.
Journal of Environmental Sciences and Health, Vol. B20, No. 1, p 1-26, February, 1985. 5 Fig, 6 Tab, 30 Ref.

Descriptors: *Sorption, *Fate of pollutants, *Pesticides, *Leaching, Organic compounds, Nematicides, Aldicarb, Oxamyl, Fenamiphos, Sand, Loam, Clay, Soil properties, Infiltration.

Sorption and leaching of three nonfumigant nematicides (aldicarb, oxamyl, and fenamiphos) were studied using three U.S. soils (Arredondo sand, Cecil sandy loam, and Webster silty clay loam). Equilibrium sorption coefficient (K) values, measured using the batch-slurry technique, were in the order: aldicarb, equal approximately to oxamyl << fenamiphos. Nematicide mobilities measured in soil columns during water infiltration were in the order: aldicarb approximately equal to oxamyl >> fenamiphos. This order was as anticipated from the K values. Leaching of aldicarb was also measured in a field microplot of Arredondo sand. Rapid leaching of aldicarb along with the infiltrating water, similar to that noted in packed soil columns, was observed. Data from the soil column and field leaching studies were used to evaluate a simple piston displacement model. The model accurately predicted the position of the wetting fronts, but underpredicted nematicide leaching. Analysis of the soil column data revealed that nematicide K values measured by the batch technique need to be adjusted by a factor of about 0.4 to accurately predict nematicide leaching in soil columns and a field microplot. The value of this factor was invariant with the soil-pesticide combination. The need for this adjustment factor and its applicability to other soils and pesticides needs to be carefully evaluated. (Author's abstract)
W85-06426

ADSORPTION AND DESORPTION OF POLYDIMETHYLSILOXANE, PCBS, CADMIUM NITRATE, COPPER SULFATE, NICKEL SULFATE AND ZINC NITRATE BY RIVER SURFACE SEDIMENTS,
Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
N. Watanabe, E. Sato, and Y. Ose.
Science of the Total Environment, Vol. 41, No. 2, p 153-161, February, 1985. 3 Fig, 2 Tab, 32 Ref.

Descriptors: *Adsorption, *Desorption, *Fate of pollutants, Polychlorinated biphenyls, Sulfates, Nitrates, River sediments, Siloxanes, Sediments, Solubility, Heavy metals, Sorption.

An investigation into the adsorption and desorption of polydimethylsiloxane, PCBs, cadmium nitrate, copper sulfate, nickel nitrate and zinc nitrate by river sediments was carried out by using either a flow-through system or a semi-static system. An equation is given to determine the material balance in the sediment compartment. The adsorption rate constants (K1), desorption rate constants (K2) and concentration factors (K1/K2) were calculated. For hydrophobic chemicals, the K1's were independent of water solubility, but the K2's were relatively related to water solubility. For both hydrophobic chemicals and heavy metals, the concentration factors per fraction organic carbon were similar to the soil sorption coefficients, expressed on a organic carbon basis. (Author's abstract)
W85-06432

TRANSPORT AND TRANSFORMATIONS OF ORGANIC CHEMICALS,
Jordan (Edward C.) Co., Inc., Portland, ME.
J. Dragun, A. C. Kuffner, and R. W. Schneiter.
Chemical Engineering, Vol. 91, No. 24, p 65-70, November, 26, 1984. 2 Fig, 1 Tab, 33 Ref.

Descriptors: *Path of pollutants, *Organic compounds, *Groundwater pollution, Fate of pollutants, Leaching, Landfills, Pipes, Spills, Seepage, Water pollution sources.

Chemicals can reach groundwater stores through five pathways: seepage from unlined lagoons and other surface impoundments; improper landfilling; improper surface and subsurface disposal; leaks in pipes, process equipment and storage tanks; and accidental spills. After establishing that a contaminant has been released to any of the above mentioned pathways, the next step is to determine its rate and direction of movement. Movement through the unsaturated zone, movement through the saturated zone, geology and lithology of aquifers, groundwater flow through aquifers, geologic and hydrologic investigations, the fate of chemicals in groundwater, adsorption, volatilization from soil, biodegradation, chemical degradation are each considered. (Baker-IVI)
W85-06451

CONTENT OF HEAVY METALS IN WATER AND IN CERTAIN AQUATIC PLANTS OF THE DANUBE AND DNIEPER MOUTH AREAS (SODERZHANIE TYAZHELYKH METALLOV V VODE I NEKOTORYKH VODNYKH RASTENIYAKH VST'EVYKH OBLASTEI DUNAYA I DNESTRA),
V. N. Kavetsky, A. I. Karnaukhov, and I. M. Palienko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 65-68, 1984. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Metals, *Natural waters, *Chromatography, *Water analysis, Mercury, Copper, Zinc, Lead, Aquatic plants,.

A chromatographic method is suggested for determining mercury, zinc, copper and lead in natural water bodies and in certain aquatic plants. Sensitivity in determining the substances is equal to 0.5, 0.5, 3 and 5 microg in a sample, respectively. (Author's abstract)
W85-06470

EVALUATION OF THE CONSUMED ORGANIC SUBSTANCE STOCK AND INTENSITY OF ITS DESTRUCTION IN THE KILIAN DELTA OF THE DANUBE (OTSENKA ZAPASA USVOYAEMOGO ORGANICHESKOGO VESHCHESTVA I INTENSIVNOSTI EGO DESTRUKTSII V VODE KILIISKOI DEL'TY DUNAYA),

For primary bibliographic entry see Field 2J.
W85-06482

CHLOROPHYLL A IN WATER OF LAKE BAIKAL (KHLOROFILL A V VODE OZ.BAIKAL),
O. M. Kozhova, V. N. Pautova, L. R. Izmestyeva, and I. K. Davydova.
Gidrobiologischeski Zhurnal, Vol. 20, No. 6, p 42-49, 1984. 7 Fig, 3 Tab, 8 Ref.

Descriptors: *Chlorophyll a, *Lake Baikal, *USSR, Spatial distribution, Eutrophication, Seasonal variation, Eutrophication, Melosira, Water depth.

The seasonal dynamics and spatial distribution of chlorophyll a were studied in Lake Baikal (USSR). During the course of a year, the chlorophyll a concentrations in 80% of cases do not exceed 1 mg/cu m. The highest values (up to 16 mg/cu m) are recorded during subglacial water blooms due to mass development of Melosira. In the whole lake area, only the Selenga shoal region is distinguished for the chlorophyll a content. Maximum concentrations are found in the upper 50 m layer of water. Below 50 m, the chlorophyll a concentrations are 4 to 10 times lower, and at the bottom, the concentrations are only 4 to 13% of those in the upper layer. (Moore-IVI)
W85-06483

DEPENDENCE OF THE RADIONUCLIDE ACCUMULATION LEVEL IN AQUATIC PLANTS ON ECOLOGICAL FACTORS (ZAVISIMOST' UROVNYA NAKOPLENIYA PADIONUKLIDOV V VODNYKH RASTENIYAKH OT EKOLOGICHESKIKH FAKTOROV),
D. P. Marchulenene, and P. F. Dushauskene-Duzh.
Gidrobiologischeski Zhurnal, Vol. 20, No. 6, p 67-73, 1984. 5 Tab, 11 Ref.

Descriptors: *Radioisotopes, *Aquatic plants, Seasonal variation, Calcium, Potassium, Pulp wastes, Industrial wastewater, DDT, EDTA, DTPA, Salinity, Lead radioisotopes, *Strontium radioisotopes, Cesium radioisotopes, Cerium radioisotopes, Ruthenium radioisotopes.

Natural factors (including season, salinity, Ca(2+) and K(+) concentration in water) and anthropogenic factors (sewage from an integrated pulp and paper mill, DDT and complexions) were studied for their effect on biologic consumption of metal radionuclides by aquatic plants from lakes and reservoirs. An increase in salinity from 0.02 to 7 0/00 results in a decrease in Sr-90 and Cs-137 accumulation by aquatic plants, whereas absorption of Ce-144, Ru-106, and Pb-210 decreased less. Salinity has less effect on the accumulation of Sr-90 and Cs-137 than the variation in Ca and K ions does. Accumulation of radionuclides by aquatic plants is affected by pulp and paper mill wastewater as well as by DDT, EDTA and DTPA complexions. (Moore-IVI)
W85-06484

STUDY OF THE PH OF RAIN IN LAFAYETTE, LOUISIANA,
University of Southwestern Louisiana, Lafayette. Dept. of Chemistry.
R. D. Braun.
Louisiana Academy of Sciences, Vol. 47, p. 42-44, December, 1984. 2 Tab, 4 Ref.

Descriptors: *Acid rain, *Precipitation, *Louisiana, *Lafayette, Water pollution sources, Sampling, Precipitation chemistry, Air pollution.

This study was conducted to determine whether the rain in Lafayette was sufficiently acidic to be considered hazardous, to study data trends attributable to day or month, and to study trends attributable to rain depth. Rain samples were collected from 18 April 1983 to 24 April 1984 at three locations in Lafayette. During the study 241 samples were collected on 119 days. The mean pH for the year was 5.21. Samples collected on Wednesdays and Fridays had significantly lower pH values than samples collected on other days. Lafayette has no major industrial sources of air pollution. Greater air pollution on days of increased automobile traffic flow could partially explain this phenomenon. If acidic rainfall were due to air pollutants that were flushed from the air with the first portion of precipitation, then the pH would be expected to be lowest for rains of small depth. Since this is not the case, this theory can be discarded. (Baker-IVI)
W85-06489

BROMIDE-OXIDATION INTERACTIONS AND THM FORMATION: A LITERATURE REVIEW,
Capitol District Library Council for Reference and Research Resources, Troy, NY.
W. J. Cooper, R. G. Zika, and M. S. Steinhauer.
Journal of the American Water Works Association, Vol. 77, No. 4, p 116-121, April, 1985. 107 Ref.

Descriptors: *Trihalomethanes, *Bromides, *Chlorination, Water treatment, Water pollution sources, Drinking water, Monochloramine, Organic matter, Ammonia, Chemical reactions.

Research findings from 1946 to 1984 concerning the formation of trihalomethanes from chlorine-bromide, chlorine dioxide-bromide, and monochloramine-bromide are summarized. For chlorine-bromide, chlorine quantitatively oxidized bromide to hypobromous acid and hypobromite ion. In the presence of natural organic matter, waters containing Br(-) will form brominated THMs when chlorinated. Bromide, when present, tends to increase the concentration of THMs in chlorinated waters when compared with the concentration of THMs in similar waters if no bromide is present. The effect of solar-induced photochemical reaction on the formation of brominated THMs when natural waters containing bromide are chlorinated is not known. The quantitative effect of the variables on the formation and distribution of THMs has not been completely described. Excess ammonia may minimize THM formation. For chlorine dioxide-bromine, the former will not oxidize bromide to HOBr and OBr(-). The formation of THMs when chlorine dioxide is used is probably caused by slight hypochlorous acid and hypochlorite ion contamination. Monochloramine reacts with bromide to form mixed halamine; the rate of the reaction is affected by pH; the higher the pH, the slower the reaction. (Baker-IVI)
W85-06490

TRANSPORT OF IMMISCIBLE FLUIDS WITHIN AND BELOW THE UNSATURATED ZONE: A NUMERICAL MODEL,
GeoTrans, Inc., Herndon, VA.
C. R. Faust.
Water Resources Research, Vol. 21, No. 4, p 587-596, April, 1985. 12 Fig, 5 Tab, 16 Ref.

Descriptors: *Mathematical models, *Path of pollutants, *Unsaturated zone, Porous media, Groundwater pollution, Groundwater movement, Saturated zone, Soil water, Immiscibility.

A numerical model is developed that describes the simultaneous flow of water and a second immiscible fluid under saturated and unsaturated conditions in porous media. The governing equations are a simplified subset of the three-phase flow equations commonly used in petroleum reservoir simulation. The simplification is analogous to that used to derive the Richard's equation for flow of water in the unsaturated zone. The assumption that pressure gradients in the air phase are negligible leads to two partial differential equations. The proposed formulation is posed in terms of volumetric water saturation and fluid pressure in the immiscible fluid. The two-dimensional equations for flow in a vertical plane are approximated by finite differences. The fully implicit equations are solved by a direct matrix technique and Newton-Raphson iteration on nonlinear terms. The resulting numerical model is potentially applicable to many problems associated with immiscible contaminants in groundwater. Unfortunately, data such as relative permeabilities and capillary pressures for the types of fluids and porous materials present in hazardous waste sites are not readily available. As this type of data becomes available and field investigation techniques improve, applications of this type of model will become more practical. Examples are used to demonstrate the potential application of the model and the sensitivity of results to fluid properties. (Author's abstract)
W85-06513

GROUNDWATER CHEMISTRY CHANGE DUE TO TIDAL FLUCTUATIONS IN THE STONEHOUSE BREWERY WELL, PLYMOUTH, ENGLAND,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2F.
W85-06516

JUDICIAL RECOURSE AGAINST FOREIGN AIR POLLUTERS: A CASE STUDY OF ACID RAIN IN EUROPE,
Harvard Law School, Cambridge, MA.
For primary bibliographic entry see Field 6E.
W85-06529

HEAVY METALS IN THE DRINKING WATER FROM CISTERNS SUPPLYING SINGLE-FAMILY DWELLINGS,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W85-06545

RECENT SEDIMENTATION RATES AND 210PB FLUXES IN GEORGIAN BAY AND LAKE HURON,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 2J.
W85-06547

HEAVY METALS IN AQUATIC PLANTS, CLAMS, AND SEDIMENTS FROM THE CHESAPEAKE BAY, U.S.A. IMPLICATIONS FOR WATERFOWL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
R. T. Di Giulio, and P. F. Scanlon.
Science of the Total Environment, Vol. 41, No. 3, p 259-274, March, 1985. 5 Fig, 5 Tab. 35 Ref.

Descriptors: *Heavy metals, *Aquatic plants, *Chesapeake Bay, *Waterfowl, *Sediments, *Clams, Lead, Copper, Zinc, Macrophytes, Cadmium, Water pollution sources, Organic matter.

Benthos and sediments were collected from 21 locations in the Chesapeake Bay region. Both plants and clams were found in three of these. Concentrations of cadmium and lead appeared generally higher in aquatic macrophytes than in clams. Zinc concentrations, were generally higher in clams, while little difference was apparent in copper concentrations. Based on these findings, the change occurring in the food habitats of some Chesapeake Bay waterfowl away from submerged macrophytes and towards greater utilization of clams would not be expected to increase exposure to the highly toxic elements cadmium and lead. Highest concentrations of cadmium were generally observed in more carnivorous species than in more herbivorous species. Lead shot appears to be an important source of lead for Chesapeake Bay waterfowl, and more herbivorous species appear at greater risk of ingesting this shot. Highest lead, copper and zinc concentrations were observed in sediments from the Patapsco River, which is probably due to the proximity of Baltimore Harbor. Highest cadmium concentrations were noted in sediments in the Port Tobacco River, a tributary of the Potomac River. These observations were generally consistent with high concentrations of the respective metals in biota from these locations. Concentrations of the four metals in sediments were highly correlated to organic matter content. (Baker-IVI)
W85-06549

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TRACE METAL CONTENT OF LIVE TISSUES OF HALIMIONE PORTULACOIDES FROM THE COASTAL AREAS OF THE SADO ESTUARY, PORTUGAL,
F. H. S. Reboredo.
International Journal of Environmental Studies, Vol. 24, No. 1, p 43-47, 1985. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Trace metals, *Plants, *Sado Estuary, *Portugal, Aluminum, Copper, Iron, Zinc, Estuaries, Fate of pollutants, Aluminum, Copper, Iron, Zinc.

Plant samples were collected in January 1982, during low tide from three points. Halimione portulacoides lives in the high zone of the marsh or bordering drainage channels. This area receives untreated domestic sewage from a populous city, Setubal, and an important input of residual elements due to the high agricultural and industrial activity around and upstream from Setubal. Live tissues of H. portulacoides from different sampling points have different degrees of Al, Cu, Fe and Zn accumulation. For Zn, two accumulating organs must be considered - roots and leaf. The highest levels of Al, Cu and Fe were always found in roots, while the lowest levels were always observed in stems. Copper and iron levels were highly correlated in all tissues, while for Al and Zn high correlations were noted between the leaf and the stem. (Baker-IVI)
W85-06558

INTERPRETATION OF LEACHING UNDER MULTIPLE FERTILIZER APPICATIONS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
D. A. Barry, C. W. Rose, P. G. Saffigna, and J.-Y. Parlange.
Journal of Soil Science, Vol. 36, No. 1, p 9-20, March, 1985. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Leaching, *Fertilizers, *Agricultural chemicals, *Soil water, Nitrates, Chloride, Groundwater, Irrigation, Permeability, Soil properties, Solute transport.

The ability of the solute transport model to partition the total measured fertilizer loss into that from each fertilizer application is demonstrated. The illustrate method can be used to aid the task of devising efficient and effective fertilizer strategies for a wide variety of soil, crop and environmental conditions. Simple theory is used which allows estimation of the mean depth of solute penetration from any sequence of infiltration and evapotranspiration events and of the apparent dispersion about this mean depth used as a Lagrangian coordinate system. This theory was used to analyze and interpret the time patterns of leachate concentrations of nitrate-nitrogen and chloride of a field lysimeter with a potato crop receiving four fertilizer applications and numerous inadvertent N and Cl application by irrigation with groundwater. The assumption of superposition of estimated solute concentrations was employed in the analysis, yielding results consistent with the data. The analysis has quantified the leaching loss from each fertilizer application. (Baker-IVI)
W85-06564

CEGB LEFT OUT IN THE RAIN,
F. Pearce.
New Scientist, Vol. 105, No. 1445, p 10-11, 28 February, 1985. 3 Fig.

Descriptors: *Great Britain, *Acid rain, Lakes, Europe, Fate of pollution, Water pollution effects, Water pollution sources, Powerplants, Air pollution.

The Central Electricity Generating Board (CEGB), Great Britain's biggest air polluter, is at the center of the controversy over acid rain. The case against Great Britain for causing acid rain is strongest over the acidification of freshwater lakes and rivers in Scandinavia and, at home, in Scotland, the Lake District and Wales. The central issue of the whole debate about acid rain concerns linearity: whether the amount of acid emitted into the atmosphere over Europe is in any way linked to the amount of acid that falls on Europe. Some scientists argue that European emissions of sulfur increased by about 35% between 1963 and 1975, yet the wet deposition fo sulfur was actually observed to have decreased at many sites. Over this same period, not one out of 120 EACN (European Air Chemistry Network) sites exhibited a significant increase in precipitation acidity. Other scientists disagree with these findings. The science of acid rain's corrosive effect on buildings is also advancing. All factors of the acid rain issue appear to have become involved in political debates with little real progress in sight. (Baker-IVI)
W85-06569

REVERSIBLE AND RESISTANT COMPONENTS OF HEXACHLOROCYCLOHEXANE (LINDANE) SORPTION TO NEW JERSEY COASTAL PLAIN AQUIFER SOLIDS,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
C. G. Uchrin, and J. Katz.
Journal of Environmental Sciences and Health, Vol. A20, No. 2, p 205-218, February, 1985. 10 Fig, 2 Tab, 10 Ref.

Descriptors: *Adsorption, *Desorption, *Lindane, *Soils, *New Jersey, Pesticides, Fate of pollutants, Aquifers, Chlorinated hydrocarbons, Groundwater pollution.

Knowledge of a pollutant's sorptive characteristics in a particular adsorber system is critical to prediction of its transport and potential fate in groundwater as well as surface water systems. The sorptive characteristics of lindane to representative soil samples from New Jersey's coastal plain aquifers was studied. Two soils, representative of different aquifer systems were used in this study. The soil from the Cohansey aquifer is a sand containing a 4.4% organic fraction. The soil from the Potomac-Raritan-Magothy aquifer is a sandy loam with a 2.2% organic fraction. Equilibrium studies exhibited linear adsorption isotherms with an association constant of 0.013 l/g for the Cohansey solids and 0.011 l/g for the Potomac-Raritan-Magothy solids. Desorption data indicated a pronounced hysteresis, indicating that the sorption processes for these systems were not completely reversible. Both Freundlich (indicating complete desorption) and linear (indicating incomplete desorption) isotherms were fitted to the data. The Freundlich isotherm must, by definition, pass through the origin, thus implying that the desorption process can be driven to completion. Examination of the data does not lead conclusively to this as it appears that complete desorption is being resisted. (Moore-IVI)
W85-06600

ROAD SALT CONTAMINATES WELL, CAUSES HEALTH HAZARD,
D. Scheel.
Journal of Environmental Health, Vol. 47, No. 4, p 202-203, January/February, 1985. 11 Ref.

Descriptors: *Water pollution sources, *Groundwater pollution, *Wells, *Deicers, *Salts, Highways, Runoff, Leaching, Drinking water, Chlorides, Bacteria, Water quality control, Water pollution effects, Corrosion.

Water pollution occurring from runoff and leaching of salt from highways into the soil presents health problems. An incident of groundwater contaminant resulting from improper storage of a sand-salt mixture for use in road deicing in New York State is reported. In the fall of 1979, sand salt mounds were dumped for storage directly on top of a 100 ft deep driven well shaft cover. In November 1980 a resident who lived near the garage where the material was stored became ill from complications of kidney disease which was traced to high levels of chloride and bacteria in the water from their privately owned driven well. The same family operates a pet grooming business on the premises and houses numerous large and small animals. Before discovery of the well water contamination, many of the small animals died. The unusually high alkalinity of the water caused by the high salt content has caused corrosion of their plumbing, problems with the hot water heater, dishwasher and faucets, and deterioration of aluminum and stainless steel cooking utensils. In addition, the property has been devalued by 40% since the well has become contaminated, and there is no safe water supply for domestic use. Through action by the State Department of Environmental Conservation, the town was required to strip the upper layer of soil, replace it with gravel, dig a drainage ditch for the property, and remove the sand-salt piles. The work was begun in April 1981. The salt is now stored indoors. In a survey of other area wells, 15 others had high levels of salt. (Baker-IVI)
W85-06611

SWINE LAGOON EFFLUENT APPLIED TO 'COASTAL' BERMUDAGRASS: III. IRRIGATION AND RAINFALL RUNOFF,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W85-06613

EFFECT OF SOIL PROCESSES ON THE ACIDIFICATION OF WATER BY ACID DEPOSITION,
Colorado State Univ., Fort Collins.
J. O. Reuss, and D. W. Johnson.
Journal of Environmental Quality, Vol. 14, No. 1, p 26-31, January/March, 1985. 4 Fig, 2 Tab, 22 Ref. DOE contract DE-AC05-840R21400.

Descriptors: *Acid deposition, *Soil chemistry, *Acidification, Path of pollutants, Hydrogen ion concentration, Alkalinity, Carbon dioxide, Degassing, Soil solution, Acid rain, Sulfuric acid, Ion exchange.

A mechanism by which surface waters may be acidified by atmospheric deposition through soil-mediated processes is identified. Chemical equilibrium models show that for soils with low to moderately low exchangeable bases (15% Ca(2+) saturation), the soil solution pH is only slightly affected by CO2 partial pressures over the range likely to be found in soils (1-5% CO2), but the alkalinity of the soil solution increases rapidly with increasing CO2 partial pressure. Solutions that are not in contact with the soil's cation exchange complex maintain alkalinity independently of CO2 partial pressure. If alkalinity is positive, the pH in such solutions rapidly increases in response to decreasing CO2 pressure. Waters having positive alkalinity will undergo a rapid rise in pH when released from the soil due to CO2 degassing, while waters with negative alkalinity (net acidity) remain acid when degassed. The effect on the soil of precipitation containing H2SO4 is to increase the SO4(2-) concentration. In acid soils, ion exchange reactions that take place in response to increasing SO4(2-) from 25 to 250 micro mol (e-) /L can be expected to depress soil solution pH by 0.2 to 0.4 units. This depression is sufficient to cause a switch from positive to negative alkalinity in many soil solutions and when water with negative alkalinity are released from the soil they remain acid when degassed. This could account for a change in pH of surface waters from 6.25 to 5.0 or less, while the change in soil solution pH would be < 0.3 units. This mechanism does not depend on soil acidification in the sense of a reduction in base saturation. The effects are instantaneous and completely reversible if no anion adsorption occurs, but will be delayed and prolonged by anion adsorption-desorption processes. (Moore-IVI)
W85-06614

SALINE COOLING TOWER WATER FOR IRRIGATION IN MINNESOTA: II. DRAINAGE WATER COMPOSITION, LEACHING FRACTION, AND EFFECT ON AQUIFER QUALITY,
Montana Agricultural Experiment Station, Huntley, MT. Southern Agricultural Research Center.
For primary bibliographic entry see Field 3C.
W85-06616

PERSISTENCE AND FATE OF 2,4-D BUTOXYETHANOL ESTER IN ARTIFICIAL PONDS,
Ontario Ministry of the Environment, Toronto.
B. C. Birmingham, and B. Colman.

Journal of Environmental Quality, Vol. 14, No. 1, p 100-104, January/March, 1985. 2 Fig, 2 Tab, 41 Ref.

Descriptors: *Herbicides, *Fate of pollutants, *2,4-D Butoxyethanol ester, Aquatic weed control, Water temperature, Dichlorophenoxyacetic acid, Watermilfoil, Sediments, Aquatic plants.

A granular formulation of the butoxyethanol ester of 2,4-dichlorophenoxyacetic acid (2,4-D) was applied at a rate of 23 kg a.i./ha to outdoor, artificial, polythene-lined ponds infested with Eurasian watermilfoil (Myriophyllum spicatum L.). Water temperature dropped from 25 C at time of treatment to 0 C after 56 d and the ponds were frozen over for the rest of the study. Samples of plant material, pond water, and sediment were taken over a 180-d period, extracted, and analyzed by gas chromatography to determine residue concentrations of ester and 2,4-D. Ester levels in water were low and dropped to < 1.0 micro-g/L within 15 d. Ester concentration in sediment 7 d post application was 1.7 micro-g/g dry wt, but dropped to 0.1 micro-g/g dry wt after 42 d. 2,4-Dichlorophenoxyacetic acid residues in water declined to 1.0 mg/L after 85 d and to 0.2 mg/L after 178 d. Residues in plant material dropped to 10 micro-g/g dry wt after 70 d; sediment residues were negligible after 50 d. Residues of 2,4-dichlorophenol or 2,4-dichloroanisole were not detected in any samples. Despite the low temperature prevailing in the latter half of the study, a relatively rapid rate of 2,4-D breakdown was maintained both in pond water and sediment. (Author's abstract)
W85-06621

EFFECTS OF ANAEROBICALLY DIGESTED POULTRY MANURE ON SOIL PHOSPHORUS ADSORPTION AND EXTRACTABILITY,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5D.
W85-06622

ADSORPTION-DESORPTION KINETICS OF ATRAZINE AND LINURON IN FRESHWATER-SEDIMENT AQUEOUS SLURRIES,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. D. Wauchope, and R. S. Myers.
Journal of Environmental Quality, Vol. 14, No. 1, p 132-136, January/March, 1985. 3 Fig, 3 Tab, 19 Ref.

Descriptors: *Atrazine, *Linuron, *Adsorption, *Desorption, *Sediments, Mixing, Fate of pollutants, Runoff, Solute transport, Equilibrium, Chemical kinetics, Organic compounds.

To understand how synthetic organic chemicals, specifically pesticides, behave in runoff streams when those streams combine in a watershed, knowledge is needed on how the mixing process affects the partitioning of the solute between sediment and water phases. A fast sampling and filtration technique was used to determine the rapidity with which the herbicides atrazine and linuron are adsorbed or desorbed in sediment-water mixtures. When aqueous solutions of the herbicides were exposed to wet sediment, or when wet sediments containing the adsorbed herbicides were exposed to water, the resulting adsorption or desorption, respectively, was initially very fast, approaching 75% of equilibrium values within 3 to 6 min. Herbicide adsorption on the sediments was completely reversible after 2 h of adsorption time: kinetic parameters obtained from a statistical fit of a sequential-equilibria model to the adsorption data also fit desorption data. It appears that in the well-mixed slurries of sediments that occur in runoff and mixing streams, adsorption and desorption equilibria of typical nonionic organic herbicides can respond rapidly and reversibly to changes in the mixture, nearing a new equilibrium in minutes. This may not apply to chemicals that have had longer times to react with soil surfaces. To a first approximation, hydrological chemical transport models of well-mixed combining streams may assume reequilibrium occurs instantly with a new sediment-water partitioning based on the sorptive properties of the combined sediment. (Moore-IVI)
W85-06624

ELEMENT ACCUMULATION AND RELEASE BY MACROPHYTES IN A WETLAND STREAM,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 2H.
W85-06625

ADSORPTION AND DESORPTION OF HEXAVALENT CHROMIUM IN AN ALLUVIAL AQUIFER NEAR TELLURIDE, COLORADO,
Geological Survey, Denver, CO.
K. G. Stollenwerk, and D. B. Grove.
Journal of Environmental Quality, Vol. 14, No. 1, p 150-155, January/March, 1985. 8 Fig, 5 Tab, 23 Ref.

Descriptors: *Chromium, *Adsorption, *Desorption, *Alluvial aquifers, *Telluride, *Colorado, Drinking water, Groundwater pollution, Iron oxides, Chemical kinetics.

A laboratory investigation of reactions between hexavalent chromium (Cr(VI)) and alluvium was conducted to evaluate reactions of Cr(VI) contaminating an alluvial aquifer near Telluride, CO and to determine the mechanisms responsible for these reactions. Uncontaminated alluvium and groundwater (spiked with CrO4(2-)) from the study site were used in batch and column experiments. Results of these experiments show that Cr(VI) was adsorbed by the alluvium. Distribution coefficients from batch experiments ranged from 52 L/kg at an equilibrium CrO4(2)-concentration of 0.4 micro-mol/L to 1.7 L/kg at an equilibrium concentration of 1400 micro-mol/L. The zero point of charge for alluvium was approximately 8.3, and the alluvium had a positive net charge at the groundwater pH of 6.8. Visual and chemical evidence indicated that Fe oxide and hydroxide coatings on the alluvial particles principally were responsible for the adsorption of Cr(VI). During column experiments, Cr(VI) initially was desorbed easily from the alluvium by Cr-free groundwater; however, the rate of desorption decreased rapidly, and > 60 pore volumes of groundwater were required to decrease the effluent concentration of Cr(VI) to 3 micro-mol/L (drinking water standard for concentration of Cr(VI) = 1 micro-mol/L). The quantity of Cr(VI) adsorbed varied with the type and concentration of other anions in solution. (Author's abstract)
W85-06626

PACKAGED BOILERS: THEIR ROLE IN WATER POLLUTION,
Cranfield Inst. of Tech. (England). School of Water Sciences.
G. S. Solt.
Effluent and Water Treatment Journal, Vol. 25, No. 1, p 14-18, January, 1985.

Descriptors: *Boiler water, *Water pollution sources, *Boilers, *Wastewater management, Water quality control, Water treatment, Blowdown.

Modern society relies on large numbers of small boilers, each of which discharges heat, inorganic and organic materials to the aqueous environment. While each boiler alone discharges small amounts of these, their combined effect may be significant. Water management in packaged boiler systems tends to be inefficient. Improvements aimed at reducing the costs of boiler operation would bring additional benefit by reducing the load of inorganic wastes added to the environment. The main objective of boiler water management is to control the quality of the boiler water. As hardness must be absent from the feed, all makeup water must be treated, normally by ion exchange. The cheapest and commonest method is base exchange softening. Internal treatment is a complex science which includes the dosing of sodium hydroxide and/or sodium carbonate to control the pH and alkalinity, phosphates to suppress scaling and create manageable sludges instead, and a variety of organic materials, some volatile, some not. Oxygen must be removed from the feed water by thermal deaeration. Wastes are discharged from boiler installations at two points - the blowdown, and the effluent from the external water treatment plant. The overall waste load from a boiler system depends on the steam rating of the boiler, the proportions of condensate recovered, and of boiler water blowdown, and on the type of external treatment used. Individual boilers will differ widely in their effect on the environment. An estimate of pollutant load from a boiler is obtained and compared with actual levels found in an industrialized river system. (Baker-IVI)
W85-06628

ESTIMATING THE EFFECTIVENESS OF VEGETATED FLOODPLAINS/WETLANDS AS NITRATE-NITRITE AND ORTHOPHOSPHORUS FILTERS,
Agricultural Research Service, Fort Pierce, FL. Southeast Watershed Research Lab.
P. Yates, and J. M. Sheridan.
Agriculture, Ecosystems and Environment, Vol. 6, No. 3, p 303-314, May, 1983. 2 Fig, 3 Tab, 12 Ref.

Descriptors: *Floodplains, *Wetlands, *Nitrates, *Nitrites, *Orthophosphorus, Forest watersheds, Agricultural watersheds, Vegetation, Water quality, Nonpoint pollution sources, Fate of pollutants, Dilution.

The role of vegetated floodplains/wetlands on the stream water quality of agroecosystems in the Coastal Plain region of the southeastern United States is reported. Water-borne nitrate plus nitrite nitrogen budgets and orthophosphate phosphorus budgets from a cropped agricultural area were compared with those of a watershed with alluvial forests below the cropped areas. Analyses were made to determine if observed differences in nutrient concentrations and loads were the result of dilution of cropped area runoff by flows from non-cropped areas. Reductions in the observed levels of nitrate plus nitrite nitrogen and orthophosphate phosphorus between upland cropped areas and watershed outlets exceed reductions that would be caused by dilution effects. Significant portions of the observed nutrients leaving cropped areas were retained, utilized and/or transformed in the vegetated floodplains/wetlands characteristic of these Coastal Plain watersheds. (Author's abstract)
W85-06634

SOLUBLE PHOSPHORUS RELEASE FROM ORGANIC SOILS,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy.
Agriculture, Ecosystems and Environment, Vol. 9, No. 3, p 373-382, July, 1983. 3 Fig, 4 Tab, 14 Ref.

Descriptors: *Organic soils, *Phosphorus, *Drainage water, *Florida, Flooding, Agronomic practice, Soil organic matter, Decomposition, Water pollution sources, Soil chemistry, Soil temperature.

Florida has approximately 1.5 million ha of organic soils, formed by the decay of wetland plants. During the summer months when crops are not planted, these soils are flooded as a management practice to control weeds and pests, and reduce soil subsidence. Following flooding they are drained, and drainage water is either pumped into recycle reservoirs or into adjacent lakes. Soluble P release during soil organic matter decomposition was measured under fluctuating seasonal temperatures in natural soil profiles obtained from seven locations in central and south Florida. Soil columns were flooded for 25 days in the months of July and August to simulate normal agronomic practice. The amounts of P released into effluent from Florida's organic soils were in the range of 2.9-26.2 micro-g P/cu cm of soil per year (16-168 kg P/ha/year). This represents 2.2-20% of the total soil P for central Florida organic soils and 0.75-1.1% of total soil P for south Florida organic soils. Soluble ortho-P accounted for about 70-89% of total effluent P for central Florida organic soils and 54-57% of effluent P for south Florida organic soils. Estimated soil P mineralization during organic matter decomposition was about 38-185 kg P/

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ha/year for central Florida organic soils and 16-23 kg P/ha/year for south Florida organic soils. Seasonal temperature fluctuations had minimal influence on the P release into effluent. Compared with drained conditions, flooding the organic soils increased P release into drainage effluent by about 4-8 times, resulting in P loads to adjacent bodies of water. (Moore-IVI)
W85-06635

DETECTION OF TOXIC INHIBITION OF BIOCHEMICAL DEGRADATION IN RIVER WATER (NACHWEIS TOXISCHER HEMMUNGEN DES BIOCHEMISCHEN ABBAUS IN FLUSSWASSER),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
D. Spott.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 11-16, 1983. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Toxicity, *Biodegradation, *Bacteria, *Fate of pollutants, Biological oxygen demand, Organic compounds, Peptone.

A technique was developed for determining the inhibition by toxic substances of the biochemical decomposition of organic substances in surface waters. Since the aim is to describe as accurately as possible the processes occurring in the water and not to test individual substances for toxic properties, experimental conditions should approximate natural river conditions. The experimental organisms should be bacteria taken from the river itself and should be adapted to a certain extent to wastewater components present in the river. The proposed procedure is based on Viehl's BOD analysis which includes Winkler's method; peptone is used as the check substrate. Three experimental conditions are used: (a) river water, undiluted and without additives; (b) river water with 10 mg/l peptone; (c) standard BOD dilution water with 10 mg/l peptone and innoculation with river bacteria (control). Innoculation material is obtained by centrifugation after the river water has been through a plankton sieve. Graphic analysis of BOD for (a), (b), and (c), showed a steady, straight-line increase of BOD with time for all three conditions with (c), (a), (b), in ascending order and the lines diverging steadily; an area of toxic inhibition was shown between the line for (b) and one for (a) + (c). An arithmetic formula is used to evaluate individual degradation times: Inhibition % = 100 - (BOD(b) x 100)/(BOD(a) + BOD(c)). Both 2- and 5-day incubation times should be studied, at least for preliminary investigation, so that any additional, unwanted adaptation of bacteria during the experiment may be detected. Results of the method using water from different sources are given under unfavorable hydrological conditions and with extremely diluted wastewater inflows: after 2-day incubation, inhibition was 6-20% for one source and 10-31% for the other. (Author's abstract)
W85-06649

RELATIONSHIP OF WATER VOLUME AND WATER QUALITY PARAMETERS (ZUM ZUSAMMENHANG VON PARAMETERN DER WASSERMENGEN UND WASSERBESCHAFFENHEIT),
Forschungszentrum fuer Wassertechnik, Dresden (German D.R.).
U. Friedrich, U. Grunewald, and G. Wernecke.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 2, p 199-213, 1983. 4 Fig, 5 Tab, 6 Ref.

Descriptors: *Water quality, *Water supply, *Elbe, *Germany (Democratic Republic), Precipitation, Chemical oxygen demand, Nitrates, Suspended solids, Phosphates, Flow discharge, Hydrology.

The water quality criteria COD-Mn, NO3(-), suspended solids, and phosphates measured at two stations on the river Elbe in the Dresden section as well as an inflow gauge at a drinking water reservoir in the Eastern Ore Mountains were used to investigate correlative connections with hydrological and meteorological quantities. Statistical connections between matter-balance and water-balance components were recorded on the basis of regression statements. The large number of the factors to be observed in the development of process-describing matter discharge models is determined by the large number of causative or influencing quantities. With respect to continuing investigations, it is recommended that the dynamic character of precipitation and the influence of vegetation should be taken into account more exactly, especially in the case of substance components carried away from areas, such as suspended solids, nitrate, and o-phosphate. (Author's abstract)
W85-06662

TRIHALOMETHANES IN GROUNDWATER SYSTEMS,
Howard Univ., Washington, DC. School of Civil Engineering.
M. M. Varma, A. Balram, and H. M. Katz.
Journal of Environmental Systems, Vol. 14, No. 2, p 115-125, 1984-85. 3 Fig, 5 Tab, 7 Ref. EPA grant R-805689-02.

Descriptors: *Trihalomethanes, *Groundwater pollution, *Water treatment, Hydrogen ion concentration, Chloroform, Chlorination, Water pollution sources, Monitoring, Public health, Chemical treatment.

The formation of trihalomethanes (THMs) in various groundwater supply systems in the State of Maryland was studied. THM formation in water is associated with the interaction of aqueous chlorine and certain precursors. Samples of both raw and finished water were collected and analyzed for THMs and for THM formation potential at ambient pH and at pH 9. In raw water samples, the only THM detected was chloroform, and the highest concentration was 2.5 micro g/l. In finished water samples, chloroform concentrations were somewhat higher and no other species were detected, except for one supply where the chloroform concentration was 24.8 micro g/l and total THMs were 103.5 micro g/l, the difference being brominated compounds. Significant amounts of brominated compounds were found in only one other supply, but total THM's were relatively low. The results of THM formation potential generally followed the same pattern, and showed a slight increase in formation potential at higher pH. Certain groundwaters may contain THM precursors; therefore, routine monitoring is necessary to safeguard the health of the people. Monitoring is more important for small towns which serve less than 10,000 people. THM formation potential was reduced in the plants where chemical precipitation was used. (Moore-IVI)
W85-06696

TRANSPORT OF ORGANIC CONTAMINANTS IN GROUNDWATER,
Stanford Univ., CA. Dept. of Civil Engineering.
D. M. Mackay, P. V. Roberts, and J. A. Cherry.
Environmental Science and Technology, Vol. 19, No. 5, p 384-392, May, 1985. 6 Fig, 33 Ref.

Descriptors: *Groundwater pollution, *Transport, *Fate of pollutants, Aquifers, Gravel aquifers, Aquifer characteristics, Groundwater, Monitoring, Water quality control, Organic compounds, Advection, Dispersion, Temperature effects, Acidity, Sorption, Retardation.

The state of understanding of the physical, chemical, and biological processes that are thought to affect organic contaminants in the saturated (groundwater) zone are reviewed. The vadose zone is not discussed in any detail. Because many aquifers used for water supply comprise horizontal geological units of sand and gravel, the discussion is limited to horizontal flow in such aquifers. Current understanding of the processes that are important to the saturated zone help to illustrate the conceptual complexities of organic contaminant transport and distribution in the groundwater zone. Some of the implications of groundwater contamination are presented. Transport processes considered include advection, dispersion, sorption and retardation. The chemical or biological transformation of organic contaminants into other compounds is considered along with factors which influence these changes such as temperature and acidity. The transport and distribution of a contaminant is different when the source is a continuous one as opposed to a one-time release or to pulse sources. Differences also occur when considering a low-density vs a high-density organic liquid. Monitoring of complex sources, predicting contaminant migration, and evaluating remedial action are also considered. (Baker-IVI)
W85-06704

SEDIMENT AND NUTRIENT EXPORT IN RUNOFF FROM BURNED AND HARVESTED PINE WATERSHEDS IN THE SOUTH CAROLINA PIEDMONT,
Clemson Univ., SC. Dept. of Forestry.
D. H. Van Lear, J. E. Douglass, S. K. Cox, and M. K. Augspurger.
Journal of Environmental Quality, Vol. 14, No. 2, p 169-174, April/June, 1985. 1 Fig, 5 Tab, 16 Ref.

Descriptors: *Sediments, *Nutrients, *Runoff, *Pine trees, *Forest watersheds, *South Carolina, *Forest Fires, Erosion, Nonpoint pollution sources, Clear-cutting, Forest management, Water pollution sources, Path of pollutants.

Soil and nutrient export in ephemeral flow were studied over a 3-yr period following clearcutting three loblolly pine (Pinus taeda L.) watersheds (0.60-1.24 ha). Two preharvest, low-intensity prescribed fires had no effect on flow or water quality. Harvesting after the third prescribed fire significantly increased sediment concentration and export, but increases were minor compared with sediment export reported for mechanical site preparation. Nutrient concentrations varied among watershed locations because of differences in surface soil depth, but were generally unaffected by harvest. Because harvest increased runoff, nutrient export (concentration x flow) was generally increased. Results of this study show that loblolly pine stands in the erosive Piedmont physiographic region can be harvested following a series of low-intensity prescribed fires with minimal soil loss or degradation of water quality. (Author's abstract)
W85-06714

SALT ACCUMULATION IN THE RIVERS OF NORTH DAKOTA,
North Dakota State Univ., Fargo. Dept. of Soil Science.
A. Maianu.
Journal of Environmental Quality, Vol. 14, No. 2, p 211-217, April/June, 1985. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Salinity, *Rivers, *North Dakota, *Conductivity, Sodium adsorption ratio, Salt, Chemical characteristics, Geochemistry.

Chemical determination on over 9000 water samples collected from 83 rivers and analyzed by the U.S. Geological Survey between 1949 and 1982 were used to establish the patterns of salt accumulation in North Dakota rivers. The concentrations of the principal anions, cations, and sodium adsorption ratio (SAR) were related with the total salinity (electrical conductivity, EC) of each water sample. Some patterns of salt accumulation were observed: first, according to the anions that accumulate as a continuum with increases in total salinity; and secondly, by the rate of anion accumulation. Taking into consideration these two factors, eight groups of river waters were established. Thirdly, the change of the ratios between the anions with increases in total salinity creates a succession of stages of salt accumulation. Each stage corresponds to the change of the river water chemical composition between particular total salinity limits. These changes are specific for each group of rivers depending on the topographic and geologic conditions that prevail in the drainage basin of the rivers. Based on these three factors, a genetic classification of river waters was derived, which consists in ranking the waters in three categories: classes, groups, and stages of salt accumulation. (Author's abstract)
W85-06718

AFLATOXIN MOVEMENT IN SOIL,
Maryland Univ., College Park. Dept. of Agrono-

my.
B. S. Goldberg, and J. S. Angle.
Journal of Environmental Quality, Vol. 14, No. 2, p 224-228, April/June, 1985. 4 Fig, 2 Tab, 31 Ref.

Descriptors: *Aflatoxin, *Groundwater contamination, *Soil properties, Fate of pollutants, Adsorption, Mycotoxins, Leaching.

Crops contaminated with > 20 microg/kg aflatoxin cannot be transported across state lines. Contaminated preharvest crops are often disposed of by plowing the crop into the soil, thereby creating the potential for aflatoxin contamination of groundwater. The objective of this study was thus to determine the leaching and adsorption potential of aflatoxin in soils. Leaching and adsorption studies were conducted with a silt loam, clay loam, sandy loam, and silty clay loam soil. Soil columns were utilized in the leaching experiment. The length of the column and the volume of soil used were 30.54 cm and 1234 cu cm, respectively. A total of 2.5 mg aflatoxin B sub 1 was applied to the soil surface and the column was leached with 1 L of water under saturated conditions for 24 h. The results demonstrate that aflatoxin B sub 1 or its derivatives, aflatoxin B sub 2 and G sub 2, were retained within the upper 20 cm of all soil types. Between 80 and 92% of the total amount of aflatoxin applied was retained in the upper 2.5 cm of the soil columns. No aflatoxin was found in the leachate from any of the soils. Freundlichs isotherm was used to establish adsorption coefficients for the soils by the slurry technique. The concentrations of aflatoxin used to establish the constants were 0.1, 1.0, 5.0, and 10 mg/L. The resulting adsorption coefficients were 238, 76, 46, and 17 mg/kg for the silty clay loam, silt loam, clay loam, and sandy loam, respectively. As a result of the two experiments, aflatoxin contamination of groundwater would not be expected to occur unless the soils were extremely sandy or shallow. (Author's abstract)
W85-06719

MOBILITY AND PERSISTENCE OF HEXAZINONE IN A FOREST WATERSHED,
Battelle-Northwest, Richland, WA.
D. C. Bouchard, T. L. Lavy, and E. R. Lawson.
Journal of Environmental Quality, Vol. 14, No. 2, p 229-233, April/June, 1985. 7 Fig, 2 Tab, 21 Ref.

Descriptors: *Hexazinone, *Forest watersheds, *Path of pollutants, *Herbicides, Pesticides, Forest management, Oak trees, Leaves.

The concentration of hexazinone (3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione) in soil, water, and plant tissue was monitored following hexazinone application (2.0 kg a.i./ha) to an 11.5-ha watershed in northwestern Arkansas. The hexazinone concentration in the top 10 cm of soil on the watershed decreased to approximately 10% of the initial concentration in 42 d. Hexazinone dissipation rate on the watershed was more rapid than could be accounted for solely by degradation. Leaching of hexazinone to lower soil depths probably was important to hexazinone dissipation. Hexazinone degradation in soil incubated at 10 and 30 C followed first-order kinetics and had a half-life of 77 d at 30 C. Hexazinone was stable in incubated stream water requiring several years for 50% disappearance of the compound at 30 C. The maximum hexazinone concentration in the stream that drained the watershed was 14 micro g/L, and hexazinone residues (< 3 micro g/L) were detected in stream discharge over 1 yr after application. The amount of hexazinone transported from the watershed in stream discharge represented 2.0 to 3.0% of the amount of initially applied. Analyses of oak foliage and leaf litter collected from the forest floor indicated that < 0.10% of the hexazinone applied was returned to the forest floor in leaf deposition. (Author's abstract)
W85-06720

REACTION OF FERTILIZER AND LIQUID MANURE PHOSPHORUS WITH SOIL AGGREGATES AND SEDIMENT PHOSPHORUS ENRICHMENT,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
For primary bibliographic entry see Field 5E.
W85-06722

LEACHING OF NITROGEN, PHOSPHORUS, AND ORGANIC CARBON FROM WHEAT STRAW RESIDUES: I. RAINFALL INTENSITY,
J. D. Schreiber, and L. L. McDowell.
Journal of Environmental Quality, Vol. 14, No. 2, p 251-256, April/June, 1985. 4 Fig, 8 Tab, 16 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Organic carbon, *Wheat straw, *Straw, *Rainfall intensity, *Agricultural runoff, Leachate, Nutrients, Crop residues, Nutrient cycling, Transport, Water quality, Source of pollutants, Runoff.

Knowledge of nutrients leached from crop residues will aid in understanding nutrient cycling in agricultural systems and in the development of small watershed chemical transport models. Using a multiple-intensity rainfall simulator, wheat straw residue (Triticum aestivum L.) was subjected to 25.4 mm simulated rainfall at intensities of 7, 12, 25, 53, and 105 mm/h. The wheat straw loading rate was 4500 kg/ha. Runoff was sampled as a function of time and analyzed for PO4(-3)-P, NH4(+)-N, NO3-N, and organic carbon (OC). Except for NO3-N, nutrient concentrations and losses were greater at the lower rainfall intensities. At each intensity, PO4(-3)-P, NH4(+)-N, and OC concentration in runoff from the wheat straw increased rapidly to maximum values and then decreased with time. After maximum nutrient concentrations were reached, a power function, Y = a(X to the b power), best described the relationship of nutrient concentrations with time, whereas a hyperbolic equation of the form Y = 1/(a + bX) best described the relationship of nutrient concentrations with runoff. The quantity (kg/ha) of nutrients leached from the wheat straw followed the order C > P > N as (NH4(+)-N + NO3-N). Amounts of N as (NH4(+)-N + NO3-N) and C leached from the wheat straw were < or = 1% of the nutrient content compared with 80 to 140 g/kg for P. The variability in both the leachability and nutrient content of crop residues from different sources will be important factors in the development of crop residue leaching models. (Author's abstract)
W85-06723

LEACHING OF NITROGEN, PHOSPHORUS, AND ORGANIC CARBON FROM WHEAT STRAW RESIDUES: II. LOADING RATE,
J. D. Schreiber.
Journal of Environmental Quality, Vol. 14, No. 2, p 256-260, April/June, 1985. 5 Fig, 4 Tab, 12 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Organic carbon, *Wheat straw, *Straw, *Rainfall intensity, *Agricultural runoff, Leachate, Nutrients, Crop residues, Nutrient cycling, Transport, Water quality, Source of pollutants, Runoff.

Using a rainfall simulator, wheat straw residue (Triticum aestivum L.) in 1.0-sq m pans was subjected to simulated rainfall. Runoff from the wheat residue was sampled as a function of time and analyzed for PO4(3-)-P, NH4(+)-N, NO3-N, and organic carbon (OC). Rainfall at 25 mm/h was applied for 1 h to five residue weights equivalent to field loading rates of 2200, 4500, 6700, 9000, and 11,200 kg/ha. As loading rates increased from 2200 to 9000 kg/ha, both concentrations and losses of PO4(3)-P, NH4(+)-N, and OC increased, whereas those of NO3-N decreased. During individual runoff events at all loading rates, PO4(3)-P, NH4(+)-N, and OC concentrations increased relatively rapidly to maximum concentration in runoff and then decreased during the remainder of the 1-h runoff event. The relationship of nutrient concentrations with time were described by a power function Y = aXb and to runoff by a hyperbolic equation of the form Y = 1/(a + bX). The quantity (kg/ha) of nutrients leached from the wheat residue followed the order C > P > N. For all loading rates, percentage N (NH4(+)-N + NO3-N) and C leached from the wheat residue was < 10 g/kg, compared with 240 to 430 g/kg for P. (Author's abstract)
W85-06724

LONG-TERM PHOSPHORUS SORPTION IN A BRUNISOL IN RESPONSE TO DOSED-EFFLUENT LOADING,
British Columbia Ministry of Environment, Victoria.
For primary bibliographic entry see Field 5E.
W85-06726

BIOACCUMULATION AND TOXICITY OF COPPER AS AFFECTED BY INTERACTIONS BETWEEN HUMIC ACID AND WATER HARDNESS,
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner.
Water Research, Vol. 19, No. 4, p 449-455, 1985. 6 Fig, 3 Tab, 14 Ref.

Descriptors: *Water pollution effects, *Copper, *Toxicity, *Daphnia, Humic acids, Hardness, Water properties, Physical properties, Bioaccumulation, Crustaceans.

Using Daphnia pulex and D. magna as models, the interactive effects of humic acid (HA) and water hardness on the acute and chronic toxicity and bioaccumulation of copper were investigated. In the absence of HA, an increase in water hardness from 58 to 115 mg/l had no significant effect on the LC50 for copper. In hard water (230 mg/l) the LC50 was significantly lower than in medium water. Humic acid significantly reduced the acute toxicity of copper. For each of the three water hardnesses tested, the LC50 was significantly higher in water containing 1.4 mg HA/l than in the same water to which no HA had been added. Reproduction was not a sensitive index of copper stress in daphnids. The accumulation of copper by daphnids was affected by water hardness, humic acid concentration and age at which animals were exposed to copper. The effect of water hardness on bioaccumulation was consistent for the two age groups and the reduction in copper bioaccmulation associated with a hardness increase from 58 to 115 mg/l can be interpreted as a result of an increased competition of Ca(2+) with Cu(2+) for binding sites at biosurfaces. The inhibiting effect of HA on bioaccumulation of copper by older daphnids decreased as water hardness increased. The effect of HA on bioaccumulation and toxicity of copper would appear to depend on the relative concentrations of Ca(2+), Mg(2+), and Cu(2+) in relation to HA concentration. Therefore, although Ca(2+) and Mg(2+) may have no direct effect on copper toxicity they may have an indirect effect through their interaction with humics. (Baker-IVI)
W85-06732

TRACE METALS IN SHATT AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Marine Science Centre.
J. K. Abaychi, and A. A. Z. DouAbul.
Water Research, Vol. 19, No. 4, p 457-462, 1985. 1 Fig, 5 Tab, 23 Ref.

Descriptors: *Trace metals, *Shatt Al-Arab River, *Iraq, *Arabian Gulf, Sediments, Particulates, Metals, Organic carbon, Geology, Catchment area.

The distribution of ten trace metals was investigated in the Shatt al-Arab River. The river originates from the confluence of the two major rivers of Iraq at Qurna. Karun River, the only tributary of the Shatt al-Arab River, joins its eastern bank south of Basrah City. The length of the Shatt al-Arab River from Qurna to its mouth in the Arabian Gulf is about 175 km. Shatt al-Arab waters are characterized as being well mixed with limited vertical stratification of temperatures and chlorinities. Low trace metal concentrations were encountered in the water along with low concentrations of particulate matter and surficial sediment. The rather high concentrations of both Ni and V have been attributed to the petroleum-rich substrate of the region. Hence, trace metals content in the Shatt al-Arab River seeems to be controlled by the abundance of metals in the rocks and soil of the river's catchment area and by their geochemical mobility. There are substantial numbers of signifi-

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cant and highly significant inter-element correlations. The most striking feature is the absence of significant correlation between the mean grain size and the total organic carbon content of the sediment with most of the trace metals studied in the River. (Baker-IVI)
W85-06733

COMPARISON OF HEAVY METALS IN AQUATIC PLANTS ON CHARITY ISLAND, SAGINAW BAY, LAKE HURON, U.S.A., WITH PLANTS ALONG THE SHORELINE OF SAGINAW BAY,
Michigan Univ., Ann Arbor. Div. of Biological Sciences.
G. F. Estabrook, D. W. Burk, D. R. Inman, P. B. Kaufman, and J. R. Wells.
American Journal of Botany, Vol. 72, No. 2, p 209-216, February, 1985. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Heavy metals, *Aquatic plants, *Michigan, *Charity Island, *Lake Huron, *Saginaw Bay, Neutron activation analysis, Silver, Aresnic, Barium, Cadmium, Cesium, Cobalt, Chromium, Nickel, Antimony, Thorium, Uranium, Zinc.

The concentrations of 15 heavy metals in aquatic plants on Charity Island was compared to those in plants on the shoreline of Saginaw Bay, Lake Huron. Heavy metal concentrations were measured by neutron activation analysis. Significant trends were encountered in 13 of 15 metals of which 9 (Ag, As, Ba, Cd, Ni, Rb, Se, Th, U) have significantly higher concentrations in the Island plants than in the plants along the shoreline of the bay. Higher values from the shoreline of Saginaw Bay were observed for Co, Cs, Sb, and Zn, but the shoreline samples also had most of the not detectable values. The location of Charity Island offers a more moderate climate than the shoreline of the bay. The bay surrounds Charity Island, keeping it cooler in the spring, and warmer than the mainland, well into the fall. The growth level of aquatic macrophytes achieved by summer is also an important factor that determines, in part, the capability and efficiency of these plants as sinks for heavy metals. The ratio of good heavy metal accumulators to all heavy metal accumulators was about the same on Charity Island and along the Saginaw Bay shore; at both sites, approximately 25% of the species sampled were good heavy metal accumulators. An understanding of heavy metal accumulation by aquatic macrophytes will contribute to an understanding of the spatial dynamics of heavy metal distribution, which in turn may enable one to more effectively control this dangerous class of pollutants, without unnecesarily reducing the efficiency of industrial activities. (Baker-IVI)
W85-06740

CONTAMINATION AND EFFECTS IN FRESHWATER DITCHES RESULTING FROM AN AERIAL APPLICATION OF CYPERMETHRIN,
Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.
For primary bibliographic entry see Field 5C.
W85-06742

FATE OF CHEMICALS IN AQUATIC SYSTEMS: PROCESS MODELS AND COMPUTER CODES,
Environmental Research Lab., Athens, GA.
L. A. Burns.
ACS Symposium Series, Vol. 225, p 25-40, 1983. 1 Fig, 56 Ref.

Descriptors: *Fate of pollutants, *Model studies, *Computers, *Aquatic environment, Transport, Transfer, Ionization, Sorption, Biosorption, Bioaccumulation, Volatilization, Photolysis, Hydrolysis, Oxidation, Biotransformation.

Aquatic fate models must account for several kinds of phenomena, including transport and transfer processes that move a compound among ecosystem segments and compartments, and degradation processes that convert the compound to transformation products. A brief summary is provided of the quantitative basis for describing these processes, a description of the logic and data structures used to asssemble fate codes, and a brief catalog of some of the main publicly available, better documented computer programs for aquatic fate. Transport and transfer processes considered include hydrodynamic transport, ionization, sorption, particle transport, interactions with benthic subsystems, biosorption, bioaccumulation, and volatilization. Transformation processes considered include direct photolysis, indirect photolysis and oxidation, hydrolysis, and microbial biotransformation. Logical and data structures of aquatic fate codes and considered with available aquatic fate codes described including EXAMS1/EMANS2, HSPF, PEST, SRI/SERATRA/TODAM/FETRA/CMRA, TOXIC, UTM-TOX, and WASP/TOXIWASP/WASTOX. (Baker-IVI)
W85-06765

SOIL AND GROUNDWATER FATE MODELING,
Little (Arthur D.), Inc., Cambridge, MA.
M. Bonazountas.
ACS Symposium Series, Vol. 259, p 41-65, 1983. 2 Fig, 4 Tab, 37 Ref.

Descriptors: *Model studies, *Groundwater movement, *Soil water, *Fate of pollutants, Unsaturated zone, Saturated zone, Chemical reactions, Mathematical models, Groundwater pollution, Soil contamination.

Soil compartment chemical fate modeling has been traditionally performed for three distinct subcompartments: land surface, the unsaturated soil zone, and the saturated zone of a region. Pollutants are released to the soil compartment through numerous human activities. Land disposal sites result in soil contamination through leachate migration. Pollutant sources include industrial, municipal, household, agricultural, mining, petroleum exploration and cooling water waste disposal. Environmental factors and the chemistry of waste deposits are reviewed with emphasis on physical processes (sorption/ion-cation exchange, diffusion/volatilization), chemical processes (ionization, hydrolysis, oxidation/reduction, complexation) and biological processes (bioaccumulation and biodegradation). Mathematical modeling is considered with emphasis on unsaturated soil zone modeling (TDE modeling, compartmental modeling, stochastic modeling and probabilistic modeling); physical, chemical, and biological processes modeled; saturated soil zone (groundwater) modeling; ranking modeling; and aquatic equilibria models. Selected models and issues described include PESTAN, SCRAM, SESOIL, PATHS, AT123D and MMT. (Baker-IVI)
W85-06766

NEW MATHEMATICAL MODELING SYSTEM,
University of the Pacific, Stockton, CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W85-06767

INTERACTIONS BETWEEN DISSOLVED HUMIC AND FULVIC ACIDS AND POLLUTANTS IN AQUATIC ENVIRONMENTS,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
C. W. Carter, and I. H. Suffet.
ACS Symposium Series, Vol. 259, p 215-229, 1983. 6 Fig, 2 Tab, 24 Ref.

Descriptors: *Fate of pollutants, *Mathematical models, *Humic acids, *Fulvic acids, Organic compounds, Solubility, Pesticides, DDT, DEPH, Lindane, Sorption, Sediments.

A number of mathematical models have been developed in recent years which attempt to predict the behavior of organic water pollutants. Work on the binding of pesticides and other pollutants by dissolved humic materials is summarized. Specific topics of discussion include methods available for quantitatively measuring the extent of binding of organic pollutants to dissolved humic materials, comparisons between methods, quantitative binding measurements, binding of various compounds by Pakim Pond Humic Acid, and binding of DDT by various humic materials. The extent of binding for a particular compound is related to the octanol/water partition coefficient for that compound. This is very similar to the sorption of compounds from water to sediment. Compounds with log Kow values less than four (such as Lindane) will probably not be bound to an appreciable extent in the environment. Compounds with very high log Kow values (DDT and DEHP) may be bound to a significant extent. The extent of binding will depend on both the concentration of humic material and on the nature of the humic material. The humic materials used in this research showed dramatically different affinities for DDT. The reasons for this are poorly understood and require further study. (Baker-IVI)
W85-06768

MATHEMATICAL MODELING APPLICATION TO ENVIRONMENTAL RISK ASSESSMENTS,
CIBA-GEIGY Corp., Greensboro, NC. Agricultural Div.
R. C. Honeycutt, and L. G. Ballantine.
ACS Symposium Series, Vol. 259, p 249-262, 1983. 1 Fig, 9 Tab, 3 Ref.

Descriptors: *Insecticides, *Mathematical models, *Environmental risk assessments, Runoff, Toxicity, Model studies, Path of pollutants, Fate of pollutants.

With any environmental risk assessment of a chemical, there are three factors: the environmental fate of a chemical; the exposure to the chemical; and the toxicity of the chemical to organisms inhabiting the environment in question. CGA-72662, a CIBA-GEIGY insect growth inhibitor, is used as an example to show how a risk assessment can be carried out using the SWRRB runoff model coupled to the EXAMS fate model. CGA-72662 is an insecticide which is being developed for use on celery in Florida. A description is offered of the runoff SWRRB and the EXAMS models. The use of SWRRB and EXAMS to assess the hazard of CGA-72662 to an aquatic environment is demonstrated with emphasis on SWRBB-EXAMS interconnections and the calculation for load input into EXAMS pond, the use of EXAMS ponds and lakes to determine environmental fate of CGA-72662, limitations of SWRRB and EXAMS models, SWRRB limitations and pitfalls, and EXAMS limitations and pitfalls. (Baker-IVI)
W85-06769

FATE OF CHEMICAL INSECTICIDES IN AQUATIC ENVIRONMENTS, FOREST SPRAYING IN CANADA,
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
K. M. S. Sundaram, P. D. Kingsbury, and S. B. Holmes.
ACS Symposium Series, Vol. 238, p 253-276, 1984. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Insecticides, *Forest watersheds, *Fate of pollutants, *Aquatic environments, Water pollution sources, Transport, Volatilization, Dilution, Distillation, Plants, Fish, Insects, Adsorption, Suspended particulates, Microbial degradation.

The environmental behavior of some forestry insecticides in aquatic systems was studied under controlled conditions in laboratory model ecosystems and in forest streams following experimental stream injections or operational forest spraying. In dynamic stream ecosystems applied chemicals reaching stream surfaces are rapidly lost by transport, dilution, volatilization and co-distillation. The small fraction that persists in water disappears partly by absorption by aquatic organisms such as plants, insects and fish, and also by adsorption onto suspended particulates, where it likely degrades by microbial reduction. In the light of this, if current use patterns are rigidly adhered to and where necessary, improved and modified, these chemicals could seldom pose any significant long-term harm (biomagnification and resultant damage) to the aquatic ecosystem. (Baker-IVI)
W85-06770

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FATE OF FENITROTHION IN SHADED AND UNSHADED PONDS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
G. P. Malis, and D. C. G. Muir.
ACS Symposium Series, Vol. 238, p 277-295, 1984. 2 Fig, 7 Tab, 19 Ref.

Descriptors: *Fenitrothion, *Fate of pollutants, *Ponds, *Shade, Organic compounds, Degradation, Sunlight, Radiation, Insecticides, Solar radiation, Pesticide residues, Carbon radioisotopes.

Fenitrothion (labelled with C-14) was applied to two outdoor ponds at a rate of 165 g/ha on two consecutive years. One pond was shaded from direct sunlight with black polyethylene for the first 17 days of the experiment to simulate a forest pond. Initial concentrations of the insecticide in water were about 70 micro-g/l. The effect of shading after fenitrothion addition was to increase the half-life of the insecticide by about 50%. Despite a 30-fold reduction in light intensity, the decline in insecticide residues in water was rapid dropping from 70 micro-g/l to about 0.01 micro-g/l by 17 days. Shaded condition decreased the quantities of other products and MNP that were formed, however, no major products unique to shaded or unshaded conditions were identified. A large portion of radioactivity in water, sediment and plants was unextractable with conventional techniques, especially in samples taken after 10 days post-treatment. Volatilization from water was slow compared to other paths of degradation of the insecticide. The radioactivity added to the ponds was only accounted for successfully during the first 5 days of post-treatment despite knowledge of the size of the major compartments and the use of direct assays such as combustion to C-14 labelled CO2. Loss of radioactivity due to penetration to lower depths in sediment and degradation of the ring label to volatile carbon fragments and C-14 labelled CO2 in the water column may have occurred but are unlikely to total all of the 70-80% unaccounted for. The ultimate fate of the radiolabelled material in aquatic systems under field conditions is needed for further study. (Baker-IVI)
W85-06771

RADIONUCLIDE SORPTION AND DESORPTION REACTIONS WITH INTERBED MATERIALS FROM THE COLUMBIA RIVER BASALT FORMATION,
Atomics International Div., Richland, WA. Energy Systems Group.
G. S. Barney.
ACS Symposium Series, Vol. 246, p 3-23, 1984. 4 Fig, 7 Tab, 10 Ref.

Descriptors: *Radioisotopes, *Adsorption, *Desorption, *Geochemistry, *Columbia River Basalt Formation, Fate of pollutants, Groundwater, Cesium, Strontium, Radium, Technetium, Neptunium, Plutonium, Uranium, Minerals, Hysteresis, Radioactive wastes.

Sorption and desorption behavior of radionuclides was studied in three samples from groundwater-interbed systems of the Columbia River (USA) basalt formation. A sandstone and a tuff from the Rattlesnake Ridge Interbed and a sandstone/claystone from the Mabton Interbed were employed in batch equilibration experiments with tracers, three types of synthetic groundwater, and interbed solids. Triplicate measurements were made for various combinations of temperature, redox (Eh) condition, tracer concentration, tracer type, groundwater composition, and interbed sample; constant temperatures were maintained. Sodium, potassium, and calcium in the groundwater decreased sorption of cesium, strontium, and radium by ion exchange reactions. Groundwater Eh strongly affected sorption of technetium, neptunium, plutonium, and uranium. Effects on sorption from radionuclide complexation by groundwater anions were not observed except for neptunium carbonate (or bicarbonate) complexes and plutonium sulfate complexes. Sorption and desorption isotherms obtained under oxidizing and reducing conditions were accurately described by the Freundlich equation except when precipitation of the radionuclide occurred. Most radionuclides were apparently irreversibly sorbed on each of the geologic solids because the slopes of sorption and desorption isotherms for a given radionuclide were different. This hysteresis effect was very large, and should cause a significant delay in radionuclide transport. The hysteresis effect should be included by modeling radionuclide transport as part of assessment of the isolation capabilities of basalt for safety of a high-level radioactive waste repository. (Rochester-IVI)
W85-06773

INTERACTION OF GROUNDWATER AND BASALT FISSURE SURFACES AND ITS EFFECT ON THE MIGRATION OF ACTINIDES,
Argonne National Lab., IL.
G. F. Vandegrift, D. L. Bowers, T. J. Gerding, S. M. Fried, and C. K. Wilbur.
ACS Symposium Series, Vol. 246, p 229-247, 1984. 4 Fig, 6 Tab, 15 Ref.

Descriptors: *Radioactive wastes, *Fate of pollutants, *Groundwater pollution, *Basalt, Geological fractures, Calcium, Potassium, Bentonite, Radioisotopes, Actinides, Geochemistry.

Analog experiments designed to simulate conditions existing in the event of a breach in a nuclear waste repository in basalt suggested a strong correlation between changes in groundwater composition and radionuclide retardation in basalt. Synthetic groundwater was pumped through a series of three vessels containing, 1) basalt chips, bentonite, and the glass waste form; then 2) bentonite and basalt chips; and finally 3) a narrow basalt fissure. Results suggest that fresh, unaltered basalt fissures and surfaces will not be in equilibrium with ground water than enters the nuclear waste repository area (Hanford, Washington). A steady-state groundwater composition will be achieved in a relatively short time (20-25 days in the laboratory); Ca(2+) and K(+) will be increased above initial concentrations, and Na(+) and pH will be decreased, probably due to hydrolysis and alteration of minerals on the basalt surface. While bentonite is transported by flowing, unaltered groundwater, interaction with unaltered basalt surfaces appears to agglomerate it and bind it to the basalt. Unaltered basalt appears to effectively limit the migration of actinides dissolved or suspended in the groundwater. Gamma radiation does not substantially affect groundwater compositional changes due to interactions with unaltered bentonite and basalt, but appears to generate identifiable differences in actinide leaching from the waste form. Gamma radiation perceptibly modifies leaching characteristics of the waste form. The mechanism responsible for actinide retardation in basalt fissures is unknown. (Rochester-IVI)
W85-06774

ROLE OF ORGANICS IN THE SUBSURFACE MIGRATION OF RADIONUCLIDES IN GROUNDWATER,
Battelle Pacific Northwest Labs., Richland, WA.
A. P. Toste, L. J. Kirby, and T. R. Pahl.
ACS Symposium Series, Vol. 246, p 251-270, 1984. 3 Fig, 6 Tab, 10 Ref.

Descriptors: *Radioactive waste, *Waste disposal, *Fate of pollutants, *Groundwater pollution, Maxey Flats, Kentucky, Groundwater movement, Migration, Geological fractures, EDTA, Organic compounds, Radioisotopes.

Subsurface migration of radionuclides has been studied at the Maxey Flats burial site, Kentucky, where the groundwater is anoxic. The Maxey Flats site is one of several commercial shallow land burial sites for low-level radioactive waste in the eastern United States where rainfall is comparatively high. Trench cap subsidence and infiltration of surface water into waste trenches are greater problems at wet eastern sites compared to arid western sites. Factors governing the subsurface migration of radionuclides appear to be extremely complex. A study has been completed of radionuclide migration and groundwater movement in an experimental study area constructed adjacent to a waste-filled trench. Currently underway is a research effort aimed at elucidating the role of organic species in the subsurface migration of radionuclides. A survey study has been completed aimed at mapping the organic content of various groundwater samples from waste trenches and the experimental study area. A detailed chemical speciation study was also begun to determine which organic compounds identified in the survey study are complexed or chelated to radionuclides. Certain radionuclides (H-3, Pu-238, Pu-239, Pu-240, Sr-90, Co-60, and Cs-137) have migrated within the study area over relatively short distances of 4 to 7 m. The chelator EDTA and three EDTA-like fragments are the major hydrophilic organic species (ppm levels) in leachate from two waste trenches and one inert atmosphere well. Trace levels of hydrophobic organic species (generally ppb levels), including two barbiturates, were also identified in waste leachate and water from an inert atmosphere well. On the basis of steric exclusion chromatography, it is clear that polar organic species in the groundwaters co-elute with certain radionulcides and are, therefore, presumably chelated. Pu and Co-60 coelute with EDTA. The appearance of EDTA and the barbiturates in only one inert atmosphere well argues that communication between the waste-filled area and the experimental study area is very specific, presumably via fracture flow. Radionuclide, inorganic and organic data indicate that the groundwater flow patterns are complex, at least in the vicinity of the experimental study area. (Baker-IVI)
W85-06775

RELEASES OF RADIUM AND URANIUM INTO RALSTON CREEK AND RESERVOIR, COLORADO, FROM URANIUM MINING,
Geological Survey, Denver, CO.
I. C. Yang, and K. W. Edwards.
ACS Symposium Series, Vol. 246, p 271-286, 1984. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Uranium, *Radium, *Path of pollutants, *Colorado, *Ralston Creek, *Ralston Reservoir, Creeks, Reservoirs, Uranium mining, Sediments, Suspended solids, Particle size, Mining.

Dissolved U concentrations were determined in wastewater from a uranium mine, in water fom Ralston Creek (Colorado) upstream from and downstream from the discharge point, and from Ralston Reservoir, located 2.5 mi downstream from the mine. Dissolved Ra-226 concentrations in the mine effluent, the creek and the reservoir were all less than the limit of 3 pCi/l set by drinking water regulations, whereas dissolved U in Ralston Creek ranges from 600 to 1200 micro-g/l and is 1,700 micro-g/l in the mine outflow. The EPA is planning to set a guidance level of 10 pCi/L (14.7 micro-g/l) of U in drinking water. The mine operator also is studying ways to remove U from the water. Suspended Ra-226 and U concentrations were very high, as much as 600 pCi/g for Ra-226 and 1,000 micro-g/g for U in the creek, and 20 pCi/g for Ra-226 and 200 micro-g/g for U in the reservoir. In bottom sediment from the creek bed, concentrations of both radionulcides increase as particle-size decreases, and as distance downstream from the mine decreases. The greatest concentrations of Ra-226 and U in the sediment are several tens to hundreds of times greater than the background concentrations. The greater than natural radioactivity in the sediment of Ralston Creek may be partly due to U-ore particles discharging directly into the creek during the early days of the mine operation and partly due to suspended solids of Ba(Ra)SO4 and fine U-ore from present day discharges. Leaching studies indicate that these radionuclides associated with sediment are not in the form of adsorbed ions, but in the form of discrete minerals, or are partly trapped inside the colloidal hydroxides of Fe and Mn coated on the sediment. (Baker-IVI)
W85-06776

URANIUM MOBILITY IN THE NATURAL ENVIRONMENT; EVIDENCE FROM SEDIMENTARY ROLL-FRONT DEPOSITS,
Battelle Pacific Northwest Labs., Richland, WA.
W. J. Deutsch, and R. J. Serne.
ACS Symposium Series, Vol. 246, p 287-302, 1984.

6 Fig, 2 Tab, 21 Ref. DOE contract DE-AC06-76RL0 1830.

Descriptors: *Uranium, *Path of pollutants, *Radioactive wastes, Model studies, Computers, Transport, Groundwater pollution, Leaching, Geochemistry, Simulation, Hydrogen ion composition, Water temperature, Mining.

The behavior of uranium stored as nuclear waste in a geologic repository will be partially controlled by the geochemical environment of the repository. The effect of groundwater leaching on the waste can be simulated by estimating a groundwater composition and then using an equilibrium thermodynamic computer model to simulate the interaction of the waste with the solution. Roll-front deposits consists of naturally occurring ore-grade U in sandstone aquifers. The geochemical environment of these roll-front deposits is analogous to the environment of a radioactive waste repository containing redox-sensitive elements during its post-thermal period. In typical aquifers with oxidizing groundwater, uranium's concentration in solution appears to be limited by its abundance in source rocks. The uranium in ground water is removed from solution and deposited at a redox interface between sediments with reducing minerals and sediments without. If the environmental condition of the ore zone changes as a result of either natural or manmade causes, the uranium can become very mobile. This is evidenced by the in situ mining process in which relatively minor modifications are made to the groundwater chemistry to produce a solution that can rapidly dissolve uranium and maintain uranium solution concentrations of hundreds of parts per million. The effect of changing environmental conditions on the stability of the uraninite was determined through a model study and the amount of uranium that might be expected in solution was estimated. The pH, Eh, and temperature of the groundwater each significantly affected the dissolution of the uraninite. This type of simulation can be useful in assessing the environmental compatibility of various proposed deep geologic repository sites to the waste form. Although a given waste form may dissolve rapidly under certain breach conditions, uranium may not be very mobile in a deep aquifer where reducing conditions are reestablished after the groundwater moves away from the repository. (Baker-IVI)
W85-06777

EFFECTS OF WATER FLOW RATES ON LEACHING,
Illinois Univ. at Urbana-Champaign.
C. Pescatore, and A. J. Machiels.
ACS Symposium, Vol. 246, p 349-358, 1984. 4 Fig, 12 Ref.

Descriptors: *Flow rates, *Leaching, *Glass, Permeability, Radioactive waste disposal, Path of pollutants, Groundwater pollution, Solubility.

In glass leaching experiments, using complex, simulated nuclear waste glasses, the rate of renewal of the corrosion solution is an important system parameter. The distinguishing feature of the flow rate effects on leaching is that they determine the long-term rate controlling leaching mechanisms. Under dynamic leaching conditions saturation of the solution is never achieved; steady state elemental releases are thus controlled by dissolution of the glass network. The higher the flow rate, the faster steady-state is approached, and the higher the resulting leach rates. Under low groundwater flow rates, leaching is controlled eventually by the selective release from the glass of modifer species which have high solubilities in water. The release of species with lower solubilities than the network former controlling the dissolution process may or may not slow down leaching of both glass modifiers and network formers. In general, the mechanistic leaching code LIX appears particularly well suited for deriving from information obtained in static tests the leach rates applicable to any flow conditions, including the low flow conditions which are difficult to simulate experimentally. (Baker-IVI)
W85-06778

TOXINS FROM FRESHWATER CYANOBACTERIA,
Wright State Univ., Dayton, OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W85-06779

PESTICIDE AVAILABILITY INFLUENCE OF SEDIMENT IN A SIMULATED AQUATIC ENVIROMENT,
Agricultural Research Service, Beltsville, MD. Pesticide Degradation Lab.
A. R. Isensee.
ACS Symposium Series, Vol. 259, p 261-277, 1984. 4 Fig, 6 Tab, 6 Ref.

Descriptors: *Pesticides, *Insecticides, *Sediments, *Aquatic environment, *Fate of pollutants, DDT, DDD, DDE, Path of pollutants, Enviromental protection, Fish, Snails, Algae, Daphnia, Chlorinated hydrocarbons.

Sediment additions were made to model aquatic environments containing DDT equilibrated between sediment, water, and four species of aquatic organisms to determine if pesticide availability to biota was reduced through normal sedimentation events. Soil treated with C-14-labeled DDT at 10, 100, and 1000 ppm was flooded and fish (Gambusia affinis), snails (Helosoma sp.), algae (Oedogonium cardiacum), and daphnids (Daphnia magna) were added. At two-wk intervals, untreated sediment additions (equalling 1% of the water weight) were made. Samples of water and organisms, taken before and after sediment additions, were analyzed for DDT, DDE, and DDD and compared to equilibrated systems not treated with sediment. DDT content in water decreased 3- to 9- fold by the first sediment addition. Polar metabolites in water increased as DDT decreased. Fish were killed at the 1000 ppm level and daphnids succumbed at 100 and 1000 ppm levels. Sediment additions substantially reduced the toxicity at lower treatment levels. Sediment additions decreased total C-14 by 6 to 13% in fish, 20 to 40% in algae, 45 to 50% in snails and 55% in daphnids (10 ppm rate). Measureable levels of DDT do not diffuse through 1 cm or more of untreated soil into water in one yr. Covering pesticide contaminated sediment with soil and sediment in situ is an effective contamination control method under certain aquatic conditions. (Author's abstract)
W85-06783

POTENTIAL PESTICIDE CONTAMINATION OF GROUNDWATER FROM AGRICULTURAL USES,
Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.
S. Z. Cohen, S. M. Creeger, R. F. Carsel, and C. G. Enfield.
ACS Symposium Series, Vol. 259, p 297-325, 1984. 5 Tab, 121 Ref.

Descriptors: *Pesticides, *Groundwater pollution, Fate of pollutants, Chemical properties, Chemical properties, Soil properties, Agricultural chemicals, Hydrolysis, Photolysis, Pesticides residues.

Combinations of pesticide characteristics and field conditions most likely to be associated with groundwater contamination as a result of agricultural use are given based on a summary of chemical uses and properties and current monitoring data. Chemical characteristics and monitoring data are reviewed for alachlor, aldicarb and products, atrazine, bromacil, carbofuran, 1,2-dibromo-3-chloropropane (DBCP), dimethyl tetrachloroterephthalate (DCPA) and products, dichloropropane, dinoseb, 1,2-dibromoethane (EDB), oxamyl, and simazine. The key environmental fate parameters for mathematical modeling, K sub oc (= soil water distribution coefficient, K sub d, divided by soil organic carbon content), K sub d, solubility, hydrolysis half-life, soil/field dissipation half-life, and pK sub a, are tabulated for these pesticides. Based on the limited data available, certain chemical characteristics in combination with certain field characteristics appear to be associated with a high potential for groundwater contamination. Chemical characteristics are solubility in water > about 30 ppm, K sub d < 5, usually < 1 or 2, K sub oc < 300-500, Henry's law constant of < 0.01 atmosphere-cu m/mol, either fully or partially negatively charged at ambient pH, hydrolysis half-life of about 25 wk, photolysis half-life of > about 1 wk, and soil half-life > 2-3 wk. Field conditions are total precipitation and irrigation recharge > about 25 cm/yr (high recharge typically is associated with low moisture holding capacity of the soil), high levels of nitrates in ground water, porous soil above an unconfined aquifer, and a soil pH providing high stability to pesticide residues. These generalizations also may apply to some degree to uncontrolled hazardous waste sites. (Rochester-IVI)
W85-06784

NITROGEN AND PHOSPHORUS IN ROTORUA URBAN STREAMS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. A. Hoare.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 4, p 451-454, 1984. 4 Tab, 4 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Lake Rotorua, *New Zealand, *Urban catchments, *Fate of pollutants, Water pollution effects, Nutrients, Wastewater treatment, Septic tanks, Septic wastewater.

Three suburban catchments of Lake Rotorua (New Zealand) were surveyed as part of the establishment of the Lake's nutrient budget. The catchments contribute about 2% of the inorganic nitrogen load and much less than 1% of the phosphorus load. However, nitrate concentrations in urban streams at Rotorua are an order of magnitude higher than those in nearby rural streams. The loads of nitrogen are consistent with the loads discharged to septic tanks in the stream catchments. Despite the large number of septic tanks in the catchment, phosphorus concentrations are no higher than in rural streams, and phosphorus loads in the streams are less than 2% of the load on the septic tanks. The soil is apparently capable of retaining almost all of the phosphorus load from septic tanks. Nitrate in the streams is slowly decreasing now that a sewerage reticulation system is almost complete. Phosphorus load on the lake from buildings in these suburban catchments will be increased by the installation of sewerage, unless effluent from the treatment plant is diverted from the lake, or very good phosphorus stripping is incorporated in the treatment process. Since the effects studied in these catchments are probably generally occurring in the Rotorua suburban area, the overall effect of sewerage reticulation on the lake could be quite important. (Collier-IVI)
W85-06796

WITHOUT WATER THE WORK OF DEATH WOULD BE INCOMPLETE,
Glasgow Univ. (Scotland). Dept. of Microbiology.
For primary bibliographic entry see Field 2K.
W85-06800

SULPHATE AND NITRATE CONCENTRATIONS IN SNOW FROM SOUTH GREENLAND 1895-1978,
Bern Univ. (Switzerland). Physikalisches Inst.
A. Neftel, J. Beer, H. Oeschger, F. Zurcher, and R. C. Finkel.
Nature, Vol. 314, No. 6012, p 611-613, April 18, 1985. 3 Fig, 1 Tab, 24 Ref.

Descriptors: *Sulfates, *Nitrates, *Snow, *Greenland, *Acid rain, Hydrogen ion concentration, Ice, Rain, Water pollution sources, History.

An understanding of the phenomenon of acid rain requires the identification of the sources of the species affecting the pH of rainwater, both natural and anthropogenic, and their temporal and spatial development. The scant data concerning the historical development of the acidity in precipitation are from urban regions or their vicinity, where local effects dominate and obscure the hemispherical pattern. The Greenland ice sheet allows us to

trace the evolution of the acid rain in a remote location that is free from local effects. Sulfuric and nitric acids are the two species that dominate the acidity in precipitation. We report here measurements of SO4(-2) and NO3(-) concentrations in firn samples spanning the period 1895-1978. Samples, each covering 1 yr, were taken from a 70-m core drilled at Dye 3, South Greenland; NO3(-) and SO4(-2) both increased by a factor of approximately 2 during the period. By comparing the recent concentrations of nitrate and sulfate with those resulting from natural sources, we conclude that anthropogenic emissions of the precursors (NOx, SO2) had already surpassed natural sources in the late 1950s. (Author's abstract)
W85-06801

CHANGES IN CHEMICAL COMPOSITION OF PRECIPITATION AS IT FALLS (OB IZMENENII KHIMICHESKOGO SOSTAVA ATMOSTERNYKH OSADKOV V PROTSESSE IKH VYPADENIYA),
T. N. Gromova, G. B. Sveshnikov, and T. M. Ungerman.
Vestnik Leningradskogo Universiteta Geologiia-Geografiia, Vol. 24, p 80-85, 1984. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Precipitation chemistry, *Fate of pollutants, *Northern Moldavia, *USSR, Sulfates, Chlorides, Nitrates, Carbonates, Sodium, Potassium, Magnesium, Calcium, Ammonium, Hydrogen ion concentration.

The changes in chemical composition of atmospheric precipitation in the process of natural washing-out of pollutants from the atmosphere were presented. The change of macroelement composition of precipitation is particularly significant during the first 40-60 min of its fall while the microelement content changes little with time. The investigation was carried out in the summer periods of 1976-1980 in the Northern Moldavia (the Soroksky district) (USSR). (Author's abstract)
W85-06808

RADIONUCLIDE LEVELS AND DISTRIBUTION IN GRAZED SALTMARSH IN WEST CUMBRIA,
Institute of Terrestrial Ecology, Grange over Sands (England). Merlewood Research Station.
A. D. Horrill.
Environmental Pollution (Series B), Vol. 8, No. 4, p 265-280, 1984. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Radioisotopes, *Salt marshes, *Cumbria, *England, *Fate of pollutants, Vegetation, Water pollution sources, Marshes, Tidal marshes, Vegetation, Fowl, Sheep, Fowl, Water pollution effects.

Radionuclides discharged by the nuclear reprocessing plant at Sellafield (formerly Windscale) are being accumulated in sediments in the estuary complex formed by the Rivers Irt, Mite and Esk at Ravenglass, Cumbria, England. Radionuclide levels and distribution in the surface silts and vegetation of the saltmarsh were investigated as they are the basis for pathways to man via grazing animals and, to a lesser extent, wildfowl. The grazed area was compared to a previously described ungrazed area in the same estuary complex. A complete gamma spectrum was obtained for samples of vegetation and silt using a pair of coaxial Ge(Li) detectors. Variability in the grazed area is large spatially and other work has demonstrated that a temporal element is also present. Stratification based on the vegetation is less successful in reducing the spatial variation than previously described ungrazed marsh. This can be explained by the absence of a physical structure due to heavy grazing pressures. Accumulation of radionuclides appears to be primarily a physical process dominated by tidal factors. A second important influence is the physical structure of the vegetation present on the saltmarsh. The levels present on the vegetation, heavily grazed by sheep and some estuarine birds, are important when transfers are considered. Radionuclides seem to be associated with the fine grain silt deposits on the vegetation and thus biological activity may be relatively low. The high levels of variability found within a distance of a few hundred meters, c. 20-460 pCi/g in the case of Cs-137, have important implications when sampling schemes are considered for research or monitoring programs. (Collier-IVI)
W85-06814

CONTAMINATION OF AQUIFERS BY OVERPRESSURING THE ANNULUS OF OIL AND GAS WELLS,
Allegheny Coll., Meadville, PA.
S. S. Harrison.
Ground Water, Vol. 23, No. 3, p 317-324, May-June, 1985. 6 Fig, 7 Ref.

Descriptors: *Aquifers, *Hydrodynamic pressure, *Oil wells, *Gas wells, *Wells, *Groundwater contamination, Well casings, Water pollution prevention, Water pollution sources, Environmental protection.

Medina gas wells and oil wells in northwestern Pennsylvania, northeastern Ohio, and western New York create a potential for contamination of the fresh-water aquifers that overlie the production zones of these wells. Most of these wells are constructed in a manner which results in an open annulus which is a few hundred to a few thousand feet long below the surface casing of the well. This annulus is a potential avenue of migration of contaminants from strata of higher hydrodynamic pressure into formations of lower hydrodynamic pressure. If gas from the strata exposed to the annulus is not permitted to escape to the atmosphere, the annulus may become pressurized, and a hydraulic gradient may be created between the potential contaminants in the annulus (e.g., brine and/or natural gas) and the overlying fresh-water aquifers. If a permeability pathway exists between the pressurized annulus and an overlying fresh-water aquifer, contamination of the aquifer will result. The risk of contaminating fresh groundwater with the contents of a gas- or oil-well annulus could be greatly reduced by filling the annulus with cement. An alternative precaution would be to operate the well in a manner that does not allow the annulus pressure to exceed the normal pressure of the formations exposed to the annulus. (Author's abstract)
W85-06820

DISTRIBUTION OF VOLATILE ORGANIC COMPOUNDS IN A NEW JERSEY COASTAL PLAIN AQUIFER SYSTEM,
Geological Survey, Trenton, NJ.
T. V. Fusillo, J. J. Hochreiter, and D. G. Lord.
Ground Water, Vol. 23, No. 3, p 354-360, May-June, 1985. 6 Fig, 3 Tab, 10 Ref.

Descriptors: *New Jersey, *Pennsylvania, *Potomac Aquifer, *Raritan Aquifer, *Magothy Aquifer, *Aquifers, *Groundwater contamination, *Volatile organic compounds, Path of pollutants, Trichloroethylene, Tetrachloroethylene, Benzene, Aromatic hydrocarbons, Chlorinated hydrocarbons, Water pollution sources.

Samples for analysis of volatile organic compounds were collected from 315 wells in the Potomac-Raritan-Magothy aquifer system in southwestern New Jersey and a small adjacent area in Pennsylvania during 1980-82. Volatile organic compounds were detected in all three aquifer units of the Potomac-Raritan-Magothy aquifer system in the study area. Most of the contamination appears to be confined to the outcrop area at present. Low levels of contamination, however, were found downdip of the outcrop area in the upper and middle aquifers. Trichloroethylene, tetrachloroethylene, and benzene were the most frequently detected compounds. Differences in the areal distributions of light chlorinated hydrocarbons, such as trichloroethylene, and aromatic hydrocarbons, such as benzene, were noted and are probably due to differences in the uses of the compounds and the distribution patterns of potential contamination sources. The distribution patterns of volatile organic compounds differed greatly among the three aquifer units. The upper aquifer, which crops out mostly in less-developed areas, had the lowest percentage of wells with volatile organic compounds detected (10 percent of wells sampled). The concentrations in most wells in the upper aquifer which had detectable levels were less than 10 micro g/l). In the middle aquifer, which crops out beneath much of the urban and industrial area adjacent to the Delaware River, detectable levels of volatile organic compounds were found in 22 percent of wells samples, and several wells contained concentrations above 100 micro g/l. The lower aquifer, which is confined beneath much of the outcrop area of the aquifer system, had the highest percentage of wells (28 percent) with detectable levels. This is probably due to (1) vertical leakage of contamination from the middle aquifer, and (2) the high percentage of wells tapping the lower aquifer in the most heavily developed areas of the outcrop. (Author's abstract)
W85-06825

TRANSPORT OF ORGANIC COMPOUNDS DISSOLVED IN GROUND WATER,
Tucson Water Dept., AZ.
J. M. Newsom.
Ground Water Monitoring Review, Vol. 5, No. 2, p 28-36, Spring, 1985. 1 Fig, 51 Ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Organic compounds, Transport, Pesticides, Adsorption, Aquifers, Biodegradation, Trace levels, Water analysis, Benzenes, Advection, Dispersion, Groundwater movement.

The transport of organic compounds is diffucult to predict, more so than the flow of groundwater itself, for the following reasons. Trace amounts of pollutants are hard to measure. Transport is complicated if the compound is partitioned into several phases. The concentration of organics in ground water may vary due to aquifer heterogeneity and other hydrologic factors. Reactions with other organic compounds and reactions with the aquifer material may affect the mobility of the organics. Biodegradation may also affect net transport. Transport processes reviewed include advection and dispersion, adsorption and biodegradation. Various chemical groups included in the discussion are halogenated aliphatics, alkyl benzenes, chorobenzenes, and pesticides. While progress has been made in understanding pollutant travel in groundwater supplies, several recommendations are offered for areas that still need research. Some polar organic compounds are not commonly detectable by present methods. In cases where the aquifer may contain sufficient carbon for adsorption to be significant, the empirical relationships that have been developed may be useful for determining the partitioning behavior of organic pollutants. Some elements, such as N, S, or P-compounds, when injected into pollution plumes may promote microbial degradation. More work is also needed to determine how flushing of an aquifer via injection and extraction wells affects those pollutants sorbed onto aquifer or soil material. (Baker-IVI)
W85-06829

DEVELOPING OBJECTIVES FOR THE GROUND WATER QUALITY MONITORING NETWORK OF THE SALINAS RIVER DRAINAGE BASIN,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7A.
W85-06830

ANALYTICAL METHODS FOR THE PREDICTION OF LEACHATE PLUME MIGRATION,
Oklahoma State Univ., Stillwater. Dept. of Geology.
D. C. Kent, W. A. Pettyjohn, and T. A. Prickett.
Ground Water Monitoring Review, Vol. 5, No. 2, p 46-59, Spring, 1985. 9 Fig, 4 Tab, 19 Ref.

Descriptors: *Plumes, *Leachates, *Mathematical models, *Groundwater pollution, Graphical analysis, Prediction, Groundwater movement, Path of pollutants, Computers.

An analytical method developed for predicting leachate movement as part of the evaluation of permit applications dealing with hazardous waste

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treatment, storage and disposal facilities can also be used to develop monitoring plans. The methods can be used to estimate or predict what the concentration in a leachate plume might be at some point in space and time. The plume evaluation system is quantitative and is suitable for computer manipulation. The assumptions of the model are: (1) ground water flow regime is saturated, (2) the aquifer is unlimited in areal extent (3) all aquifer properties are homogeneous and isotropic (4) ground water flow is continuous and uniform in direction and velocity. The value or accuracy of the prediction, at best, can be no better than the estimate of the hydrogeologic and chemical parameters that are factored into the equations. (Cutty-IVI)
W85-06831

INVESTIGATIONS AT SITES CONTAMINATED WITH DENSE, NON-AQUEOUS PHASE LIQUIDS (NAPLS),
Pennsylvania Power and Light Co., Allentown. Environmental Management Div.
J. F. Villaume.
Ground Water Monitoring Review, Vol. 5, No. 2, p 60-74, 1985. 15 Fig, 51 Ref.

Descriptors: *Groundwater contamination, *Organic compounds, *Path of pollutants, Fate of pollutants, Water pollution, Hydrocarbons, Density, Unsaturated zone, Saturated zone.

Increasingly, groundwater supplies are being found to be contaminated with organic substances. Depending on the nature of these substances and the method by which they were introduced into the environment, they may form a second, dense liquid phase. Several such cases have been reported in the recent literature. In other cases, such a second phase might have actually been present but was not found because the principles governing its distribution were not understood and no effort was made to look for it. In this case, the undetected material could continue to migrate and act as a source of dissolved organics. The general principles governing the behavior of dense, immiscible second-phase organic liquids in both the unsaturated and saturated zones were reviewed based primarily on the petroleum industry literature for primary hydrocarbon migration and on the oil spill literature. This specialized knowledge can be used to conduct a meaningful and efficient investigation of such contamination sites and can also be used to select and implement successful remedial measures. Several actual case studies applying the principles of multi-phase flows were presented. (Author's abstract)
W85-06832

MODELING FLUID FLOW IN SELECTIVE PLACEMENT OF TOXIC MINE SPOIL,
Pennsylvania State Univ., University Park. Dept. of Mining Engineering.
L. B. Phelps, J. C. Mills, and L. W. Saperstein.
Mining Engineering, Vol. 37, No. 4, p 328-333, April, 1985. 9 Fig, 6 Ref.

Descriptors: *Mine wastes, *Waste disposal, *Water pollution control, *Burial, Finite element method, Water table, Permeability, Drainage, Anisotropy, Infiltration, Model studies, Groundwater movement.

Methods of burial of mine spoil to control environmental damage are not well understood. Using the finite element method, the burial of toxic material is investigated within low permeability packages below the water table. The effects of differing package and spoil permeabilities, anisotropy, and infiltration are modeled to provide information about their effect on the flow system. Projections can then be made that will assist in the design of the toxic spoil package to limit the amount of ground water flowing through them. The experiment was designed to measure the effects of package permeability, higher permeabily basal spoil, anisotropy, and infiltration when using a single densified package. When using a single undensified package surrounded by a low permeability barrier the following parameters were investigated: effect of barrier permeability, effect of increasing package wall thickness, effect of infiltration, and the effect of higher permeability basal spoil. (Baker-IVI)
W85-06839

COMPARATIVE STUDY OF MERCUPV CONTAMINATION IN THE TAGUS ESTUARY (PORTUGAL) AND MAJOR FRENCH ESTUARIES (GIRONDE, LOIRE, RHONE),
Ecole Normale Superieure, Paris (France).
G. Figueres, J. M. Martin, M. Meybeck, and P. Seyler.
Estuarine, Coastal and Shelf Science, Vol. 20, No. 2, p 183-203, February, 1985. 9 Fig, 3 Tab, 34 Ref.

Descriptors: *Mercury, *Tagus Estuary, *Portugal, *Gironde estuary, *Loire estuary, *Rhone estuary, *France, *Metals, *Estuarine environment, Heavy metals, Organic mercury, Inorganic mercury, Path of pollutants, Source of pollutants, Sediments, Particle size.

Concentrations of mercury were determined for the waters, suspended matter and sediments of the Tagus and of major French estuaries. The Tagus estuary is one of the most contaminated by mercury derived from the outfalls of a chloralkali plant and from other industrial sources. In deposited sediments the median level, 1.0 micro g Hg/g, is twenty times higher than the natural background and Hg contents depend on the sediment grain-size, age and the distance from waste-outfalls. Suspended matter is more regularly and highly contaminated (median value: 4.5 micro g Hg/g). In the French estuaries Hg levels in the suspended material decrease with salinity due to dilution and/or remobilization processes. In June 1982, in the Loire estuary, high values of Hg were observed in the middle estuary and attributed to urban and industrial sources. In the Tagus estuary, the general distribution of total dissolved Hg confirms the contamination: it increases seaward from 10 ng/l in the river to 80 ng/l in the estuary outlet. The dissolved Hg is almost totally organic in the river, inorganic in the middle estuary due to inorganic Hg effluents and again organic in the lower estuary. This variation is related to the dissolved organic carbon values. The dissolved Hg levels in the Loire Estuary (5-300 ng/l) are much higher than in the Gironde estuary (3-6 ng/l) and of the same order as those observed in the Tagus estuary. (Author's abstract)
W85-06854

BACTERIAL DEGRADATION OF SELECTED ORGANICS IN NATURAL WATERS OF NORTHEASTERN MINNESOTA,
Minnesota Univ.-Duluth. Dept. of Chemistry.
J. Cooley, R. Caple, J. Nichol, and N. Fontaine.
Journal of Great Lakes Research, Vol. 11, No. 1, p 34-39, 1985. 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Biodegradation, *Organic matter, *Minnesota, *Bacteria, Degradation, Chlorinated hydrocarbons, Kinetics, Fate of pollutants, Lipopolysacharides, Epifluorescence counts.

An evaluation of a standardized kinetic procedure that determines the ability of bacteria to degrade organic pollutants was conducted using natural water samples from the Lake Superior watershed in northern Minnesota. Second-order rate constants for the degradation of butoxyethyl and butoxypropyl esters of 2,4-dichlorophenoxyacetic acid, methyl 2,4-dichlorobenzoate, ethyl-2,4-dichlorobenzoate, and p-nitrophenyl ether were determined using three different bacterial enumeration methods. The reproducibility of the bacterial enumeration method is especially important if reliable degradation kinetics are to be obtained. Comparisons of lipopolysaccharide measurements, epifluorescence counts, and standard plate counts to enumerate bacteria suggest bacterial stabilization has a minor, yet notable, effect on kinetic results. (Author's abstract)
W85-06863

CHLORIDE LOADING TO LAKE ONTARIO FROM ONONDAGA LAKE, NEW YORK,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, S. P. Devan, and P. W. Rodgers.
Journal of Great Lakes Research, Vol. 11, No. 1, p 53-58, 1985. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Chloride, *Water pollution sources, *Lake Ontario, *Onondaga Lake, *New York, *Syracuse, *Lake Erie, *Great Lakes, Industrial wastes, Chemical wastes, Path of pollutants, Projections, Pollution load, Chlor-alkali.

Chloride is an often-used indicator of pollution that is generally considered symptomatic of a variety of cultural activities. The recent history of chloride loading to Lake Ontario was investigated in the single largest source, Onondaga Lake, located in metropolitan Syracuse, New York. The mean annual release of chloride from Onondaga Lake was 765,000 metric tons for the period 1970-1981, representing approximately 12% of the total load to Lake Ontario for that period. Approximately 85% of the load from Onondaga Lakes originates from an adjacent chlor-alkali production plant. It is projected that the expected discontinuance of this manufacturing operation will reduce the current chloride levels in Lake Ontario by 1.3 mg/L and the future long-term concentration by 3.2 mg/L. This projection for Lake Ontario is in contrast to the long-term trends predicted for the other four Great Lakes, all of which are expected to experience elevated chloride levels. Thus, in Lake Ontario the reduced loading from Onondaga Lake will more than compensate for the projected increase in loading from the upstream lakes. The new projected steady-state chloride concentration for Lake Ontario will essentially equal the Lake Erie level, reflecting the near equivalence of the future average tributary chloride concentration for Lake Ontario and the input concentration from Lake Erie. (Collier-IVI)
W85-06865

SOURCES OF ACIDIFICATION IN CENTRAL EUROPE ESTIMATED FROM ELEMENTAL BUDGETS IN SMALL BASINS,
Ustredni Ustav Geologicky, Prague (Czechoslovakia).
T. Paces.
Nature, Vol. 315, No. 6014, p 31-36, 2 May 1985. 1 Fig, 7 Tab, 30 Ref.

Descriptors: *Acidification, *Water pollution sources, *Czechoslovakia, *Elbe River, River basins, Sulfates, Agricultural chemicals, Fertilizers, Acid rain.

In order to collect quantitative data on the environmental changes and their rates, an evaluation and comparison was made of mass budgets of H(+), Na, K, L, Mg, Ca, Fe, Al, Si, N-NH4(+), N-NO3(-), C-HCO3(-), Cl, S and P in small hydrologically and geologically well defined drainage basins in the watershed of the Elbe river in Czechoslovakia. Four representative basins considered have similar bedrock, soil and climate conditions but differ in mean slopes and anthropogenic impacts. Comparison of their elemental budgets will help to elucidate the mechanisms that affect the fluxes of elements and cause acidification of soil and water. The data are used to calculate weathering and erosion rates influenced by acid emission and agricultural practice. The elemental budgets in basins affected by industry and agriculture serve as background data for a comparison with representative basins in other regions. Long term increases in acidification of water and soils in the Elbe river basin is caused mainly by the deposition of dry SO2 and the application of industrial fertilizers. The direct input of hydrogen ions by acid rain is less significant. The budgets of elements and protons indicate natural and anthropogenic processes that acidify and buffer the environment. (Baker-IVI)
W85-06874

RESIDUE LEVELS OF ORGANOCHLORINE INSECTICIDES IN SEWAGE PLANT EFFLUENT,
Biological Research Center, Baghdad (Iraq). Dept. of Environmental Pollution.
M. A. Al-Omar, N. H. Al-Ogaily, S. J. Tawfiq, and M. Al-Bassoumy.

Journal of Biological Sciences Research, Vol. 16, No. 1, p 145-151, January, 1985. 1 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Chlorinated hydrocarbons, *Insecticides, *Iraq, *Baghdad, *Diayla river, Fate of pollutants, Water pollution sources, Seasonal variation, Wastewater facilities.

Organochlorine Insecticides (OC) are fairly resistant compounds to biological treatment in sewage plants. Incomplete or imperfect treatment of wastewater containing significant concentrations of these compounds would transfer them to the riverstream through effluent water. The objective of this study is to determine the OC levels in wastewater before and after treatment in the Rustamiya Sewage Treatment Plant which is one of the major plants in Baghdad, Iraq. Samples were collected before and after treatment; residues were extracted by liquid-liquid extraction, cleaned up by Florisil column and detected by electron capture-gas chromatography. Most of the samples taken were found to be contaminated with OC residues and metabolites. Physical and biological processes have little or no effect on the residue levels. The environmental hazard is considered to be low, especially after the dilution of sewage effluent by the Diayla river except in March and April when a case of zero dilution might occur. (Author's abstract)
W85-06875

BIOACCUMULATION AND PARTITIONING OF CADMIUM WITHIN THE FRESHWATER MUSSEL DREISSENA POLYMORPHA PALLAS,
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
R. Bias, and L. Karbe.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 1, p 113-125, 1985. 8 Fig, 3 Tab, 22 Ref.

Descriptors: *Cadmium, *Mussels, *Bioaccumulation, Fate of pollutants, Uptake, Kinetics, Elimination.

Kinetics of uptake, partitioning and elimination of cadmium were investigated in experimental studies with the freshwater mussel, Dreissena polymorpha. A nearly linear increase in cadmium over long periods of time at low level exposure (3.3 micro-g Cd/cu dm) was found. The uptake rates decreased with time during long term experiments with high cadmium concentration in the water (50 micro-g Cd/cu dm). Accumulation factors have consistently been higher in mussels exposed to low concentrations of cadmium. Distinct differences in the affinity of cadmium for the different shell layers and for specific organs were demonstrated. The major portion of cadmium in the soft parts is strongly bound and cannot be eliminated by exchange processes. The shells bound a great deal of cadmium, but only loosely, and the metal could be readily eliminated after transfer to uncontaminated water. (Baker-IVI)
W85-06884

WET DEPOSITION OF CADMIUM, LEAD AND COPPER AT DEONAR (BOMBAY) AND ITS RELATIONSHIP WITH RAINFALL,
Bhabha Atomic Research Centre, Bombay (India). Div of Radiological Protection.
S. C. Ashawa, D. N. Kelkar, and U. C. Mishra.
Water, Air and Soil Pollution, Vol. 25, No. 1, p 63-71, 1985. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Rainfall, *Bombay, *India, *Copper, *Cadmium, *Lead, Wet deposition, Precipitation, Industrial wastes, Water pollution sources, Highways, Petroleum industry, Agricultural chemicals, Monsoons.

A relationship is presented between the wet deposition of trace metals and the amount of rainfall for short term precipitation samples (wet only) collected at Deonar (Bombay) during 1982. The sampling site was the terrace of the BARC Hospital, 16 m above ground, at Deonar. There is a thermal power station, fertilizer plant, and petroleum refineries situated from south to west of the sampling site. Bombay-Poona National Highway is about 500 m away. Rainwater samples collected had pH between 5 and 7. Concentrations of Cd, Pb, and Cu range from 0.05 to 0.2 micro-g/L, 0.35 to 3.2 micro-g/L, and 0.5 to 19.7 micro-g/L, respectively. The wet deposition of Cd, Pb, and Cu for periodic samples is plotted against total rainfall. Size distribution of aerosols at Bombay revealed that 81% of the Pb is associated with particles of size less than 4.7 micro-m and 73% of the Cd is also associated with particles of this size. The half power law relationship shows that the scavenging behavior of these metals associated with fine particles is also similar to that of sulfate. The values for Pd, Cu, and Cd support the use of a power law exponent of 0.6 to describe the relationship between wet deposition of Cd, Pb, and Cu and rainfall amounts. (Baker-IVI)
W85-06888

EVALUATION OF TECHNIQUES TO ESTIMATE ANNUAL WATER QUALITY LOADINGS TO RESERVOIRS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. E. Westerdahl, W. B. Ford, J. Harris, and C. R. Lee.
Technical Report E-81-1, February 1981. Final Report. 61 p, 5 Fig, 18 Tab, 29 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Lakes, *Nonpoint pollution sources, *Pollution load, *Reservoirs, Nitrogen, Phosphorus, Suspended solids, Watersheds, Land use, Sandusky River, Honey Creek, Ohio, Caddo River, Arkansas, Midwest Research Institute technique, National Eutrophication Survey, Instream flow, Sediment yield, Agricultural watersheds, Forest watersheds.

Five techniques for determining annual water quality loadings were compared and evaluated. The techniques included two regional methods (Midwest Research Institute and National Eutrophication Survey) and three instream techniques (average flow, average concentration; flow-weighted concentration; and flow interval). Watersheds used in the study were Sandusky River and Honey Creek, Ohio, (agricultural) and Caddo River, Arkansas (forested). Water quality parameters included were suspended solids, total Kjeldahl nitrogen, and total phosphorus. The regional methods were not adequate for estimating annual water quality loadings to reservoirs. The Midwest Research technique was useful in describing the watershed's physiographic features and hydrologic response characteristics. The National Eutrophication Survey method was applicable only to selected geographical areas. The flow interval method was the only instream flow technique which was statistically valid. It is recommended for estimating annual water quality loadings to reservoirs. However, intensive sampling would be required to account for water quality parameters dependent on season and flow. The average flow, average concentration technique is applicable for water quality constituents that maintain fairly constant concentrations through the range of streamflow. The flow-weighted concentration technique needs data representative of the flow range and runoff water quality characteristic of the watershed.
W85-06908

ANALYSIS OF ISSUES CONCERNING 'ACID RAIN': REPORT TO THE CONGRESS OF THE UNITED STATES.
General Accounting Office, Washington, DC. Office of the Comptroller General.
For primary bibliographic entry see Field 6B.
W85-06944

PHOSPHORUS DYNAMICS IN AN ARKANSAS RESERVOIR: THE IMPORTANCE OF SEASONAL LOADING AND INTERNAL RECYCLING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W85-06964

FIELD SURVEY OF HEAVY METAL UPTAKE BY NATURALLY OCCURRING SALTWATER AND FRESHWATER MARSH PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. W. Simmers, B. L. Folsom, C. R. Lee, and D. J. Bates.
Technical Report EL-81-5, June 1981. Final Report. 155 p, 35 Fig, 17 Tab, 23 Ref, 7 Append.

Descriptors: *Bioaccumulation, *Heavy metals, *Spartina alterniflora, *Cyperus, *Marsh plants, Field tests, Aquatic plants, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Nickel, Manganese, Zinc, Mercury, Baseline studies.

A natural marsh heavy metal survey was conducted to establish a baseline for comparison to plant concentration and uptake data from contaminated and perturbed sediments. Extensive field sampling of natural marshes was conducted along the East and gulf coasts of the United States, and along the shores of the Great Lakes. Spartina alterniflora was collected from the saltwater marshes and Cyperus species were collected from the freshwater marsh areas. In the saltwater, marsh, Mn and Zn concentrations were slightly lower than those previously determined in greenhouse and disposal site studies with contaminated sediments, while the concentrations of the other heavy metals were similar. Calculation of total uptake values indicated that only Cd may be of concern. Cd levels in Cyperus species in naturally occurring marshes were similar to those of a greenhouse flooded (reduced) environment. Fe and Mn were present in lower concentration in the natural marsh than in the greenhouse plants grown on contaminated sediment; the remainder of the heavy metals examined were present in higher concentrations. It is concluded that marsh plants grown on contaminated dredged material in a flooded environment do not bioconcentrate excessive or even significantly higher levels of toxic metals than those same plant species in naturally occurring marshes.
W85-06976

FATE OF CORROSION PRODUCTS RELEASED FROM STAINLESS STEEL IN MARINE SEDIMENTS AND SEAWATER; PART 2: SEQUIM BAY CLAYEY SILT,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
R. L. Schmidt.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82013873. PNL-3466 PT2, April 1982. 26 p. 4 Fig, 10 Tab, 25 Ref. Contract/Grant No. DE-AC06-76RL0-1830.

Descriptors: *Path of pollutants, *Fate of pollutants, *Corrosion, *Sediments, *Silt, *Distribution patterns, Steels, Marine sediments, Aeration, Anoxic conditions, Chromium, Manganese, Iron, Nickel, Copper, Metals.

Laboratory experiments in which neutron-activated 347 stainless steel specimens were exposed to clayey silt from Sequim Bay, Washington are reported. The distributions of Cr, Mn, Fe, Ni and Cu in the Sequim Bay sediment show that diethylenetriaminepentaacetic acid (DTPA) removed < 10% of extractable Cr, Fe and Mn, 20% of extractable Ni and 30% of extractable Cu. The inorganic fraction accounted for 30% of total extractable Mn and 10% or less of Cr, Fe, Ni and Cu. Major portions of Cr and Cu, and a large amount of Fe were in the organic fraction. Extractable Mn, Fe and Ni were associated with hydrous oxides. No Co was detectable in any of the extracts. Neutron-activated 347 stainless steel specimens were exposed to slurries of Sequim Bay clayey silt under aerated and non-oxygenated conditions for a period of 90 days. In aerated sediment the estimated corrosion rate was 6.3 mg/yr/sq cm of stainless steel surface area. Relatively labile substances constituted about half of the 60Co activity released in aerated sediment. Forty-nine % of the 60Co activity was released as, or converted to, relatively inert substances, requiring rigorous treatment to dissolve. The distribution of 60Co released to anoxic Sequim Bay clayey silt showed that relatively labile substances constituted 95% of the 60Co released. In the absence of O2 the association of

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60Co with the refractory (oxidic) fraction was inhibited only 5% of the 60Co activity was in relatively inert forms.
W85-06981

BEHAVIOUR OF CRUDE OIL SPILLED UNDER MULTI-YEAR ICE,
ARCTEC Canada Ltd., Kanata (Ontario).
G. Comfort, and W. Purves.
EPS 4-EC-82-4, August 1982. Environment Canada, Environmental Protection Service, Ottawa (Ontario). 76 p, 9 Fig, 8 Tab, 6 Ref, 3 Append.

Descriptors: *Oil, *Ice cover, Evaporation, Clean-up, Oil spills, Cold regions.

In June 1978, 1.8 cu m of Norman Wells crude oil was discharged at three locations under a multi-year ice cover in Griper Bay, Northwest Territories. A site investigation was carried out during September 1979 to determine the fate of the spilled oil. The three sites were cored and drilled and the quantity of the oil remaining in the ice sheet was estimated. Samples of surface oil and oil within the ice sheet were collected and analyzed to obtain estimates of the amount of weathering the oil had undergone. Only a small amount of the oil which was originally discharged was still remaining in the ice sheet. A maximum of 10% of the oil originally discharged was found in the ice sheet at one site, while the other two sites had only 1% and none of the oil remaining. Oil on the ice surface was severely weathered with an average weight loss (by evaporation) of > 42%. The oil had migrated horizontally within the ice sheet as well as vertically. The test sites still containing oil within the ice sheet had experienced a 400% increase in area of contamination over that originally occupied by the initial discharge. The test site was relatively free of oil and it appeared that the natural processes of dispersion and evaporation had been relatively effective in cleanup.
W85-06987

METHODOLOGY FOR OVERLAND AND INSTREAM MIGRATION AND RISK ASSESSMENT OF PESTICIDES,
Battelle Pacific Northwest Labs., Richland, WA.
Y. Onishi, S. M. Brown, A. R. Olsen, M. A. Parkhurst, and S. E. Wise.
EPA-600/3-82-024, May 1982. Environmental Research Laboratory, Athens, GA. 205 p, 61 Fig, 10 Tab, 44 Ref, 3 Append. Contract/Grant No. 68-03-2613.

Descriptors: *Computer models, *Nonpoint pollution sources, *Pesticides, *Agricultural runoff, *Water pollution effects, *Fish, *Decision making, *Fate of pollutants, Models, Simulation analysis, Land management, Model studies, Aquatic animals, Toxicity, Water pollution control.

The CMRA (Chemical Migration and Risk Assessment) Methodology was developed to predict the occurrence and duration of pesticide concentrations in surface waters receiving runoff from agricultural lands and to assess potential acute and chronic damages to aquatic biota. The CMRA Methodology uses the ARM and SERATRA models to continuously simulate nonpoint source pollution processes. The risk assessment procedure of the model coupled with the FRANCO computer program provides a good scientific basis for pesticide risk assessment of the direct effects of dissolved pesticide concentrations on aquatic biota. The CMRA Methodology was used to evaluate the migration and fate of alachlor and toxaphene, and their potential acute and chronic impacts on fish in the Four Mile Creek Watershed (Iowa). Results showed that the CMRA Methodology is capable of predicting rate and effects of pesticides for a wide range of compounds, agricultural lands, receiving streams, and aquatic biota. The fitting of overland and instream pesticide concentrations with statistical distributions did not prove feasible because an excessive number of simulations would be required. The CMRA Methodology will provide researchers with a way to evaluate the relative importance of various mechanisms that control transport and fate phenomena occurring on watersheds and in receiving streams.
W85-06989

PROCEEDINGS OF STORMWATER AND WATER QUALITY MODEL USERS GROUP MEETING: JANUARY 27-28, 1983.
Environmental Protection Agency, Athens, GA.
For primary bibliographic entry see Field 5G.
W85-06999

SIGNIFICANCE OF SOLVATION PHENOMENA FOR THE PARTITION OF HALOGENATED ORGANIC COMPOUNDS BETWEEN WATER AND A PARAFFINIC PHASE (DIE BEDEUTUNG DER SOLVATATION FUR DIE VERTEILUNG VON HALOGENORGANISCHEN VERBINDUNGEN ZWISCHEN WASSER UND EINER PARAFFINPHASE),
Essen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich Chemie.
For primary bibliographic entry see Field 2K.
W85-07024

POLLUTION OF TWO STREAMS IN A RURAL REGION - A COMPARISON BY INVESTIGATIONS OF SEVERAL YEARS (VERGLEICH DER BELASTUNG ZWEIER BACHE IM LANDLICHEN RAUM ANHAND MEHRJAHRIGER UNTERSUCHUNGEN),
Giessen Univ. (Germany, F.R.). Inst. fuer Mikrobiologie und Landeskultur.
W. Sussmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 2, p 56-66, April, 1985. 5 Fig, 5 Tab, 14 Ref.

Descriptors: *Fate of pollutants, *Klingebach stream, *Reiherbach stream, *Germany (Federal Republic), *Waldeck-Sachsenhausen, *Self-purification, Ammonia, Organic matter, Sodium, Potassium, Chloride, Water temperature.

Since 1975 water quality investigations have been carried out at two streams north of Edersee reservoir (Federal Republic of Germany). The Klingebach stream (drainage basin: 8.8 sq km) is polluted by the waste water clarification plant of the little town Waldeck-Sachsenhausen (1850 inhabitants), while the Reiherbach stream (drainage basin: 16.7 sq km) is only influenced by the waste water of a little village with 100 inhabitants. In both streams the concentrations of phosphorus compounds, ammonia, organic substances, sodium, potassium and chloride are markedly higher than those in their unpolluted tributaries. Great differences in concentrations exist between both streams, corresponding to the wastewater pollution. However, along a reach of approx. 3 km in both streams a noticeable self-purification can be observed; the influence of temperature is evident. (Author's abstract)
W85-07025

EXPERIMENTAL STUDY OF BLUFF SURFACE DISCHARGES WITH SMALL RICHARDSON NUMBER,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam.
Journal of Hydraulic Research, Vol. 23, No. 1, p 47-55, 1985. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Diffusion, *Turbulent flow, *Jets, *Bluff surface discharge, Richardson numbers, Outfall, Heated water, Discharge hydrographs.

An experimental study was conducted on the near field diffusion of bluff buoyant turbulent surface jets with small (source) Richardson number in a large body of water without any ambient currents. The velocity scale decreases inversely with the axial distance, x, from the outfall whereas the vertical and surface length scales h and b grow linearly with x. The variation of the coefficients in the relations for these scales, with the source Richardson number has been evaluated using the experimental observations. Based on these observations made with Richardson number in the range of 0.002 to 0.091, the following conclusions were formulated. The velocity scale in terms of the velocity at the outfall varies inversely with the area of cross section of outfall/axial distance from outfall with the coefficient varying with the 1/10th power of the Richardson number at source. The vertical length scale, h, in the central plane increases linearly with x, the distance from the outfall, with the slope dh/dx decreasing strongly with the Richardson number at source, falling to almost zero when the source Richardson number approximately equals 0.1. The horizontal length scale, b, at the water surface increases linearly with x with the rate of increase db/dx increasing gradually with increasing Richardsons number at source. Further the velocity profiles in the centerplane and at the surface have been found to be similar. (Baker-IVI)
W85-07032

ESTIMATING NONPOINT POLLUTION FROM SMALL URBAN WATERSHEDS,
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
V. Novotny, H.-M. Sung, R. Bannerman, and K. Baum.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 339-348, April, 1985. 10 Fig, 6 Tab, 24 Ref.

Descriptors: *Urban runoff, *Nonpoint pollution sources, *Urban watersheds, Model studies, Street sweeping, Suspended solids, Nitrogen, Roads, Computer models.

The Milwaukee project was one of 28 Nationwide Urban Runoff Program (NURP) projects conducted in the United States. Modeling pollution accumulation on steel surfaces and the quality and quantity of runoff are investigated. In the Milwaukee NURP project, street refuse deposition, traffic emissions on roadways with a high traffic density, and urban erosion contributed the largest mass of pollutants to urban runoff. Wet and dry deposition were not as significant, except for nitrogen loads. The pollution accumulation on street surfaces generally follows a decreasing rate-of-increase model. The magnitude of the removal coefficient can be related to the traffic volume, traffic speed, and wind speed above a certain threshold value. The magnitudes of the removal coefficient for the experimental watersheds in this study ranged from 0.2 to 0.3/day. A statistical comparison of pollutant concentrations in the runoff from test and control sites showed a very small, statistically unrecognizable effect of street sweeping on pollution loads. Efficiency of street sweepers was generally low, and street-sweeping efficiency was often negative at low street solids loads. Simulated loadings by a computer model confirmed the findings. Loadings and concentrations in the runoff, estimated by the model for the swept and unswept sites, were not different in a watershed with imperviousness of less than 80%. (Baker-IVI)
W85-07055

EMERGENCY: INTRUSION OF PROPANE INTO WATER MAINS,
Bridgeport Hydraulic Co., CT.
For primary bibliographic entry see Field 5F.
W85-07063

SLOW-ZONE MODEL FOR LONGITUDINAL DISPERSION IN TWO-DIMENSIONAL SHEAR FLOWS,
Nigeria Univ., Nsukka. Dept. of Mechanical Engineering.
S. C. Chikwendu, and G. U. Ojiakor.
Journal of Fluid Mechanics, Vol. 152, p 15-38, March, 1985. 5 Fig, 21 Ref.

Descriptors: *Mathematical models, *Dispersion, *Path of pollutants, *Shear flows, Turbulent flow, Open channel flow, Differential equations, Mixing, Diffusivity, Spatial distribution.

One problem with the one-dimensional model for the longitudinal dispersion of contaminants in turbulent flow in open channels always predicts a normal distribution of matter down the channel for all time, whereas observed distributions of dispersing clouds are always skewed, especially at small times. A partial-differential-equation approach is proposed to explain the skewed profile by means of

a two-zone model. The flow is divided into a fast zone and a slow zone which interact while each zone is governed by a linear one-dimensional dispersion equation. The usual one-dimensional dispersion approach is used in each zone, but with different flow speeds and dispersion coefficients in the fast and slow zones. Turbulent vertical mixing is allowed at the interface between the two zones, with a small vertical diffusivity. This leads to a pair of coupled, linear, one-dimensional dispersion equations, which are solved by Fourier transformation. The Fourier-inversion integrals are analyzed using two different methods. In the first method asymptotically valid expressions are found using the saddle-point method. The peak value of the average concentration decays exponentially with time at a rate which is close to the rate observed in the early stage of the dispersion process. The solution is useful for fairly small times. In the second method an exact solution is found in the form of a convolution integral. Explicit expressions which are valid for small times and for large times from the release of contaminant are found. For small times this exact solution confirms the basic results obtained by the saddle-point method. For large times the exact solution gives a contaminant concentration which approaches a Gaussian distribution travelling with the bulk speed as predicted by the Taylor model. The overall longitudinal dispersion coefficient at large times consists of the diffusivity D0 plus a contribution which depends entirely on the vertical mixing. (Moore-IVI)
W85-07083

CONTAMINANT DISPERSION AS VIEWED FROM A FIXED POSITION,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol. 152, p 217-233, March, 1985. 8 Fig, 13 Ref.

Descriptors: *Dispersion, *Spatial distribution, *Mathematical equations, Path of pollutants, Flow, Fate of pollutants.

A Hermite series expansion is used to describe the time evolution of the contaminant concentration at a fixed location in a flow. Exact expressions are derived for the dosage, centroid and temporal variance. A two-mode approximation is proposed which gives accurate results at moderate to large distances downstream of the discharge. This work, along with some others, demonstrates how temporal moments can be used in numerical predictions, in the analysis of field data, and to obtain exact analytic results. On all accounts the temporal approach is of similar complexity, and hence is a genuine alternative to the longer-established spatial approach to contaminant dispersion. One facet of the exact analysis is that it can provide canonical examples for the testing of numerical methods. More substantially, the exact form of solutions can give valuable insight for the qualitative understanding of the dispersion process, and towards the development of efficient approximation schemes. (Baker-IVI)
W85-07084

ANATOMY OF A GROUNDWATER CONTAMINATION EPISODE,
Haifa Univ. (Israel). Dept. of Economics.
M. Shechter.
Journal of Environmental Economics and Management, Vol. 12, No. 1, p 72-88, March, 1985. 1 Fig, 4 Tab, 29 Ref.

Descriptors: *Price Landfill, *New Jersey, *Groundwater pollution, *Cost analysis, Landfills, Public health, Mortality, Aquifers, Damages, Water pollution control.

Using the contamination episode at Price Landfill, New Jersey, as a case study, major analytical and informational issues characterizing groundwater pollution are addressed with special emphasis on uncertainty associated with the environmental medium, especially solute-transport processes, and the valuation of health risks, principally dose-response relationships. Alternative approaches to modeling the physical-chemical processes are described and subsequently coupled with mortality risk predictions to derive estimates of expected polution costs: reduced longevity (pollution damage costs) an. cost of control and remedial measures (damage reduction costs). Price Landfill is a 22 acre site situated on the Cohansey aquifer which is 210 to 245 ft deep. It operated as an active waste disposal site from 1068 until about 1976, and received significa.. quantities of chemical and liquid waste. Atlantic City draws its water from this aquifer. Various models were constructed of the landfill in order to understand more fully and accurately the obvious spread of contamination from the landfill through the groundwater. The conclusiveness of the damage valuation thus made is considered. (Baker-IVI)
W85-07090

COLIPHAGE SURVIVAL IN SEAWATER,
Malaga Univ. (Spain). Dept. of Microbiology.
J. J. Borrego, and P. Romero.
Water Research, Vol. 19, No. 5, p 557-562, 1985. 5 Fig, 1 Tab, 35 Ref.

Descriptors: *Coliphages, *Water quality control, *Indicator organisms, Viral analysis, Viruses, Water analysis, Bacteriophages.

The relative survival of coliphages isolated from seawater under controlled conditions in different media, in the lab and in the marine environment, was investigated. In experiments carried out under lab conditions in seawater, suspensions of the viruses in treated seawater were incubated at 18 C and their inactivation rates followed. The inactivations of coliphages H55 and S1 were slight and similar, whereas bacteriophage V2 showed anomalous resistance to inactivation. After 360 days all coliphage activities were practically nil. In determining the effects of different biotic factors, the bacteriophage concentration decreased markedly in natural clean seawater, whereas in clean seawater sterilized by autoclaving and subsequent membrane filtration, and in sterile distilled water, titers remained constant 50 days after sampling. In tests of the dispersion and survival of the coliphages in natural seawater, the initial coliphage titer of 1:10 survived 2.4 min, whereas the higher ratios, 1:100 and 1:1000, lasted 11.4 and 84 min, respectively. Coliphages T-90 values varied between 10.8 and 18.33 min, the average was 13.7 min. Disappearance of the coliphage titer in the sea took place between 112 and 121 min, depending on the host bacterial strain used for their detection. (Baker-IVI)
W85-07114

BIOTRANSFORMATION OF TETRACHLOROETHYLENE TO TRICHLOROETHYLENE, DICHLOROETHYLENE, VINYL CHLORIDE, AND CARBON DIOXIDE UNDER METHANOGENIC CONDITIONS,
Stanford Univ., CA. Dept. of Civil Engineering.
T. M. Vogel, and P. L. McCarty.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1080-1083, May, 1985. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Biotransformation, *Vinyl chloride, *Dichloroethylene, *Tetrachloroethylene, *Trichlorethylene, *Fate of pollutants, Methanogenesis, Carcinogens, Public health, Industrial wastes, Solvents, Toxicity.

Widespread contamination of groundwater by halogenated compounds has led to investigations to determine their fate in the environment. The study confirms that tetrachloroethylene (PCE) can be transformed by reductive dehalogenation to trichlorethylene (TCE), dichloroethylene and vinyl chloride (VC) under anaerobic conditions. PCE was at least partially mineralized to carbon dioxide as well. Mineralization of 24% of the PCE occurred in a continuous flow fixed film methanogenic column with a liquid detention time of 4 days. TCE was the major intermediate formed, but traces of dichloroethylene isomers and VC were also found. In other column studies under a different set of methanogenic conditions, nearly quantitative conversion of PCE to VC was found. These studies clearly demonstrate that TCE and VC are major intermediates in PCE biotransformation under anaerobic conditions and suggest that potential exists for the complete mineralization of PCE to carbon dioxide in soil and aquifer systems and in biological treatment processes. (Baker-IVI)
W85-07127

EFFECT OF TEMPERATURE, PH, AND OXYGEN LEVEL ON THE MULTIPLICATION OF NATURALLY OCCURRING LEGIONELLA PNEUMOPHILA IN POTABLE WATER,
Pittsburgh Univ., PA. Graduate School of Public Health.
R. M. Wadowsky, R. Wolford, A. M. McNamara, and R. B. Yee.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1197-1205, May, 1985. 5 Fig, 2 Tab, 33 Ref.

Descriptors: *Legionella, *Water temperature, *Hydrogen ion concentration, *Dissolved oxygen, *Potable water, Bacteria, Water analysis, Public health, Temperature effects, Water quality control, Anaerobic conditions.

The plumbing systems of large buildings may frequently be contaminated with Legionella pneumophila. The occurrence of L. pneumophila in plumbing systems raises questions concerning the growth and survival of the organism in potable water. A method has been developed for the preservation of naturally occurring L. pneumophila and associated microbiota in the laboratory. Maintenance of the water culture depended upon transferring the culture when the growth of L. pneumophila was in the late-exponential to early-stationary phase. The results of studies on the multiplication of L. pneumophila indicate that multiplication in aquatic environments may occur between 25 and 45 degrees C and at pH values of 5.5 to 9.2. Although multiplication of L. pneumophila does not occur under relatively anaerobic conditions, prolonged survival may occur. Water stock cultures may be useful in delineating symbiotic relationships which may exist between L. pneumophila and other microorganisms. (Baker-IVI)
W85-07128

TRACE-METALS AND CHLORINATED HYDROCARBONS IN BIRDS' EGGS FROM THE DELTA OF THE DANUBE,
Dipartimento di Biologia Ambientale, Univ. de Siena, Italy.
C. Fossi, S. Focardi, C. Leonzio, and A. Renzoni.
Environmental Conservation, Vol. 11, No. 4, p 345-350, Winter, 1984. 1 Fig, 4 Tab, 23 Ref.

Descriptors: *Trace elements, *Chlorinated hydrocarbons, *Danube River, *Deltas, *Birds, *Eggs, Polychlorinated biphenyls, Chemical analysis, Pesticides, DDT, Mercury, Selenium, Cadmium, Lead, Lindane.

The levels of some common persistent contaminants (trace elements and chlorinated hydrocarbons) in the birds of the Danube Delta were investigated. Eggs were examined from the following species: white pelican, common cormorant, pygmy cormorant, glossy ibis, grey heron, night heron, and mallard. Of the trace elements sought (Hg, Se, Cd, and Pb) cadmium and lead occurred in very low concentrations. Mercury reached high levels in predatory birds (4.9 mm in the common cormorant). Selenium concentrations were quite high but homogeneous in the different species. No correlation between selenium and mercury concentrations was found, suggesting that the possible protective action of selenium enters into effect only when a certain threshold of mercury concentration has been reached. DDTs occurred at very high levels in the first three species. PCB levels were lower with the PCB/DDE ratio being about 0.3 to 0.8. Lindane was present in amounts greater than those found in the Mediterranean and in the East Atlantic; alpha-HCH and HCB levels were similar to those found in these other areas. (Baker-IVI)
W85-07146

ARSENIC IN THE DUNLIN (CALIDRIS ALPINA) FROM THE DUTCH WADDENZEE,

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Interuniversitair Reactor Inst., Delft (Netherlands).
A. A. Goede, and M. de Bruin.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 617-622, May, 1985. 3 Fig, 7 Ref.

Descriptors: *Arsenic, *Waddenzee, *Netherlands, *Dunlin, Birds, Metals, Estuaries, Water pollution effects, Feathers.

The Waddenzee is a large estuarine area in The Netherlands, which has an important significance in the life cycle of waders. The area is severely polluted by the rivers Rhine and Scheldt. In the Waddenzee, the arsenic concentration was found to be higher in feathers of adult birds in this area than in juvenile feathers formed on the remote breeding grounds. In birds collected while migrating in Sweden, arsenic kidney concentrations were all below detectable limits of 0.35 mg/kg. For seven out of eight birds collected in the Western part of the Waddenzee shortly after arrival, the kidney concentrations were already elevated. In October a mean value of nearly 6.6 mg/kg was reached. For juveniles, with the exception of one sample, all primary vane concentrations were below 1.0 mg/kg. For the adults, all vane concentrations except three were above 10 mg/kg, as is a non-essential trace element which concentration is not internally controlled. Relatively high As liver concentrations can be expected for Dunlins from the Dutch Waddenzee. (Baker-IVI)
W85-07148

CHANGES IN THE SULFIDE CONTENT OF BOTTOM MUDS IN GOING FROM RIVER TO SEA,
Hiroshima Univ. (Japan). School of Medicine.
Y. Hiraoka, and H. Okuda.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 623-626, May, 1985. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Sulfides, *Bottom sediments, *River mouth, *Ohta River, *Hiroshima Bay, *Japan, River beds, Mud, Water pollution sources, Sulfates.

Water is usually analyzed chemically with little attention to bottom mud content when determining the level of pollution in rivers and the sea. At 10 sampling locations on the Ohta River and Hiroshima Bay, low tide muds were collected with a scoop for total sulfide determination. Total sulfide content in the bottom muds of Stations 1 and 2 were 0.051 mg/kg dry mud and ND, respectively. Station 1 was a fresh water zone and Station 2, a tidal zone. There was a low amount of organic matter at each of these two stations. Total sulfide content gradually increased from 0.58 to 1.7 mg/g dry mud at Stations 3, 4, 5, and 6. In these water areas the concentration of sulfate was always greater as a result of the mixing of river and sea water, which contains 2560 ppm sulfate on the average. At Stations 7, 8, 9, and 10 total sulfide gradually decreased from 0.74 to 0.098 mg/g dry mud. At these stations sulfates and sulfate-reducing bacteria are sufficiently present for sulfide production to occur in proportion to the quantity and quality of the organic matter. The production of sulfides therefore was highest in the muds of the river mouth. The mud of such water is apt to be polluted and have an adverse influence on water with which it comes into contact. (Baker-IVI)
W85-07149

NATIONAL CONTAMINANT BIOMONITORING PROGRAM: CONCENTRATIONS OF SEVEN ELEMENTS IN FRESHWATER FISH, 1978-1981,
Fish and Wildlife Service, Columbia, MO.
T. P. Lowe, T. W. May, W. G. Brumbaugh, and D. A. Kane.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 363-388, May, 1985. 1 Fig, 8 Tab, 23 Ref, 1 Append.

Descriptors: *Fish, *Lead, *Mercury, *Cadmium, *Arsenic, *Selenium, *Copper, *Zinc, Heavy metals, Monitoring, Water pollution effects.

As a continuing part of the National Contaminant Biomonitoring Program, the U.S. Fish and Wildlife Service collected freshwater fish at 112 monitoring stations in 1978-1979 and 1980-1981. Three composite samples of three to five fish were collected at each of about half of the stations in odd-numbered years and at the other half in even-numbered years, and analyzed for lead, mercury, cadmium, arsenic, selenium, copper, and zinc. The geometric means, minimum, and maximum of elemental concentrations (micro-g/g wet weight) during 1978-1979 and (in parentheses) during 1980-1981 were as follows: Pb 0.19, 0.10-6.73 (0.17, 0.10-1.94); Hg 0.11, 0.01-1.10 (0.11, 0.01-0.77); Cd 0.04, 0.01-0.41 (0.03, 0.01-0.35); As 0.16, 0.04-2.08 (0.14, 0.05-1.69); Se 0.46, 0.09-3.65 (0.47, 0.09-2.47); Cu 0.86, 0.29-38.75 (0.68, 0.25-24.10); and Zn 25.63, 7.69-168.1 (23.82, 8.82-109.2). The 85th percentile, calculated for station mean concentrations (micro-g/g wet weight) for 1978-1979 and 1980-1981, respectively, were: Pb 0.32 and 0.25; Hg 0.18 and 0.18; Cd 0.09 and 0.06; As 0.23 and 0.22; Se 0.70 and 0.71; Cu 1.14 and 0.90; and Zn 46.26 and 40.09. There was no significant upward or downward trend between collection periods of the national geometric means of any of the elements except for copper which decreased significantly. Species differences in elemental concentrations contributed more variability to the data set than did station differences. The proportion of the collections composed of each species changed little between collection periods. Thus, the magnitude of the species effect on the national geometric mean of each period was probably fairly consistent; however, it precludes one making sound comparisons among various regions of the United States. (Author's abstract)
W85-07161

5C. Effects Of Pollution

PORT SOLVES ENVIRONMENTAL PROBLEMS,
Port of Long Beach, CA.
G. Knatz.
Journal of Environmental Health, Vol. 47, No. 5, p 233-240, March/April, 1985. 13 Fig, 10 Ref.

Descriptors: *Ports, *Long Beach, *California, Ships, Water pollution control, Hazardous materials, Oil spills, Air pollution, Monitoring, Ballast water, Waste disposal.

Vessel activity in the busiest United States port on the West Coast requires specialized solutions to environmental problems. This activity can result in discharges of ballast water, accidental oil spills and the generation of shipboard garbage, all of which require specialized monitoring and treatment. Over its 70 years of growth, the Port of Long Beach, California developed in increments, sometimes without regard to compatibility of surrounding land uses. A shift in focus occurred after the water quality problems of the 1950's were solved, to emphasis on localized air pollution problems and risks inherent in storing and handling large quantities of hazardous materials. Developing facilities to ship large amounts of western U.S. coal to the Far East and resolving conflicts between neighboring auto import dealers and a coke calcining facility are two examples of port involvement in reducing the impact of localized air pollutants. Procedures now exist for siting new port facilities that handle or store large quantities of hazardous materials to reduce the risks of exposure to surrounding personnel and facilities. (Author's abstract)
W85-06176

RESPONSE OF PLANKTONIC AND MICROBENTHIC ALGAL ASSEMBLAGES TO NUTRIENT ENRICHMENT IN SHALLOW COASTAL WATERS, SOUTHWEST SWEDEN,
Lund Univ. (Sweden). Dept. of Marine Botany.
For primary bibliographic entry see Field 2L.
W85-06210

EFFECTS OF WATER QUALITY AND WATER QUANTITY ON NUTRITIONAL STATUS: FINDINGS FROM A SOUTH INDIAN COMMUNITY,
United Nations Children's Fund, Kampala (Uganda).
J. R. Hebert.
Bulletin of the World Health Organization, Vol. 63, No. 1, p 143-155, 1985. 3 Fig, 5 Tab, 36 Ref.

Descriptors: *Public health, *Water quality, *Water supply, *India, Drinking water, Bacteria, Nutrition, Sanitation, Children, Developing countries.

Data were collected concerning the nutritional status of 627 children in three urban communities in South India. Information was also collected on water quality, water quantity, household sanitation, socioeconomic conditions and housing. A statistical technique is presented that allows for controlling potential confounding factors in the analyses. For children aged 3 years or older the findings of this study are consistent with the notion that water quantity is a relatively stronger determinant of child health than in water quality. For younger children, however, the data support the opposite view. That is, for children under 3 years of age, water quality tends to be a stronger predictor of nutritional status than either washing- or cooking/drinking-water volume or availability. (Baker-IVI)
W85-06216

RESPONSES OF MODEL FRESHWATER ECOSYSTEMS TO CRUDE OIL,
Texas Univ. Health Science Center at San Antonio. School of Public Health
M. D. Werner, V. D. Adams, V. A. Lamarra, and N. L. Winters.
Water Research, Vol. 19, No. 3, p 285-292, 1985. 8 Fig, 7 Tab, 31 Ref.

Descriptors: *Water pollution effects, *Oil spills, *Lakes, Ecological effects, Crude oil, Oxygen demand, Nutrients, Toxicity, Productivity, Aquatic plants, Hydrocarbons.

Petroleum hydrocarbon stimulated the activity of the decomposer community immediately following the addition of crude oils to model freshwater ecosystems. Major effects of this on the overall ecosystems included: lower oxygen conditions, increased nutrient (nitrate and phosphate) utilization and a shift from an autotrophically to heterotrophically dominated diurnal ecosystem. Crude oil led to low oxygen condition in these experiments in at least three ways. First, a high oxygen demand was placed on the ecosystems because of biological degradation of petroleum hydrocarbons. Secondly, oil caused a reduction in primary production due to initial toxic inhibition and ongoing nutrient limitation. Thirdly, an oil film at the water surface apparently reduced the oxygen diffusion across the air-water interface. Unweathered oil caused a significant reduction in the growth of Selenastrum capricornutum due to toxic effects, but oil weathered for 48 days in an aqueous medium did not inhibit growth. The research indicates toxic effects of crude oil on plants in freshwater ecosystems will not be as harmful as oxygen and nutrient demand placed on a system by remaining oil. Cleanup efforts should reflect these potential impacts, efforts should be made to continue to remove as much oil from a site as possible, even after toxic effects have subsided. (Baker-IVI)
W85-06219

LAKE ALGAL POPULATIONS AND PHYSICO-CHEMICAL CHANGES AFTER 14 YEARS INPUT OF METALLIC MINING WASTES,
Victoria Univ. (British Columbia). Dept. of Biology.
A. Austin, J. Deniseger, and M. J. R. Clark.
Water Research, Vol. 19, No. 3, p 299-308, 1985. 6 Fig, 2 Tab, 39 Ref.

Descriptors: *Mine wastes, *Algae, *Water pollution effects, *Buttle Lake, *British Columbia, Lead, Zinc, Copper, Nutrients, Heavy metals, Periphyton, Phytoplankton, Species diversity, Acid mine drainage.

A primarily lead-zinc-copper mine operating since May 1967 has continuously discharged heavy metal mine tailings into the south basin of Buttle

Lake (British Columbia). Sampling of this previously undisturbed, wilderness park lake, during initial activities in 1966-1968 and again in 1980-1982 has indicated a pattern of change. Nutrient levels have remained stable while concentrations of heavy metals have greatly increased. This increase is largely due to acid generation and metals release to groundwater. Species of both periphyton and phytoplankton, known to be sensitive to heavy metals, have dramatically decreased in abundance. Other more tolerant forms such as Navicula cryptocephala, Synedra acus, Synedra filiformis and Cyclotella bodanica have subsequently increased in quantity. Additionally, species number and diversity have decreased throughout the lake while near the source of tailings effluent cell density was substantially lower. (Author's abstract)
W85-06221

TOXIC EFFECTS OF PETROLEUM AND SHALE JP-4 AND JP-8 AVIATION FUELS ON FATHEAD MINNOWS,
Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH.
J. W. Fisher, T. P. Hunt, M. E. Putnam, and M. J. Livingston.
Water Resources Bulletin, Vol. 21, No. 1, p 49-52, February, 1985. 2 Tab, 11 Ref.

Descriptors: *Fuel, *Shale oil, *Toxicity, *Fathead minnows, Hydrocarbons, Fish, Water pollution effects, Oil spills.

Static 96-hour median lethal concentrations were determined for the water-soluble fraction (WSF) of both petroleum-derived and shale-derived aviation fuels (JP-4 and JP-8) using fathead minnows. JP-8 was more toxic than JP-4 except for one shale JP-4 sample that was as toxic as the JP-8. Petroleum and shale JP-8 were similar in toxicity. The toxicity of shale JP-4 was less clear. Shale JP-4 from three vendor sources revealed differing toxicity values. One shale JP-4 sample was more toxic and one less toxic than its petroleum analogue, with the third being equally toxic. Toxicity of the fuels may be enhanced by compounds in the WSF that correspond to chemicals containing 10 or more carbon atoms. (Author's abstract)
W85-06238

WATER POLLUTION - PHYCOLOGICAL PERSPECTIVES,
Banaras Hindu Univ., Varanasi (India). Centre for Advanced Study in Botany.
J. P. Gaur, and L. C. Rai.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 375-389, 1983. 2 Tab, 75 Ref.

Descriptors: *Water pollution effects, *Algae, Species diversity, Food chain, Heavy metals, Synergism, Bioaccumulation, Biological wastewater treatment, Adaptation.

Water pollution exerts selection pressure on algal populations. In spite of a possible adaptation, often a changed diversity and sociological structure result, from which other effects on higher levels of the nutrient chain may emanate. A table represents some biological indices for characterizing algal communities which may serve as a biological measure of pollution and self-purification, the problem of diversity being especially taken into account. Moreover, algal tests are used for representing the trophic situation and for determining the limiting nutrient, but also for determining the toxic influencing of biocenosis by hydrocarbons. Special attention is paid to heavy metals with regard to their synergistic action and bioaccumulation. On the other hand, the mass culture of algae is a valuable method of wastewater treatment and the recovery of valuable materials, and algae ponds provide an important technique for advanced wastewater purification. (Author's abstract)
W85-06266

CUMULATION OF ZINC, CADMIUM AND MERCURY ON THE ALGA SCENEDESMUS OBLIQUUS,
Ceske Vysoke Uceni Technicke v Praze. Fakulta Jaderna a Fysikalne Inzenyrska.
J. Stary, B. Havlik, K. Kratzer, J. Prasilova, and J. Hanusova.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 401-409, 1983. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Zinc, *Cadmium, *Mercury, *Algae, *Bioaccumulation, Heavy metals, Radioisotope tracers, Cumulation factor, Hydrogen ion concentration.

The cumulation factor F (the ratio of the concentration of metal in algal cells and in the medium) depends on the species of algae, on the type of metal, its chemical form, concentration, etc. In batch experiments with the radionuclide labeled metals, the cumulation of zinc, cadmium and mercury on Scenedesmus obliquus is measured in relation to pH, because the original pH-value of the solution is changed by the algae due to their absorption of hydrogen ions. For the uptake of zinc and cadmium the logarithm of the cumulation factor in the range of 2-5 is a linear function of the pH in the range of 5-9, cumulation increasing with rising pH. In contrast, mercury cumulation is pH-independent. If the change in pH is taken into account, the cumulation factors are independent of the metal concentration in the range to 0.0001 mol/l. The degree of cumulation is not changed by the presence of other metals. The cumulation factor is reduced by substances forming negatively charged complexes with metals. In the presence of potassium bromide or iodide, the cumulation of mercury decreases because of the formation of negatively charged complexes; the decrease is not directly proportional to the equilibrium concentration of the bromide or iodide. (Moore-IVI)
W85-06268

SHORT TERM EFFECTS OF ALDRIN AND SWASCOFIX CD-38 ON THE FEEDING AND RESPIRATORY BEHAVIOURS OF CLARIAS BATRACHUS AND CIRRHINA MRIGALA,
Punjabi Univ., Patiala (India). Dept. of Zoology.
A. K. Gupta, S. S. Dhillon, I. P. Tonk, and S. R. Verma.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 423-432, 1983. 5 Fig, 18 Ref.

Descriptors: *Aldrin, *Swascofix CD-38, *Fish behavior, *Feeding, *Respiratory rate, *Toxicity, Insecticides, Surfactants, Behavior, Water pollution effects.

Fish were kept in non-toxic water or at 0.5, 0.25, and 0.125 of the 96h LC50 of the tenside or insecticide for 24 h and fed with toxified and non-toxified feed. Toxified feed in normal water resulted in maximum feed intake, while normal feed in toxified water result in a minimum one. In each case, the feed intake was lower compared with the control, and the feed intake was inversely proportional to the toxicant concentration. In a simple respirometer the oxygen consumption in mg/kg/h was tested for 1, 2, 4, 6, 8, 10, 12, 24, 36, 48, 60, 72, 84 and 96 h of exposure to 1.5, 1.0 and 0.5 of the 96h LC50 of both substances. It was a flow device which was closed only for measurement for one hour. Aldrin (1.5 LC50) causes a continuous reduction of respiration until death. The same effect occurred with Clarias batrachus for 1.5 LC50 of the tenside, whereas with Cirrhina mrigala death was caused by a pronounced increase of respiration. In all other cases, after a phase of sensitization for 4-8 h respiration increased considerably to more than 300% of the control, which was followed after 12-24 h by acclimatization to normal respiration values. (Author's abstract)
W85-06269

NITROGEN, PHOSPHORUS AND PRIMARY PRODUCTION IN THE POMERANIAN BAY,
Akademia Rolnicza w Szczecinie (Poland). Inst. of Fisheries, Oceanography and Protection of the Sea.
For primary bibliographic entry see Field 2L.
W85-06270

ACUTE TOXICITY OF PHENOL, PENTACHLOROPHENOL AND SODIUM PENTACHLOROPHENATE TO A FRESHWATER OSTRACOD CYPRIS SUBGLOBOSA (SOWERBY),
Udaipur Univ. (India). Dept. of Limnology and Fisheries.
P. S. Rao, V. S. Durve, B. S. Khangarot, and S. S. Shekhawat.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 457-465, 1983. 1 Fig, 4 Tab, 32, Ref.

Descriptors: *Toxicity, *Phenol, *Pentachlorophenol, *Sodium pentachlorophenate, *Ostracods, Phenols, Biocides, Chlorinated phenols.

The toxicity of phenol, pentachlorophenol and Na-pentachlorophenate to Cypris subglobosa was determined in a batch experiment for 96 h. The 96 h LC50 of the three substances were 71.8, 6.56 and 4.41 mg/l, respectively. In the range of 6-95 h the mean survival time shows a negative regression to the toxicant concentration, which, however, is not significant statistically for Na-pentachlorophenate. In agreement with this, the LC50 for 12, 24, 48, 72 and 96 h of exposure shows a significant decrease. Due to the comparatively high 96 h LC50 for pentachlorophenol and Na-pentachlorophenate for C. subglobosa in comparison with fish, the species is little suited to the toxicological investigation of wastewater. (Author's abstract)
W85-06271

TOXICITY AND TRACE ANALYSIS OF TENSIDES IN WATER (ZUR TOXIZITAT UND SPURENANALYSE VON TENSIDEN IN WASSER),
Akademie der Wissenschaften der DDR, Leipzig. Forschungsstelle fuer Chemische Toxikologie.
For primary bibliographic entry see Field 5A.
W85-06272

OXYGEN BUDGET OF THE WATERS OF THE FELDBERGER LAKEPLAIN BASED ON SUMMER DEPTH PROFILES FOR 1924 AND 1962, PART 3: SCHARTEISEN, WASCH-SEE, DOLGENER SEE (ZUM SAUERSTOFFHAUSHALT DER GEWASSER DER FELDBERGER SEENPLATTE AN HAND AUSGEWAHLTER SOMMERLICHER TIEFENPROFILE SEIT 1924 UND 1962, TEIL 3: SCHARTEISEN, WASCH-SEE, DOLGENER SEE),
W. M. Richter.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 5, p 539-558, 1983. 10 Fig, 4 Tab, 41 Ref.

Descriptors: *Depth profile, *Oxygen budget, *Scharteisen, *Wasch-See, *Dolgener See, Transparency, Water temperature, Hydrogen sulfide, Eutrophication, Dissolved oxygen, Water quality, Drinking water, Fisheries.

This paper presents the depth profiles for 1951-1980 for the Scharteisen, and in later years for the Wasche lake and the Dolgen lake for the oxygen regime, showing oxygen concentration, transparency, water temperature and the upper limit of the occurrence of hydrogen sulfide. The profiles demonstrate that eutrophication has occurred for the Scharteisen and is the present state of the three lakes. The general situation of the drainage areas and the causes of changes of the water quality as well as possible measures and aims of sanitation measures are discussed. Also the most important data are given on the hydrography of these waters related to their utilization for drinking water and by fisheries. (Author's abstract)
W85-06274

OCCURRENCE OF DDT AND POLYCHLORINATED BIPHENYLS (PCB) IN FISH FROM LAKES IN SCHWERIN COUNTY (ZUM VORKOMMEN VON DDT UND POLYCHLORIERTEN BIPHENYLEN (PBC) IN FISCHEN AUS SEEN DES BEZIRKES SCHWERIN),
Bezirks-Hygieneinspektion und -Inst., Schwerin (German D.R.).
J. Stechert, and A. Jantz.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 5, p 559-567, 1983. 4 Fig, 29 Ref.

Descriptors: *DDT, *Polychlorinated biphenyls, *Fish, *Schwerin, *Germany (Democratic Republic), Water pollution effects, Eels, Trout, Aquaculture, Bioaccumulation.

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Investigations were made of 212 fish samples of eight fish species from 29 lakes in Schwerin county (German Democratic Republic). Determinations were made gas-chromatographically after chemical derivatization. In lakes with a low anthropogenic load the following concentrations were found: 0.05 mg/kg DDT, 0.03 mg/kg PCB. In lakes with higher pollution, the concentrations were 0.21 mg/kg DDT and 0.42 mg/kg PCB. The limit of tolerance for foodstuffs was never exceeded and predatory fish did not show higher concentrations than non-predacious fish. For ten eels, however, the mean contents were 1.6 mg/kg DDT and 0.36 mg/kg PCB. The total content of DDT in all fishes was composed as follows: 70-75% p,p'-DDE, 15-20% p,p'-DDD and 5-10% p,p'-DDT. Trout from an intensive-breeding plant contained 0.16 mg/kg DDT and 0.04 mg/kg PCB from the contaminated feed. By means of a change-over to different feed the contents were reduced to 0.03 mg/kg DDT and 0.04 mg/kg PCB. (Author's abstract)
W85-06275

STABILITY OF THE STATIONARY STATE OF A EUTROPHIC WATER POOL,
Bulgarian Academy of Sciences, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika.
I. K. Sivriev.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 5, p 603-606, 1983. 4 Ref.

Descriptors: *Eutrophication, *Stability analysis, *Ponds, Dissolved oxygen, Water temperature, Water pollution effects, Model studies, Stationary process.

Over the course of time a given pool eutrophies and the total quantity of substance in the pool increases, due to the increased pollution of the environment. Since this is a slow process, for any fairly short period of time the state of the pool can be considered as stationary with respect to the total quantity and distribution of substances in it. A simple analytical model of the conditions at which the stationary state of a pool is disturbed is used to study the stability of the stationary state on the eutrophic pond. The scheme of circulation of the substances in a eutrophic water pool along the cycle minerals-photosynthesizing biomass-organic substrate is given. The requirement that the average time value of the oxygen concentration in the pool is greater than the saturation oxygen concentration at the existing temperature and presssure is a necessary condition for disturbance of the stability of the stationary state. (Baker-IVI)
W85-06277

IN SITU NITROGEN ENRICHMENT EXPERIMENTS IN TWO IDAHO (U.S.A.) STREAMS,
Idaho State Univ., Pocatello. Dept. of Biology.
C. Y. Manuel-Faler, G. W. Minshall, R. W. Dunn, and D. A. Bruns.
Environmental Monitoring and Assessment, Vol. 4, No. 1, p 67-79, March, 1984. 2 Fig, 3 Tab, 38 Ref.

Descriptors: *Nitrogen, *Nutrients, *Streams, *Algae, *Idaho, *Deep Creek, *Big Wood River, Chlorophyll a, Algal growth, Periphyton, Biomass, Species composition, Water pollution effects.

A series of in situ experimental nutrient additions was conducted in two Idaho streams: Deep Creek, a desert stream located in Southeastern Idaho, and Big Wood River, situated in a mountainous region of Central Idaho. In both streams, a homogeneous reach was partitioned into almost identical channels. This allowed one to vary nutrient levels and measure algal response in experiments uncomplicated by differences in other factors. Ammonium nitrate was added to the treatment channels in Deep Creek. After nine days, Cladophora glomerata still predominated in both the control and treatment channels and algal biomass was not statistically different between the two. In the Big Wood River experiment significant differences in chlorophyll a concentrations were not detected among three treatments of differing nitrogen enrichment and the control for both natural and artificial substrates. Also chlorophyll a levels were not correlated with nitrogen concentrations, and the composition of algal communities remained similar among all treatments. It is concluded that macronutrient enrichment of streams does not necessarily result in an increase in algal density or a change in algal community structure so long as other factors, which may limit the use of nutrients by algae, remain unaltered. The results suggest that light, current velocity, and macroinvertebrate grazing may account for the failure of the periphyton to respond to in situ additions of nitrogen (and phosphorus) in the study streams. (Author's abstract)
W85-06284

HIGH PCB RESIDUES IN BIRDS FROM THE SHEBOYGAN RIVER, WISCONSIN,
Patuxent Wildlife Research Center, Laurel, MD.
G. H. Heinz, D. M. Swineford, and D. E. Katsma.
Environmental Monitoring and Assessment, Vol. 4, No. 2, p 155-161, June, 1984. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Polychlorinated biphenyls, *Birds, *Sheboygan River, *Wisconsin, Water pollution effects, Foods.

Organochlorine residues were measured in the carcasses and, in some cases, brains and stomach contents of four species of birds collected along the Sheboygan River, Wisconsin during the years 1976 to 1980. Polychlorinated biphenyls (PCBs) were high in all samples and were the contaminants of greatest concern. Carcass residues ranged from 23 to 218 ppm PCBs on a wet weight basis; these are levels associated with reproductive impairment in laboratory studies with some birds. Food items in the stomachs of collected birds contained from 12 to 58 ppm PCBs, indicating a heavy contamination of food sources. The brain of one bird contained 220 ppm PCBs, a level that is not in the lethal range but is very high. Birds feeding in the contaminated portions of the Sheboygan River may have been harmed by high PCB levels. (Author's abstract)
W85-06288

CHANGES IN WATER QUALITY IN FINNISH LAKES 1965-1982,
R. Laaksonen, and V. Malin.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 52-58, 1984. 10 Fig, 4 Tab, 3 Ref.

Descriptors: *Water quality, *Lakes, *Finland, Linear regression analysis, Electrical conductivity, Nutrients, Sulfur, Chloride, Cluster analysis, Water pollution.

Linear regression analysis was used to uncover possible trends in water quality at a network of observations (160) at deep places in lakes in Finland. Observations were made in March 1965-1982 at 4 depth levels in the water column. The parameters included were oxygen, conductivity, alkalinity, pH, color, total sulfur, chloride, iron, organic carbon, total nitrogen and total phosphorus. The trends uncovered in water quality in the period 1965-82 have grown clearly in number and statistical significance since the investigation of the period 1965-77. According to the records for 1970-82, the increase has come to a stop. The parameter that has changed the most is still electrolytic conductivity, which accounts for 34% of the total trends. It is followed by chloride, alkalinity and sulfur. Of the trends evident in 1965-82, 73% indicate a deterioration in water quality; the corresponding proportion for 1970-82 is 65%. Half of this slowing down of the deterioration is due to electrolytic conductivity. Cluster analysis has also been employed to examine the changes in water quality at the middle depth in the water column in the periods 1965-70 and 1977-82. The dominant feature appears to be a decrease in the group of stations in a natural condition. Evidence of change was found especially in shifts in the distribution of the values for electrolytic conductivity and total nitrogen. (Moore-IVI)
W85-06295

CHANGES IN IONIC DISTRIBUTIONS IN FINNISH LAKE WATER DURING THE PERIOD 1968-1983,
R. Laaksonen, and V. Malin.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 59-60, 1984. 1 Tab. 1 Ref.

Descriptors: *Finland, *Lakes, *Acid rain, Water pollution effects, Sulfates, Nitrates, Water quality, Chemical composition, Calcium, Magnesium, Sodium, Potassium, Carbonates, Chlorides, Electrical conductivity.

Considerable changes were noted during the period 1968-1983 in the ionic distributions in Finnish lake water. These changes are thought to be related to acid rain effects. Specific measurements were made of the concentrations of calcium, magnesium, sodium, potassium, hydrocarbonate, sulfate, and chloride. Data from 104 deepwater stations was used for the investigation. The concentrations of cations was 4.0% greater than that of anions during the period 1968-1970. By 1981-1983 this discrepancy had increased to 11.5%. The concentration of cations increased between the two observation periods by 9.5%, while that of anions increased only by 2.1%. The mean electrical conductivity of the water at the stations increased during the same period by 11.3%. The change was similar whether the waters were known to be polluted or were relatively undisturbed. (Baker-IVI)
W85-06296

EFFECTS OF SILTATION ON EMBRYONIC MORTALITY OF TROUT,
Case Western Reserve Univ., Cleveland, OH. Dept. of Biology.
J. Koonce, and M. Teraguhi.
Available from the National Technical Information Service, Sprinfield, VA 22161 as PB85 157642/AS, Price codes: A05 in paper copy, A01 in microfiche. Ohio State University, Columbus, Water Resources Center, Project Completion Report No. 544, July 1980. 28 p, 3 Fig, 11 Tab, Project No. OWRT B-071-OHIO (1), Contract/Grant No. 14-34-0001-7178.

Descriptors: *Silt load, Water pollution effects, Silts, Fish reproduction, Stream fisheries, Stream pollution.

The hypothesis that siltation in streams eliminates the natural reproduction of trout by increasing mortality during embryonic development was tested. Several environmental factors (temperature, dissolved oxygen and flow rates) are known to affect embryonic development. These factors all change with siltation in streams, but the interaction of these factors with silt needed more definition. If the extent of which silt alone affects embryo mortality could be determined, procedures could be developed to improve trout reproduction in silted streams. This project attempted to define the critical period of susceptibility of trout embryos to siltation. The findings were that the effects of siltation on embryonic development are indirect. Silt alone does not increase embryonic mortality but it apparently alters the physical characteristics of the gravel substrate and affects the flow rates through the gravel and the dissolved oxygen concentrations within the gravel. Further, it may restrict embryonic emergence.
W85-06311

EFFECT OF ASH FALLOUT ON WATER QUALITY IN WESTERN MONTANA,
Montana Univ., Missoula. Dept. of Chemistry.
R. E. Juday, and E. J. Keller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157824/AS, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, March, 1984. 147 p, 2 Fig, 46 Tab, 106 Ref, 5 Append, Project No. OWRT C-10095-V (1), Contract/Grant No. 14-34-0001-1469.

Descriptors: Mt. St. Helens, *Washington, Ash fallout, Water quality changes, Algal productivity, Clearwater lakes, Extractable nutrients, *Volcanoes, Trophic states, Sedimentation.

Subsequent to the eruption of Mount St. Helens in 1980, a water quality study was conducted on lakes

and streams of the Clearwater drainage of Western Montana and several oligotrophic high mountain lakes in Idaho. Field studies indicated that the fallout, although containing appreciable amounts of water soluble nutrients, had virtually no effect on productivity of oligotrophic lakes. Appreciable increases in algal productivity were noted in the mesotrophic study lakes in 1980, although they were no larger than might be expected from climatological changes or from local logging activity. Laboratory studies showed that, imitating natural conditions, appreciable amounts of nutrients could be extracted from the ash, and that the extracts increased algal productivity in incubated lake samples.
W85-06325

1,2-DICHLOROPROPANE (1,2-D)--1,3-DICHOLOROPROPENE (1,3-D),
California State Water Resources Control Board, Sacramento.
D. B. Cohan, D. Gilmore, C. Fisher, and G. W. Bowes.
Special Projects Report No. 83-8sp, August 1983, 86 p, 20 Fig, 25 Tab, 142 Ref, 10 Append.

Descriptors: *Soil-water-plant relationships, *Fumigants, *Pesticides, *Agricultural chemicals, *Soil organic matter, *Repellants, *Carcinogens, Pesticide toxicity, Nematodes, Soil contamination, Dichloropropane, Dichloropropene, 1,2-D, 1,3-D.

The investigation of 1,2-dicholoropropane (1,2-D) and 1,3-dichoropropene (1,3-D) was prompted by a concern about the long-term use of these soil fumigants because of their chemical similarity to DBCP and possible persistence in soil of 1,2-D. In addition, there has been a recent dramatic increase in their reported use in California from 4 million pounds in 1977 to over 16 million pounds in 1981, and there is a suspected potential mutagenicity and carcinogenicity. Initial surveys discovered 1,2-D in California ground water in an increasing number of shallow and deep wells in eight counties from Kern County in the south to Del Norte County in the north. None of the sites sampled contained detectable concentrations of 1,3-D. Most of the 1,2-D findings appeared to be related to agricultural use of nematicides rather than from industrial discharge. Repeated exposure to 1,2-D causes liver and kidney damage in experimental animals, yet 1,2-D is much less effective than 1,3-D as a soil nematicide and therefore is not essential. To prevent further contamination of ground water by 1,2-D in California, it is recommended that EPA and registrants of products containing 1,2-D take immediate action to reduce the 1,2-D content to the lowest practical level (i.e., less than 2%), and that permits should not be issued by county agricultural commissioners for restricted materials having unacceptably high levels of 1,2-D. (Hawkins-Omniplan)
W85-06332

CALIFORNIA STATE MUSSEL WATCH, 1981-1983, BIENNIAL REPORT,
California State Water Resources Control Board, Sacramento, CA. Div. of Surveillance and Monitoring.
J. M. Ladd, S. P. Hayes, M. Martin, M. D. Stephenson, and S. L. Coale.
Water Quality Monitoring Report No. 83-6TS, January 1984. 78 p, 31 Fig, 5 Tab, 24 Ref, 10 Append.

Descriptors: *Mussels, *Baseline studies, *Pesticide toxicity, Water pollution sources, *Water pollution effects, *Mollusks, *Mytilus, On-site data collections, Trace metals, Estuarine environment, Bays, Wastewater pollution, Humboldt Bay, Alamitos Bay, San Francisco Bay, Redwood Creek, Moss Landing, California, Los Angeles, Long Beach, DDT, Toxaphene, Endosulfan, Pentachlorophenol, PCB, Chlorinated hydrocarbons.

Toxic pollutant levels in mussels from coastal, bay and estuarine areas were monitored during 1981-1983 as part of an ongoing Mussel Watch Program. Samples were analyzed for about 55 synthetic organic compounds, primarily chlorinated pesticides and PCBs. Also studied were about ten trace metals. Collections were made at more than 150 stations, and there were site-specific surveys at five locations. Silver concentrations in mussels were found over a wide range of about 50,000 fold. In addition, there appears to be a good relationship between silver concentration in mussels and the proximity of mussels to municipal wastewater discharges. Baseline monitoring in bay and estuarine areas indicated that shellfish in Alamitos Bay should continue to be monitored due to the elevated lead and chlorinated pesticide levels found there. The detection of a wood preservative, pentachlorophenol, in mussels from Humboldt Bay warrants further study. The Redwood Creek area of South San Francisco Bay no longer appears to be the site of a significant silver input; however, there was evidence of a significant input (1981-82) with its abatement unexplained. The Moss Landing drainage area yielded mussels, fish and water with relatively high levels of a wide variety of pesticides, particularly toxaphene, endosulfan, and DDT. Los Angeles/Long Beach Harbor should continue to be monitored to determine if clean-up and abatement actions result in reduced levels of DDT and metabolites in the harbor. (Hawkins-Omniplan)
W85-06333

RELATIVE EFFECTS OF CHLORINE AND AMMONIA FROM WASTEWATER TREATMENT FACILITIES ON STREAM BIOTA,
Southern Illinois Univ. at Carbondale.
R. C. Heilinger, W. M. Lewis, M. H. Paller, J. H. Waddell, and L. J. Wawronowicz.
Illinois Department of Energy and Natural Resources Document No. 83/24, September 1983, 109 p and 220 p, 14 Fig, 25 Tab, 31 Ref, 12 Append (in separate volume).

Descriptors: *Fish populations, *Chemical treatment, *Stream degradation, *Fish toxins, *Streams, *Stream pollution, *Secondary wastewater treatment, Chlorination, Wastewater treatment, Sludge, Ammonia, Wastewater facilities.

Three Champaign-Urbana area sewage receiving streams were monitored with regard to on biological, chemical and physical variables from 1979 to 1983. During a period when the streams received chlorinated secondary effluent, the fish community in Copper Slough was extremely poor quantitatively and qualitatively; but within seven days after the cessation of chlorination, the fish community recovered to levels characteristic of ambient areas above the outfall. The Kaskaskia Ditch fish community responded similarly to the cessation of chlorination. Recovery occurred in these streams despite ammonia-nitrogen concentrations typical of good quality secondary sewage effluent. However, the fish community in Saline Branch did not recover immediately after the cessation of chlorination, in part because this coincided with a worsening of other effluent quality parameters due to operational problems caused by plant renovation. As a result, very high ammonia levels, very low oxygen levels and the deposition of sludge materials were observed. The elimination of residual chlorine from good quality secondary sewage effluents will result in restoration of fish communities in average Illinois streams receiving such effluents. The reduction of ammonia concentrations from typical secondary treatment levels to extremely low levels by tertiary treatment will not necessarily effect obvious improvements. (Hawkins-Omniplan)
W85-06342

EVALUATION OF WASTES FROM THE EAST ST. LOUIS WATER TREATMENT PLANT AND THEIR IMPACT ON THE MISSISSIPPI RIVER,
Illinois State Water Survey Div., Champaign.
S. Lin, R. L. Evans, D. Schnepper, and T. Hill.
ISWS Circular 160, 1984. 62 p. 16 Fig, 20 Tab, 24 Ref, 3 Append.

Descriptors: *Waste disposal, *Solid waste disposal, *Waste identification, *Wastewater disposal, *Wastewater treatment, *Clarification, *Clarified wastewater, River bed, Navigable rivers, River mechanics, Benthic fauna, Iron, Aluminum, Wastewater Facilities, East St. Louis, Illinois.

The disposal of wastes has been troublesome and costly for the water industry. For nearly two decades a number of alternative methods, including lagooning, mechanical or gravity thickening, and pipeline transport have been practiced. Unfortunately, little information on the impact of wastes from water treatment plant discharges on receiving streams is available. The quantity and characteristics of wastes generated by the East St. Louis, Illinois, water treatment plant, which is a large plant employing the clarification process were studied. The major chemical constituents of the solid wastes are iron and aluminum. Except during 7-day 10-year low-flow conditions, increases in suspended solids in the Mississippi River during occurrences of maximum waste discharges will not be perceptible. The influence of the waste is detectable in the bottom sediments of the river by increases in iron, aluminum, moisture, and organic content, and by changes in particle size distribution. However, that influence is limited to an impacted area about 100 feet offshore and within 4,000 feet downstream of the waste outfalls. The types of changes in the composition of the sediments are not a mark of environmental degradation. This conclusion is strengthened by observations of benthic macroinvertebrates in the area. There was no significant difference in the nearshore stations upstream or downstream of the waste outfalls in terms of macroinvertebrates. (Hawkins-Omniplan)
W85-06343

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, APPENDIX--RARITAN RIVER BASIN,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-C: 1.B, June 1983. 94 p, 1 Tab, 50 Fig.

Descriptors: *Rivers, *Watersheds, On-site data collections, *Water pollution sources, Dissolved oxygen, Anaerobic conditions, Groundwater basins, Large watersheds, Drainage area, On-site test data, Coliforms, *New Jersey, *Raritan River basin, Water quality.

The Raritan River's five watersheds are surveyed in terms of water quality, problem assessment, and goal assessments and recommendations. The North Branch of the Raritan is primarily in a wooded and rural area, where septic systems are employed in most areas. Water quality varied from good to marginal in localized areas, and there have been periodic problems with dissolved oxygen and nutrient levels. Current municipal treatment plants need to be upgraded. At the South Branch, where the watershed is also primarily rural, high levels of trihalomethanes were found at two locations. Point source controls are needed at several locations. The Millstone River basin has several population centers with generally good water quality in its upstream segment which declined to marginal conditions downstream. Fecal coliform concentrations increased downstream and were periodically above 200 MPN/100 ml in two locations. Biological data suggest the presence of a stressed community. Some dredging and agricultural best management practices need to be implemented. At the Lawrence Brook and South River watersheds, the terrain is varied as is the water quality. There were fluctuations in pH values at various sites, and 36 percent of the fecal coliform data for Lawrence Brook exceeded 200 MPN/100 ml. The Lower Raritan River Basin is primarily urban/suburban, where water quality was moderate to poor due to frequently excessive levels of BOD5, total ammonia and un-ionized ammonia and dissolved solds. PCB Arochlor 1254 was recorded in virtually all tissue samples. (Hawkins-Omniplan)
W85-06352

SULPHURIC ACID AND OLEUM, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W85-06355

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SULPHUR, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W85-06356

BENZENE, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W85-06357

ROCKY MOUNTAIN ACIDIFICATION STUDY,
Colorado State Univ., Fort Collins. Natural Resources Ecology Lab.
J. H. Gibson, J. N. Galloway, C. Schofield, W. McFee, and R. Johnson.
Available from Supt. of Documents, GPO, Washington, D.C. 20402. Report FWS/OBS-80/40.17; Air Pollution and Acid Rain Report No. 17, October 1983. 137 p, 32 Fig, 24 Tab, 109 Ref, 4 Append.

Descriptors: *Watersheds, *Deposition, *Acidification, *Sensitivity analysis, *Fish populations, *Geology, Nitrate, Sulfate, Acidity, Fisheries, Granite, Schist, Gneiss, Water chemistry, Rocky Mountains, *Acid rain, Colorado, Wyoming.

This report presents information gathered to: 1) determine the sensitivity of watersheds characteristic of the Rocky Mountain Region and the relationship of watershed sensitivity to geology and soils, 2) evaluate the extent of current acidification and the potential for increasing acidification with increasing deposition of nitrate and sulfate, 3) evaluate the results of the above in terms of impacts on fish populations, 4) develop recommendations for assessment of future trends in both changing water chemistry and impacts on fish populations. Areas were selected for study which had minimal human impact and for which the maximum amount of data on soils, geology and water chemistry already existed. The Rocky Mountain National Park and Yellowstone National Park areas selected exemplified two different geologic types. The geology of these areas is representative of a large portion of that in the total Rocky Mountain region. In addition, data on precipitation chemistry were available from the National Atmospheric Deposition Program monitoring studies in the two parks. Tha analysis of sensitive aquatic systems have been extra-polated to the Central Rocky Mountain Region (CRMR) by delineating areas underlain by granite biotite gneiss and schist and similar gneisses and schists. Areas underlain by these formations are classified as sensitive (alkalinity $<$ 200 micro eq/l), lakes and streams located at higher elevations ($>$ 3300 m) can be classified as very sensitive (alkalinity $<$ 100 micro eq/l). Areas underlain by tertiary intrusive rocks were classified as nonsensitve (alkalinity $>$ 200 micro eg/l). The CRMR receives precipitation that is somewhat acidic (average annual pH approximately equal to 5.0, NADP 1982). With respect to fish populations, this acidification is not chronic enough to impact on area fisheries.
W85-06359

LOWER CUCKELS BROOK WATER BODY SURVEY AND USE ATTAINABILITY ANALYSIS,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
J. T. Reading, and W. P. Minervini.
Revised April, 1983. 20 p. 4 Tab, 7 Ref, 1 Append.

Descriptors: *Water analysis, *Chemical wastes, *Industrial wastes, *On-site data collections, *On-site tests, *Streams, *Wastewater pollution, *Aquatic environment, Wastewater disposal, Sewage disposal, Effluent streams, Sludge, Effluent.

This study illustrates the application of use attainability analysis to Cuckels Brook, a small stream segment in heavy industrial surroundings in New Jersey that receives large volumes of wastewater. A water body survey was comprised of water chemistry sampling at five stream stations and of sampling of effluent from the American Cyanamid plant. This data was supplemented for the use attainability analysis by existing effluent self-monitoring chemistry and bioassay data, effluent compliance monitoring data, and stream data from surveys and studies. The Cyanamid discharge contained 0.8 mg/l TRC. Concentrations at two stations were 0.3 mg/l TRC, 100 times the state criterion. Concentrations of instream filterable residue levels were 1,100 mg/l, more than three times the state criterion. Three species of fish, collected with a quarter-inch seine and a dip net, were found: the banded killifish, the creek chub and th blacknose dace. At Lower Cuckels Brook, visual observation and chemical data suggest that virtually no aquatic life exists there, including algae. Numerous organic chemicals were found in effluents, but their concentrations were generally at low levels, under 10 mg/l. If discharges were removed from Lower Cuckels Brook and piped to the Raritan River, wastewater sludge deposits on the bottom would need to be removed to permit limited aquatic life and recreational uses, since this segment is on private land. (Hawkins-Omniplan)
W85-06361

IMPACT OF SEWAGE BYPASS ON NEWARK BAY,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
S.-F. Hsueh, and T.-R. Jeng.
April 1982. 22 p. 6 Tab, 4 Fig, 7 Refs.

Descriptors: *Estuarine environment, *Sewer districts, *Wastewater disposal, *Jurisdiction, *Bays, *Wastewater treatment, *Wastewater discharge, Wastewater, Sewage bacteria, Biochemical oxygen demand, Dissolved oxygen, Treated water, Estuaries.

Severe stress on the dissolved oxygen concentrations in Newark Bay and the adjacent areas of the tributaries was placed when construction and upgrading of sewerage facilities was delayed for three months. The magnitude of the impact, based on two sets of water quality data, was that the bypass discharge of approximately 270 mgd of sewage from the Passaic Valley Sewerage Commission (PVSC) facility violated the DO standard for Newark Bay, and that the water quality was in a severely degraded and anaerobic condition during the summer of 1980. During the high tide period, the impact on the Passaic and Hackensack Rivers was detected (Higher T0C and lower D0) at stations S-1 and S-2. Relatively high DO was detected at station S-8. As this station was located at the mouth of Newark Bay, the impact due to the incoming tide through the Kill Van Kull River was considered the major reason. Under the low tide period, stations in the Passaic and Hackensack Rivers were not affected by the bypass discharge. All other stations in the complex are considered to be in an anaerobic condition due to the extremely low DO levels. The physical characteristics and dynamic behavior of the estuarine system must be established in order to provide a sound basis for further analysis. The longitudinal distribution of chlorides was used to estimate dispersion coefficients for different segments. One year after cessation of the bypass discharge, a follow-up monitoring program was conducted by the PVSC using two more sampling stations. The entire system had already recovered from the damage. (Hawkins-Omniplan)
W85-06362

STUDIES OF TOXIC EFFECTS OF HG(II) ON PISTIA STRATIOTES,
Visva-Bharati Univ., Santiniketan (India). Dept. of Chemistry.
A. K. De, A. K. Sen, D. P. Modak, and S. Jana.
Water, Air and Soil Pollution, Vol. 24, No. 4, p 351-360, April, 1985. 5 Tab, 28 Ref.

Descriptors: *Mercury, *Toxicity, *Absorption, *Pistia, *Aquatic plants, Chlorophyll, Protein, Phytotoxicity, Water pollution effects, Industrial wastes.

The uptake of Hg(II) and toxicity effect of the metal on some biochemical parameters in Pistia stratiotes were studied. At 20 ppm, Hg(II) promotes senescence of Pistia plants by general inhibition of the biosynthesis of cellular metabolites, impairing the degradation of the biochemical constituents and also interfering with the nucleic acid biosynthesis and protein synthesizing machinery in the plant. At concentrations below 20 ppm of Hg(II), the metabolic activities of the plant are least affected, probably because there is a route by which the metal ion may be accumulated in the vacuolar system of the plant. Maximum removal (about 90%) of Hg(II) by plants was recorded below 20 ppm within 24 hr. (Baker-IVI)
W85-06372

MICROBIAL TRANSFORMATION OF ALKYLPYRIDINES IN GROUNDWATER,
Battelle Pacific Northwest Labs., Richland, WA.
J. E. Rogers, R. G. Riley, S. W. Li, M. L. O'Malley, and B. L. Thomas.
Water, Air, and Soil Pollution, Vol. 24, No. 4, p 443-454, April, 1985. 1 Fig, 4 Tab, 18 Ref. DOE contract AC06-76RLO 1830.

Descriptors: *Microbial degradation, *Groundwater pollution, *Alkylpyridines, Aerobic degradation, Anaerobic degradation, Degradation, Bacteria, Water pollution effects, Water quality control.

The microbiological degradation of a mixture of alkylpyridines in groundwater maintained under aerobic and anaerobic conditions was examined. For 5 years, sampling wells located within a drainage adjacent to the Anvil Points oil shale facility near Rifle, Colorado, were monitored for the presence of nitrate, ammonium ion, DOC, DO and alkylpyridines. The persistence of the mixture of alkylpyridines present in alluvial groundwaters obtained from well AV3 was investigated. In the presence of soil inoculum and under aerobic conditions, the residual alkylpyridine concentrations generally approached zero concentration within 10 to 31 days of incubation. The observed range of biotransformation rates was dependent on molecular weight with the lighter alkylpyridines generally being transformed at a faster rate than the heavier analogs. A marked effect on the biotransformation rate was also noted with respect to the specific ring substitution of structural isomers within a given weight class. The concentration of two of the 5-carbon substituted alkylpyridines were reduced by microbial activity to less than detectable values within 10 days of incubation, whereas the concentration of a third was reduced to less than detectable concentration within 24 days and a significant level of the fourth remained over the duration of the study. Microbiological transformation of alkypyridines was also noted under anaerobic conditions. The biotransformation rates and the effects of molecular weight and the specific ring substitution of stuctural isomers were not as pronounced when compared with degradation rates observed under aerobic conditions. A 12- to 18-fold reduction in the concentration of all alkylpyridines, C3 and greater, was noted in anaerobic experiments following the purging of water samples with argon to remove oxygen. Microbial population increased during the incubation period for aerobic and anaerobic experiments. (Baker-IVI)
W85-06374

PHYTOPLANKTON OF THE LOWER DNIEPER (FITOPLANKTON NIZHNEGO DNEPRA),
V. S. Polishchuk, and V. A. Tomnitsky.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 8-11, 1985. 2 Fig, 10 Ref.

Descriptors: *Phytoplankton, *Water pollution effects, *Dnieper, *USSR, Primary productivity, Organic matter, Photosynthesis, Hydrological properties.

The paper presents data concerning the qualitative and quantitative phytoplankton development in different branches and the river-bed part of the lower Dnieper (USSR). Hydrological conditions and waste waters are analyzed for their effect on phytoplankton development as well as on the pri-

mary production and destruction. Organic substances formed by phytoplankton in the mouth under photosynthesis are qualitatively estimated for their flow into the Dnieper-Bug leman. (Author's abstract)
W85-06375

DYNAMICS OF ZOOPLANKTON IN THE CHERNOBYL ATOMIC POWER PLANT WATER COOLING (SEZONNAYA DINAMIKA ZOOPLANKTONA VODOEMA-OKHLADITELYA CHERHOBY'SKOI ATOMNOI ELEKTROSTANTSII),
O. A. Sergeeva.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 32-36, 1985. 3 Fig, 4 Tab, 4 Ref.

Descriptors: *Zooplankton, *Thermal pollution, *Nuclear powerplants, *Pripyat River, *USSR, Cooling water, Water pollution effects, Wastewater pollution, Species composition, Weather.

The paper presents data concerning the species composition and quantitative development of zooplankton, its distribution along the water area of the Chernobyl Atomic Power Plant (APP) water cooling (heat demand 7.5 t.cal/sq m/day) depending on a degree of artificial heating in different years in the season aspect. Long discharge of APP heated waters as well as of domestic sewage, and constant water pumping from the Pripyat River, USSR under different weather conditions result in changes in the structure of zooplanktonic community. (Author's abstract)
W85-06377

INFLUENCE OF CERTAIN TOXICANTS ON DAPHNIA MAGNA STRAUS SURVIVAL RATE IN THREE-FACTOR EXPERIMENT (VLIYANIE NEKOTORYKH TOKSIKANTOV NA VYZHIVAEMOCT' DAPHNIA MAGNA STRAUS V TREKHFAKTORNOM EKSPERIMENTE),
M. Preshing.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 72-75, 1985. 1 Tab, 12 Ref.

Descriptors: *Daphnia, *Toxicity, *Pesticides, 2,4-D, Atrazine, Copper, Herbicides, Diconirte, Actikone K, Synergism, Water pollution effects.

The combined effect of three pesticides on Daphnia magna survival rate is determined according to the CFE = 23 procedure under laboratory conditions at the temperature 20 C and 1-, 2-, 3-, 4- and 5-day exposure. The toxicant concentrations are as follows: 400 mg/l for 2,4-D, 10 mg/l for atrazine and 0.04 mg/l for copper. The combined effect of herbicides on Daphnia survival rate is synergism, that of diconirte and copper is antagonism and that of actikone K and copper is an additive effect. (Author's abstract)
W85-06379

DISTRIBUTION AND ELIMINATION OF HEXACHLOROBENZENE, OCTACHLOROSTYRENE AND DECACHLOROBIPHENYL IN RAINBOW TROUT, SALMO GAIRDNERI,
National Veterinary Inst., Oslo (Norway).
G. Norheim, and S. O. Roald.
Aquatic Toxicology, Vol. 6, No. 1, p 13-24, February, 1985. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Trout, *Organochlorine compounds, *Water pollution effects, Path of pollutants, Hexachlorobenzene, Octachlorostyrene, Decachlorobiphenyl, Hydrocarbons.

In two experiments rainbow trout, Salmo gairdneri, were injected intraperitoneally with an oil solution containing hexachlorobenzene (HCB) and octachlorostyrene (OCS), or a mixture of hydrocarbons extracted from fish in a contaminated area. HCB and OCS were determined by gas chromatography in fat, liver, and muscle, and decachlorobiphenyl (DCB) was determined in fat. The water temperature was 7 C and both experiments lasted 37 weeks. The distribution of HCB, OCS and DCB in liver, fat, and muscle tissue, after ip injection did not seem to reach a steady state during this study period. When comparing concentrations in different tissues, larger variations were seen for OCS than for HCB. The ratio for HCB between liver and fat in experiment 1 decreased with a factor of about two from week 1 to week 37. The corresponding figure for OCS was almost 7. The ratio between liver and muscle also decreased for both substances. The ratio between muscle and fat increased slightly with regards to HCB, while it reached a maximum at week 5 for OCS. Consequently the ratio between HCB and OCS decreased in all tissues analyzed, and in fat this ratio decreased by a factor of about 10 from week 1 to week 37 of the study. Changes in the ratios during experiment 2 showed in most cases the same trends. (Baker-IVI)
W85-06381

EFFECTS OF ACUTE EXPOSURE TO ACIDIFIED WATER ON THE BEHAVIORAL RESPONSE OF FATHEAD MINNOWS, PIMEPHALES PROMELAS, TO CHEMICAL FEEDING STIMULI,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
A. D. Lemly, and R. J. F. Smith.
Aquatic Toxicology, Vol. 6, No. 1, p 25-36, February, 1985. 1 Fig, 1 Tab, 27 Ref.

Descriptors: *Fish behavior, *Water pollution effects, *Acidity, *Fathead minnow, Acid rain, Behavior, Fish, Feeding.

Fathead minnows, exposed to acidified water (pH 6.0) for 72 hr, did not respond to a chemical stimulus that elicited a strong feeding response at higher pH levels. The lowest pH at which a statistically significant response occurred was 6.5. Visually oriented feeding still occurred. These results indicate that acidification significantly affects the ability of fathead minnows to detect and/or respond to a chemical feeding stimulus. The study also shows that the behavioral bioassay technique used in the experiments is suitable for detection and quantification of imparied chemoreception in fishes. Data suggest that feeding and hence growth, activity and reproduction could be seriously affected under natural conditions of acidification. Impairment of chemoreception, manifest in reduced ability to locate or select proper food, would be an important contribution factor to reduced fecundity and ultimate elimination of fathead minnows from acidified lakes. (Baker-IVI)
W85-06382

EXPOSURE OF TWO SPECIES OF DEPOSIT-FEEDING AMPHIPODS TO SEDIMENT-ASSOCIATED (3H)-BENZO(A)PYRENE: UPTAKE, METABOLISM AND COVALENT BINDING TO TISSUE MACROMOLECULES,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
W. L. Reichert, B.-T. Le Eberhart, and U. Varanasi.
Aquatic Toxicology, Vol. 6, No. 1, p 45-56, February, 1985. 2 Fig, 2 Tab, 34 Ref.

Descriptors: *Amphipods, *Macromolecules, *Water pollution effects, *Sediments, *Benzo(a)pyrene, Metabolism, Organic compounds, Marine environment.

Two species of deposit-feeding marine gammaridian amphipods, Rhepoxynius abronius and Eohaustorius washingtonianus, were exposed to sediment associated tritium-labeled benzo(a)pyrene (BaP) at 12 C. After 1 day of exposure both E. washingtonianus and R. abronius accumulated detectable levels of BaP-derived radioactivity. Concentrations of radioactivity in both species of amphipods increased significantly from 1 to 7 days. Total BaP-derived radioactivity was significantly higher in E. washingtonianus than in R. abronius after 1 day of exposure. At 3 and 7 days no significant differences were noted. Concentrations of unconverted BaP were significantly higher in E. washingtonianus than in R. abronius throughout the exposure. Reversed phase HPLC analyses of organic solvent-soluble metabolites after enzymatic treatment showed the presence of the following metabolites in both E. washingtonianus and R. abronius: 7,8-dihydroxy-7,8-dihydroBaP, 9,10-dihydroxy-9,10-dihydroBaP, 9-hydroxyBaP, 3-hydroxyBaP and PaP quinones. BaP metabolism was more extensive in R. abronius and higher levels of intermediates were covalently bound to macromolecules in R. abronius. Both E. washingtonianus and R. abronius biotransformed BaP to potentially carcinogenic and mutagenic metabolites. Analysis of the minor metabolites formed by the two amphipod species revealed the presence of the K-region metabolite, BaP-4,5-diol, in tissue extracts from E. washingtonianus but not in R. abronius. The findings demonstrate for the first time that covalent binding of BaP intermediates to tissue macromolecules occurred in both amphipod species. The higher levels of BaP intermediates in R. abronius may be due in part to the higher concentrations of metabolites in R. abronius as compared to E. washingtonianus. Other factors, such as protein turnover, may also affect the binding levels. The higher levels of covalent binding of PaB intermediates suggests a higher potential for disruption of cellular processes and subsequent impairment of the overall health of R. abronius in PAH-contaminated sediments. (Baker-IVI)
W85-06383

REDUCTION BY A SURFACTANT OF OLFACTORY MEDIATED ATTRACTION BETWEEN JUVENILES OF ARCTIC CHARR, SALVELINUS ALPINUS (L.),
Uppsala Univ. (Sweden). Inst. of Zoophysiology.
K. H. Olsen, and L. B. Hoglund.
Aquatic Toxicology, Vol. 6, No. 1, p 57-69, February, 1985. 4 Fig, 2 Tab, 27 Ref.

Descriptors: *Fish behavior, *Toxicity, *Water pollution effects, *Char, *Surfactants, Organic compounds, Salmonids, Olfactory behavior.

The effect of sublethal concentration of linear alkylbenzene sulfonate (LAS) on attraction to conspecific compounds was studied in juvenile Arctic charr, Salvelinus alpinus. Results indicated that LAS has an effect on odor perception in fish at concentrations as low as 0.02 ppm. The possibility of interaction between stimuli and surfactant by electrostatic and/or hydrophobic forces cannot be excluded. The conclusion reached in the present study is that sublethal concentrations of LAS disturb chemo-attraction in Arctic charr which indicates that the olfactory senses are affected. The disturbance is at least partly reversible. This does not reduce the ecological importance of the observations as even a short blockade of odor perception might be fatal if occurring at unsuitable occasions. Surfactants in low concentrations might make a home river less attractive to mature fish and affect their upstream movement. Morphological studies with the scanning electron microscope did not reveal any damage of the cell surface of the olfactory epithelium, including the receptor cells, after 4 days exposure to 2 ppm LAS. Locomotor activity in charr was not affected in this study. The fluviarium technique as performed here can be used for testing xenobiotic disturbance of fish behavior to predict effects of pollution. (Baker-IVI)
W85-06384

EFFECT OF AN AQUATIC HERBICIDE ON SEDIMENT NUTRIENT FLUX IN A FRESHWATER MARSH,
Manitoba Univ., Winnipeg. Dept. of Botany.
L. G. Goldsborough, and G. G. C. Robinson.
Hydrobiologia, Vol. 122, No. 2, p 121-128, March, 1985. 5 Fig, 1 Tab, 27 Ref.

Descriptors: *Marshes, *Water pollution effects, *Herbicides, *Sediments, *Nutrients, Organic compounds, Simazine, Dissolved oxygen.

Three concentrations of the herbicide simazine were added to in situ macrophyte-free enclosures with and without sediment contact. Changes in the concentrations of total ammonia, total reactive phosphorus, and silicon were monitored, and net sediment flux was calculated from the difference in nutrient concentration between bottomed (SB) and unbottomed (OB) enclosures. Two phases in the change in dissolved oxygen status of OB vs SB enclosures were identified. The first occurred soon

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after enclosure placement and was characterized by lower oxygen concentrations in OB enclosures. This trend continued over the pretreatment period of 12 days suggesting that the decrease was a reflection of normal BOD and/or COD of marsh sediments. At the same time, lower oxygen levels appeared to be correlated with higher nutrient levels explaining the initial nutrient differences between the enclosures. The second change in dissolved oxygen levels of the enclosures occurred following herbicide treatment, specific levels being a function of herbicide concentration. This is indicative of a change in photosynthetic oxygen evolution and corresponding increases in BOD due to decay processes. Since macrophytes were not present in the enclosures, the observed deoxygenation may reflect inhibition of sediment epipelon, with some lesser influence upon planktonic and haptobenthic organisms. In light of the fact that simazine concentrations in OB enclosure decreased significantly over the experimental period, sediment adsorption of herbicide is probable, thereby increasing the phytotoxic concentration at the sediment/water interface. The change in oxygen concentration in relation to the herbicide level coincided with substantial changes in the concentrations of total ammonia, TRP, and silicon, pointing to a connection between inhibition of sediment biota and increase in nutrients. A major assumption of this work, is that the observed differences in nutrient levels between SB and OB enclosures following herbicide treatment reflects all and only sediment effects. Preliminary data indicate that the difference in algal colonization between SB and OB enclosures following herbicide treatment was greatest in control and 0.1 mg/l pairs, and decreased in relation to herbicide concentration at 1.0 and 5.0 mg/l simazine. (Baker-IVI)
W85-06386

EFFECT OF ACIDIFICATION IN ENCLOSURES ON THE BIOMASS AND POPULATION SIZE STRUCTURE OF BOSMINA LONGIROSTRIS,
West Virginia Univ., Morgantown. Dept. of Biology.
K. Havens, and J. DeCosta.
Hydrobiologia, Vol. 122, No 2, p 153-158, March, 1985. 5 Fig, 2 Tab, 12 Ref. NSF grant DEB-8211706.

Descriptors: *Acidity, *Water pollution effects, *Biomass, *Cladocera, Population dynamics, Zooplankton, Lakes, Acid rain, Lake O'Woods, West Virginia.

An in situ enclosure experiment was performed from June to September, 1982, in Lake O'Woods, West Virginia, pH 7.0, to examine the effects of acidification on the Bosmina longirostris population. Treatments were two control enclosures and two enclosures acidified from an initial pH of 7.2 to pH 4.2 over a 44 day period, using sulfuric acid. After day 44 chlorophyll a declined in the control but increased rapidly in the acid treatment so that by day 75 it was 8 times that in the control. An initial rapid increase in the abundance of B. longirostris in the acid treated water is noted. From day 16 onwards mean body length was consistently higher in the acid treatment. The difference was especially significant on day 30, coinciding with the maximal difference in abundance of the two populations. On days 16 and 20 the other dominant herbivores were significantly reduced in abundance in the acid treatment. Later in the experiment, the abundance of other herbivores increased in the acid treatment, and on day 58 was significantly higher than in the control. After day 16 carnivores declined rapidly in the acid treatment and were extinct by day 58. Acidification may have indirect secondary effects on lacustrine plankton populations. Altered competitive and predatory interactions may sometimes result in changes as dramatic as those caused by direct toxic effects of increased acidity. (Baker-IVI)
W85-06388

EXPERIMENTAL STUDIES ON THE EFFECT OF SODIUM CHLORIDE, DIMETHOATE AND BAYLUSCIDE ON THE GROWTH AND METABOLISM OF THE ALGA STAURASTRUM BOREALE W. WEST,
Institute of Oceanography and Fisheries, Cairo (Egypt).
E. A. Ibrahim.
Bulletin of the Zoological Society of Egypt, Vol. 33, p 87-97, 1983. 1 Fig, 1 Tab, 30 Ref.

Descriptors: *Water pollution effects, *Algal growth, *Salinity, *Dimethoate, *Bayluscide, Insecticides, Molluscicides, Organic compounds, Chlorophyll a, Pesticide residues.

The freshwater Lake Wadi el-Rayan is located in the lowest part of the Fayoum depression in Egypt. The organisms inhabiting Wadi E-Rayan are threatened by increasing salinity caused by evaporation and by pesticides used extensively in the area. Effects of sodium chloride, dimethoate and bayluscide on growth and chemical constituents of the freshwater chlorophyte Staurastrum boreale were studied. The calculated concentration of sodium chloride that inhibit 50% (EC50) of the growth, chlorophyll a and protein content are 0.52, 0.82, and 0.5 g/l, respectively, while that of the dry weight and carbohydrate content are 50% higher than that of the control at the highest concentration of sodium chloride of 1 g/l. The EC50 values of dimethoate are 14.2, 9.8, 15.8 and 8.7 mg/l for population growth, dry weight, chlorophyll a, protein, and carbohydrate content, respectively. For bayluscide, the EC50 values are 0.355, 0.37, 0.36, 0.275, and 0.37 mg/l for growth, dry weight, chlorophyll a, protein and carbohydrate, respectively. (Baker-IVI)
W85-06390

STUDIES ON THE ACUTE TOXICITY OF POLLUTANTS TO FRESHWATER MACROINVERTEBRATES, 2. PHENOL,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
D. W. J. Green, K. A. Williams, and D. Pascoe.
Archiv fur Hydrobiologie, Vol. 103, No. 1, p 75-82, March, 1985. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Toxicity, *Invertebrates, *Phenol, Water pollution effects, Organic compounds, Aquatic insects, Fish, Crustaceans, Mollusks, Arachnids.

Seven species of freshwater macroinvertebrate were exposed to a range of phenol concentrations using a continuous flow bioassay procedure. Considerable interspecific differences in sensitivity were observed. The most sensitive species tested was Baetis rhodani (96 hr LC50 15.5 mg phenol/l) and the most tolerant was Limnodrilus hoffmeisteir (96 hr LC50 780 mg/phenol). Results are in general agreement with a previously proposed order of increasing tolerance: fish to crustaceans to tolerant insects to worms to mollusks to highly tolerant insects to arachnids. There is evidence to suggest that some species may be more sensitive than previously tested fish or crustaceans. The modifying effects of water quality variables, particularly temperature, need further study. (Baker-IVI)
W85-06393

BIOCHEMICAL ALTERATIONS INDUCED IN FISH BY AN ACUTE KEROSINE-SPILLAGE,
Mainz Univ. (Germany, F.R.). Physiologisch-Chemisches Inst.
J. J. Stuber, and R. K. Zahn.
Archiv fur Hydrobiologie, Vol. 103, No. 1, p 117-127, March, 1985. 1 Fig, 3 Tab, 40 Ref.

Descriptors: *Kerosine, *Toxicity, *Fish, Water pollution effects, Trout, Organic compounds, Industrial accidents, Spills.

Three months after an acute aviation kerosine spillage followed by clean-up, exposed rainbow trout were investigated for induction level in mixed-function oxygenases (MFO) and deoxyribonucleic acid damage. For comparison trout kept in clean water yet in otherwise the same conditions were used as controls. The exposed specimens showed a threefold rise in MFO activity and a threefold increase of the absolute value of the slope factor characterizing the alkaline elution, signifying substantial DNA damage. In a discussion of the events triggered by the interaction of bioactive polycyclic aromatics, xenobiotics or allelochemicals, benzo(a)pyrene is used as a model substance. The evaluation of the events-chain in principle is possible with the analysis of many steps, however only a few are stable, reliable and long enough lasting to be practical. Among these few the MFO activities and the DNA damage have been chosen as these parameters represent biological damage potentials in a most obvious manner. The possible response to pollution impact in time is considered. The relative amount of DNA damage in relation to the MFO activity is the same for controls and exposed fish. (Baker-IVI)
W85-06394

SYSTEM FOR EXAMINING THE RESPONSE OF AQUATIC ECOSYSTEMS TO GRADUAL CHEMICAL INPUTS, AND FIELD APPLICATION IN OKEFENOKEE SWAMP, GEORGIA,
Georgia Univ., Athens. Inst. of Ecology.
J. D. Oliver.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 415-423, February, 1985. 2 Fig, 1 Tab, 17 Ref. NSF grants BSR 8114823 and BSR 8215587.

Descriptors: *Okefenokee Swamp, *Georgia, *Ecosystems, *Water pollution effects, Industrial wastes, Ammonia, Phosphates, Marshes, Nutrients.

A convenient standardized system for testing effects of chemical inputs on ecosystems in remote regions is described. Clear 2-m sq enclosures made of plastic film and steel fencing were placed in an Okefenokee Swamp marsh. Half of these enclosures contained 1 liter porous clay pots filled with 0.2M (NH4)2HPO4-enriched agar to simulate N and P fertilization by birds. Diel oxygen fluctuation, chlorophyll-a and total N and P concentrations in water were not significantly different in experimental mesocosms than in controls, but abundance of zooplankton was increased. In the laboratory, pots released an average of 45 mg NH4-N/d and 11 mg PO4-P/d into deionized water and more than this into Okefenokee black water. (Baker-IVI)
W85-06396

STUDIES ON THE ACUTE TOXICITY OF POLLUTANTS TO FRESHWATER MACROINVERTEBRATES; 1. CADMIUM,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
K. A. Williams, D. W. J. Green, and D. Pascoe.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 461-471, February, 1985. 1 Fig, 3 Tab, 32 Ref. EEC grant ENV.484.81.UK(H).

Descriptors: *Toxicity, *Cadmium, *Invertebrates, Water pollution effects, Aquatic insects, Crustaceans.

Information on the toxicity of compounds to macroinvertebrates can help in the determination of maximum permissible levels of pollutants that may be discharged into freshwater ecosystems. Acute toxicity tests (14 days) using a continuous-flow testing apparatus were conducted on ten species of freshwater macroinvertebrate. The median period of survival (LT50) for each species decreased with increasing cadmium concentration. Median lethal concentrations (24, 48 and 96 hour LC50's) calculated by indirect and direct methods indicated a wide range of species sensitivity. Members of the class Crustacea appeared extremely sensitive while insect species of the orders Plecoptera and Trichoptera exhibited high tolerance to cadmium poisoning in the short term. Considerable variation in sensitivity occurred within the Ephemeroptera. The most resistant species of all, the net-spinning caddis fly Hydropsyche angustipennis had a 96 hour LC50 value of 520 mg Cd/l, 26000.0 times greater than the corresponding value of 0.02 mg Cd/l, recorded for the most sensitive species, the freshwater shrimp Gammarus pulex. Four species had lower 96 hour LC50 values than that recorded for Salmo gairdneri. The results underline the importance of toxicity studies on invertebrates in establishing a broad toxicity data base for use in evaluating and regulating pollutant effects. (Moore-IVI)
W85-06399

STRIPED BASS MANAGEMENT IN LAKES WITH EMPHASIS ON MANAGEMENT PROBLEMS,
Kentucky Dept. of Fish and Wildlife Resources, Frankfort.
For primary bibliographic entry see Field 2H.
W85-06402

DECLINE OF STRIPED BASS IN THE SACRAMENTO-SAN JOAQUIN ESTUARY, CALIFORNIA,
California State Dept. of Fish and Game, Stockton.
D. E. Stevens, D. W. Kohlhorst, L. W. Miller, and D. W. Kelley.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 12-30, January, 1985. 15 Fig, 6 Tab, 39 Ref.

Descriptors: *Striped bass, *Sacramento-San Joaquin Estuary, *California, Fish populations, Reproduction, Water pollution effects, Mortality, Entrainment, Diversion, Estuarine fisheries, Fish food organisms, Plankton.

The abundance of young striped bass Morone saxatilis in the Sacramento-San Joaquin Estuary has suffered an unsteady but persistent decline from population levels that were high in the middle 1960's. The decline was particularly severe in 1977 and abundance of young striped bass has been low every subsequent year. The adult striped bass population also has fallen during the past 20 years, but the exact period over which the decline occurred and the rate of decline are not clear. The adult population is now about one-quarter of its former size and there is little sign of recovery. It is believed that the Sacramento-San Joaquin striped bass population and the fishery that it supports are in serious danger. The cause is most likely one or more of four factors. (1) The adult population is now so low that egg production may be inadequate. (2) The plankton food supply of young striped bass in the western Sacramento-San Joaquin Delta and Suisun Bay has been greatly reduced each spring. Diversion of water from the delta for agricultural purposes is a prime suspect for the decrease in food production. (3) Large numbers of young fish are lost by entrainment in water diversions. (4) The population is stressed by toxic substances such as petrochemicals and pesticides. Additional studies are underway to help determine the principal cause(s) of the striped bass decline. (Author's abstract)
W85-06403

STRIPED BASS, TEMPERATURE, AND DISSOLVED OXYGEN: A SPECULATIVE HYPOTHESIS FOR ENVIRONMENTAL RISK,
Oak Ridge National Lab., TN. Environmental Sciences Div.
C. C. Coutant.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 31-61, January, 1985. 12 Fig, 139 Ref. DOE contract DE-AC05-84OR21400.

Descriptors: *Striped bass, *Water temperature, *Dissolved oxygen, Fish populations, Fish stocking, Age, Fish behavior, Fisheries, Overfishing, Habitats.

Striped bass Morone saxatilis has a paradoxical record of distribution and abundance, including population declines in coastal waters and variable success of freshwater introductions. This record is analyzed for consistency with a hypothesis that striped bass are 'squeezed' between their thermal and dissolved oxygen preferences or requirements. A commonality among diverse field and laboratory observations supports an inherent thermal niche for the species that changes to lower temperatures as fish age. This shift can cause local conditions, especially warm surface strata and deoxygenated deep water, to be incompatible with the success of large fish. Crowding due to temperature preferences alone or coupled with avoidance of low oxygen concentrations can lead to pathology and overfishing, which may contribute to population declines. Through a mixture of evidence and conjecture, the thermal niche-dissolved oxygen hypothesis is proposed as a unified perspective of the habitat requirements of the species that can aid in its study and management. (Author's abstract)
W85-06404

INFLUENCES OF WATER QUALITY ON DISTRIBUTION OF STRIPED BASS IN A TENNESSEE RIVER IMPOUNDMENT,
Florida Game and Fresh Water Fish Commission, De Leon Springs.
T. E. Cheek, M. J. Van Den Avyle, and C. C. Coutant.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 67-76, January, 1985. 3 Fig, 35 Ref. Federal Aid in Fish Restoration Act project F-38, DOE contract DE-840R21400.

Descriptors: *Water quality, *Distribution, *Striped bass, *Watts Bar Reservoir, *Tennesee, Water temperature, Dissolved oxygen, Seasonal variation, Thermal pollution, Water pollution effects, Ecological distribution.

Telemetry techniques were used to evaluate relationships between water quality and distribution of adult striped bass Morone saxatilis during an 18-month period in Watts Bar Reservoir, Tennessee. Distribution and movements of fish were influenced by water temperature and dissolved oxygen concentration. During winter and early spring, temperature was vertically and horizontally uniform, and striped bass were relatively mobile and occurred in both tributary arms as well as in the main body of the reservoir. As the reservoir warmed in summer, fish were less mobile and progressively limited to areas in the tributary arms where temperature was less than 24 C and dissolved oxygen exceeded 4 mg/liter. Parts of the tributary arms of Watts Bar Reservoir provided such areas due to hypolimnetic discharges from upstream impoundments and groundwater inflows. Striped bass were restricted to these areas until late fall, when the entire reservoir cooled and again was nearly isothermal. Knowledge of relationships between striped bass habitat use and water quality is useful for fishery management and resource protection for reservoirs; an example is provided for Watts Bar Reservoir. (Author's abstract)
W85-06406

NUTRIENT ENRICHMENT OF CHESAPEAKE BAY AND ITS IMPACT ON THE HABITAT OF STRIPED BASS: A SPECULATIVE HYPOTHESIS,
Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W85-06409

TOXIC MATERIALS, FISHING, AND ENVIRONMENTAL VARIATION: SIMULATED EFFECTS ON STRIPED BASS POPULATION TRENDS,
National Fisheries Center-Leetown, Kearneysville, WV.
C. P. Goodyear.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 107-113, January, 1985. 1 Fig, 1 Tab, 28 Ref.

Descriptors: *Chesapeake Bay, *Fish populations, *Population dynamics, *Water pollution effects, Bays, Toxicity, Survival, Fishing.

Decreased survival of larval striped bass Morone saxatilis resulting from toxic chemicals in the environment and decreased survival of adults caused by fishing both are suspected as agents contributing to the decline in the Chesapeake Bay stock since the mid-1970's. The relative power of each type of mortality to cause population declines was evaluated with simulation techniques. Equivalent levels of added mortality induced qualitatively identical and quantitatively similar trends in population simulations for all conditions examined except if strong density-dependent mortality preceded in contaminant toxicity. In this case the contaminant effect caused a greater reduction in yield, but the population did not tend toward extinction. The results indicate that the observed downward trend in the Chesapeake Bay population can be halted or reversed by a reduction in fishing mortality, even if contaminant toxicity is the proximate cause for the decline. (Author's Abstact)
W85-06410

ACUTE AND CHRONIC TOXICITY OF ATRAZINE TO ESTUARINE FAUNA,
Environmental Science and Engineering, Inc., Gainesville, FL.
G. S. Ward, and L. Ballantine.
Estuaries, Vol. 8, No. 1, p 22-27, March, 1985. 4 Tab, 18 Ref.

Descriptors: *Water pollution effects, *Atrazine, Organic compounds, Herbicides, Estuaries, Toxicity, Invertebrates, Fish, Fauna.

Acute and chronic estuarine invertebrate and fish toxicity tests were conducted to evaluate possible consequences of measured concentrations of atrazine in estuarine areas. The 96-h LC50 values ranged from 0.094 mg per l for copepods to $>$ 30 mg per l for larvae of eastern oysters. Maximum acceptable toxicant concentrations of $>$ 0.08 $<$ 0.19 mg per l and $>$ 1.9 $<$ 3.4 mg per l were determined by mysid shrimp and sheepshead minnows, respectively in life cycle and early life cycle tests. The approximate application factor limits in both tests were 0.1-0.2. Use of an application factor of 0.1 with the most sensitive species tested acutely provides a no effect concentration of approximately 0.009 mg per l for estuarine fauna. Therefore, the maximum reported measured concentration of approximately 0.002 mg per l atrazine in estuarine areas would not be suspected to adversely impact estuarine fauna. (Author's abstract)
W85-06413

EFFECTS OF COPPER ON PRODUCTION OF PERIPHYTON, NITROGEN FIXATION AND PROCESSING OF LEAF LITTER IN A SIERRA NEVADA, CALIFORNIA, STREAM,
Geological Survey, Menlo Park, CA.
H. V. Leland, and J. L. Carter.
Freshwater Biology, Vol. 15, No. 2, p 155-173, April, 1985. 9 Fig, 3 Tab, 48 Ref.

Descriptors: *Copper, *Litter, *California, *Nitrogen fixation, *Streams, *Periphyton, Population dynamics, Bacteria, Photosynthesis, Algae, Organic matter.

Production of periphyton, nitrogen fixation and processing of leaf litter were examined in Convict Creek, an oligotrophic Sierra Nevada stream and the responses of these processes to copper (2.5, 5, and 10 micro-g/liter total filtrable copper, T-Cu, which is approximately 12, 25, and 50 ng/liter Cu(2+)) were determined. Autotrophic production in Convict Creek was inhibited at 2.5 micro-g/liter T-Cu. The specific rate of photosynthesis of the mature community also declined at 2.5 micro-g/liter T-Cu. The results reflect a change in composition of the community during the year of exposure to an assemblage tolerant of copper. An increased tolerance to copper may have developed in some species during the year of exposure. Total production was inhibited at 2.5 micro-g/liter T-Cu, but the inhibition was more pronounced for autotrophic production than for heterotrophic production. The greater reduction in autotrophic production may reflect a narrower range in sensitivities to copper of autotrophic than of heterotrophic microorganisms. Nitrogenase activities of mature communities in Convict Creek were measured to assess the sensitivity of nitrogen-fixing blue-green algae to copper. Nitrogenase activity initially declined at 5 and 10 micro-g/liter T-Cu, but returned to control levels after 9 months of exposure. Nitrogenase activity did not vary consistently with population density of any of the common blue-green taxa. Reductions in microbial activity occurred at all test concentrations. (Baker-IVI)
W85-06414

EFFECT OF PHENOL ON THE PHOSPHOMONOESTERASES AND ATPASE ACTIVITY IN THE FISH SAROTHERODON MOSSAMBICUS (PETERS) IN SALINE WATERS,
Presidency Coll., Madras (India). Dept. of Zoolo-

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gy.
S. Ravichandran, and B. Anantharaj.
Proceedings of the Indian Academy of Sciences, (Animal Sciences), Vol. 93, No. 6, p 557-563, October, 1984. 4 Tab, 21 Ref.

Descriptors: *Salinity, *Phenols, *Fish, *Water pollution effects, Toxicity, Enzyme activity, Adenosine triphosphate.

Effect of phenol at different salinities on the phosphomonoesterases and adenosine triphosphatase activity in the liver, muscle and brain of cichlid fish Sarotherodon mossambicus (Peters) is studied. Results indicate a general decrease in the activity of all the three enzymes assayed. The pattern of decrease shows a direct linear relationship with salinity and the toxicity is enhanced as salinity increases. It is possible that at higher salinities severe hydromineral imbalances are induced which further decrease the ability of the fish to combat the effect of the toxicant. Increased uptake of phenol is also possible at higher salinities. Salinity may therefore act as a contributory factor to phenol in increasing its toxicity and bringing about the observed higher inhibition of the enzyme activities. (Baker-IVI)
W85-06425

PROXIMATE COMPOSITION AND ORGANOCHLORINE AND HEAVY METAL CONTAMINATION OF EGGS FROM LAKE ONTARIO, LAKE ERIE AND LAKE MICHIGAN COHO SALMON (ONCORHYNCHUS KISUTCH WALBAUM) IN RELATION TO EGG SURVIVAL,
Guelph Univ. (Ontario). Dept. of Zoology.
P. F. Morrison, J. F. Leatherland, and R. A. Sonstegard.
Aquatic Toxicology, Vol. 6, No. 2, p 73-86, March, 1985. 8 Fig, 2 Tab, 28 Ref.

Descriptors: *Heavy metals, *Organochlorines, *Fish, *Great Lakes, *Lake Erie, *Lake Ontario, *Lake Michigan, Lakes, Toxicity.

A comparative study was made of the proximate composition and heavy metal and organochlorine content of coho salmon eggs collected from Lake Ontario, Lake Michigan and Lake Erie stock in 1981 and 1982 with the purpose of determining whether the poor survival of Lake Erie coho salmon eggs (24% compared with 78-86% in the other stocks) has a nutritional or toxicological etiology. Although there were marked interlake differences in egg ion, lipid, and protein content, the nutrient levels in the Lake Erie coho salmon eggs were similar to levels found in other egg stocks, and thus the poor survival does not appear to be related to gross nutrient deficiency; nor were the interlake differences in egg heavy metal or organachlorine residue levels consistent with a toxicological etiology for the high level of mortality of Lake Erie salmon eggs. (Author's abstract)
W85-06436

FREE RADICAL DERIVATIVES OF NITROGEN HETEROCYCLES IN LIVERS OF ENGLISH SOLE (PAROPHRYS VETULUS) WITH HEPATIC NEOPLASMS AND OTHER LIVER LESIONS,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
W. T. Roubal, and D. C. Malins.
Aquatic Toxicology, Vol. 6, No. 2, p 87-103, March, 1985. 7 Fig, 18 Ref.

Descriptors: *Water pollution effects, *Fish, *Duwamish River, *Seattle, *Washington, *Nitrogen compounds, Nitrogen, Organic compounds, Carbazole.

Free radicals of xenobiotics in liver microsomes of English sole (Parophrys vetulus) with hepatic neoplasms and other liver lesions were shown to be N-oxyl derivatives of nitrogen heterocycles. The fish were obtained from the highly polluted Duwamish River in Seattle, Washington State. The chemical structures of the free radicals were elucidated primarily by electron paramagnetic resonance (EPR) spectroscopy. Carbazole-9-oxyl was identified and other N-oxyl derivatives of nitrogen heterocycles also appeared to be present. Evidence showing that English sole are capable of forming nitroxyl free radicals from nitrogen heterocycles was obtained when carbazole was administered via injection into the caudal vein: that is EPR spectroscopy of bile and lyophilized liver microsomes showed the presence of carbazole-9-oxyl. The evidence for the formation of N-oxyl derivatives in the English sole liver is of interest in regard to the etiology of hepatic lesions in fish. (Author's abstract)
W85-06437

PHOTOENHANCED TOXICITY OF ANTHRACENE TO JUVENILE SUNFISH (LEPOMIS SPP.),
Michigan State Univ., East Lansing. Center for Environmental Toxicology.
J. T. Oris, and J. P. Giesy, Jr.
Aquatic Toxicology, Vol. 6, No. 2, p 133-146, March, 1985. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Fish, *Toxicity, *Pesticides, *Anthracene, Organic compounds, Ultraviolet radiation, Hydrocarbons.

The acute toxicity of anthracene to juvenile sunfish (Lepomis spp.) in the presence of simulated sunlight has been assessed. Previously, anthracene was considered not to be acutely toxic to fish. However, in this study 96 h LC50 values were found to be 190-1800-times less, with concurrent exposure of anthracene and simulated sunlight, than a reported 24-h no-effect anthracene concentration for L. macrochirus derived under standard laboratory conditions. Opercular ventilation rate was significantly increased in UV light-anthracene treated fish, and histological evidence indicated that major structural changes occurred in the gills of these fish as compared to UV light-only controls. The site of toxic action does not appear to be limited to respiratory surfaces, however, since dorsal epidermal structure was also disrupted in UV light-anthracene treated fish as compared to UV light-only controls. A mathematical relationship to estimate the potential of anthracene to fish is presented which closely predicts the results of toxicity studies conducted under natural sunlight. It is concluded that solar radiation is an important accessory parameter that deserves consideration in the toxicity assessment of polycyclic aromatic hydrocarbons in the aquatic environment. (Author's abstract)
W85-06439

USE OF FISH CELL CULTURES AS AN INDICATION OF CONTAMINANT TOXICITY TO FISH,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W85-06440

RETROSPECTIVE ASSESSMENT OF A POTENTIAL CADMIUM HAZARD,
Akron Univ., OH. Dept. of Geology.
B. M. Manner, R. F. Lee, and R. G. Corbett.
Ohio Journal of Science, Vol. 85, No. 1, p 12-16, March, 1985. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Fish, *Toxicity, *Cadmium, *Accidents, *Ravenna, *Ohio, *West Branch Reservoir, Water pollution effects, Metals.

In 1968 an accidental discharge of cadmium plating solution caused a significant fish kill near Ravenna, Ohio. Water (130 samples) from West Branch Reservoir in 1971 and 1973 contained up to 0.055 mg/l cadmium, and fish (nine species, muscle tissue) contained up to 0.34 mg/kg. As a control, water and fish were sampled from Nimisila Reservoir. Cadmium was not detected in water (eight samples, 0.001 mg/l detection limit) and was detected in only one of eight species of fish (0.21 mg/kg). There is a delicate balance of responsibility between concern for public health or safety and the need for conclusive data in assessing and announcing a potential hazard. Water samples from West Branch Reservoir exceeded the drinking water standard of 0.01 mg/l, but it was not used as a public source. All fish sampled from West Branch Reservoir contained measurable cadmium, but no standard had been set. Under these circumstances one could not clearly assess the hazard. In 1979, the Environmental Protection Agency (EPA), in developing guidelines for application of sewage sludge to agricultural lands, concluded that 70 microg per day cadmium is a reasonable maximum dietary intake. The possibility of an imminant hazard was investigated. Consumption of 227 g of fish (muscle tissue, average of seven species) would have resulted in an increase of 45 microg cadmium per day; 227 g of carp (Cyprinus carpio) (muscle tissue, highest value) in an increase of 77 microg cadmium per day. Added to the estimated of 39 microg per day dietary intake of cadmium, each situation exceeded the recently set 70 microg/day limit. Because the EPA standard is set low (allowing for the equivalent of 75 microg/day intake by heavy smokers plus 55 microg/day as a safety margin between the limit and the minimum at which damage occurs), the occasional consumption of fish would not have represented a major hazard. (Author's abstract)
W85-06448

RELATION BETWEEN CERTAIN COMPONENTS OF PLANKTONIC COMMUNITY AND THE CONTENT OF PHOSPHATES AND OXYGEN IN WATER (VZAIMOSVYAZI MEZHDV NEKOTORYMI KOMPONENTAMI PLANKTONNOGO SOOBSHCHESTVA I SODERZHANIEM FOSFATOV I KISLOROBA V VODE),
For primary bibliographic entry see Field 2H.
W85-06459

TOXICITY OF CONDENSATE FROM POLYESTER II-520 PRODUCTION FOR DAPHNIA MAGNA STRAUS AND ITS EFFECT ON SELF-PURIFICATION (TOKSICHNOST' KONDENSATA OT PROIZVODSTVA POLIEFIRA P-520 DLYA DAPHNIA MAGNA STRAUS I EGO VLIYANIE NA PROTSESSY SAMOOCHISHCHENIYA),
L. I. Chuprina, S. I. Elbaum, L. I. But, N. I. Avdeeva, and N. I. Mikhaleva.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 58-61, 1984. 1 Fig, 10 Ref.

Descriptors: *Water pollution effects, *Industrial wastewater, Bacteria, Self-purification, Water fleas, Plankton, Chemical oxygen demand, Daphnia, Crustaceans.

Water bodies were studied to determine an admissible content of condensate from polyester II-520 production. The harmful effects of the condensate on the self-purification of water bodies was studied with special attention given to its influence on the vital activities of water fleas, bacteria, plankton biocenosis and hydrochemical regime. The condensate concentration of 0.9-14.4 mg oxygen/l by chemical oxygen demand (COD) had a sublethal effect on copepods. The the highest concentration found, (14.4 mg oxygen/l by COD) increased the 5-day biochemical oxygen demand by 12%. A concentration of 0.45 mg oxygen/l by COD may be considered harmless, as it gives results similar to those obtained with controls. (Author's abstract)
W85-06461

EVALUATION OF SAPROBIC CHARACTER OF CERTAIN SMALL RESERVOIRS OF THE UKRAINE FOR PHYTOPLANKTON (OTSENKA SAPROBNOSTI NEKOTORYKH MALYKH VOVOKHRANILISHCH UKRAINY PO RITOPLANKTONU),
R. P. Zhupanenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 3, p 46-49, 1984. 1 Tab, 11 Ref.

Descriptors: *Ukraine, *USSR, *Reservoirs, *Phytoplankton, Algae, Bioindicators, Water pollution effects, Saprobity, Seasonal variation.

Reservoirs created in basins of the small rivers of the Ukraine (the Seversky Donets, Ingul and the Berda. Mius and Kalmius flowing into the Sea of Azov) are estimated for their saprobic character, making use of phytoplankton and comparing a list of algae found in the reservoirs under study with a

list of pollution indicating species, determining saprobic index and saprobic valency. The seasonal and water area saprobic character is determined for the Pechenezhsky, Krasnooskolsky, Lozovenkovsky, Sugokleevsky, Berdyansky, Grabovsky and Verkhne-Kalmiussky reservoirs. (Author's abstract)
W85-06475

FISH SUFFOCATION IN LAKE NAINITAL (INDIA) CAUSED BY POLLUTION AND PARASITE INFECTION (GIBEL'RYB V OZERE NAINITAL (INDIYA) V REZUL'TATE ZAGRYAZNENIYA I ZARAZHENIYA PARAZITAMI),
S. M. Das, and A. K. Shrivastava.
Gidrobiologischeski Zhurnal, Vol. 20, No. 4, p 58-63, 1984. 3 Tab, 12 Ref.

Descriptors: *Mortality, *Fish, *Water pollution effects, *Lake Nainital, *India, Seasonal variation, Fish parasites, Organic matter, Ammonia, Hydrogen sulfide, Methane.

The paper deals with reasons for high fish mortality in Lake Nainital, Kuman, India. High early winter mortality (December-January) is shown to be caused by increased content of pollutants (such as DOM, SOM, NH3, H2S and methane) in the lake water. The lake, however remains somewhat polluted throughout the year. Early spring mortality (February-March) is shown to be due to an extensive attack by parasites. The physicochemical hazards of environmental pollution to fish of the lake, actual mortality caused by them, and parasites causing fish mortality are discussed. (Author's abstract)
W85-06478

EFFECTS OF TEMPERATURE ON THE LOCOMOTOR ACTIVITY OF THE BLUEGILL SUNFISH, LEPOMIS MACROCHIRUS,
Tulane Univ., New Orleans, La. Dept. of Biology.
A. A. Malizia, Jr., K. S. Bloom, and E. G. Ellgaard.
Louisiana Academy of Sciences, Vol. 47, p 10-14, December, 1984. 2 Fig, 8 Ref.

Descriptors: *Fish behavior, *Temperature effects, *Heat stress, *Bluegill, Thermal pollution, Heated water, Kinetics, Locomotor activity.

Laboratory conditions have been established that permit a group of bluegill to demonstrate kinetic behavior analogous to an opposed first-order chemical reaction. The locomotor activity of the bluegill approximated an opposed first order reaction at all temperatures examined. Locomotor activity, which increased with temperature over the range of 4 to 32 C used in this study, is also temperature dependent. It is not directly proportional throughout the entire range. From 4 to 8 C activity increases 100-fold, because fish at 4 C are virtually motionless. In the range from 8 to 26 C locomotor rates double with the temperature increase of 10 C, suggesting the locomotor activity of the bluegill may be governed mainly by changes in metabolic rate under the influence of temperature. From 26 to 32 C the locomotor rates double when the temperature is increased about 2 C, which is seen as a behavioral reaction to stress. Extension of these studies to derive similar descriptions for bluegill acclimated to other temperatures would provide a complete profile for locomotor activities of the fish. These could be used to determine whether the swimming behavior of bluegill in different temperature zones has been altered to any measurable extent. (Baker-IVI)
W85-06487

RELATIONSHIPS BETWEEN CARBON AND CADMIUM UPTAKE IN MYTILUS EDULIS,
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
T. Borchardt.
Marine Biology, Vol. 85, No. 3, p 233-244, March, 1985. 5 Fig, 5 Tab, 39 Ref.

Descriptors: *Mussels, *Carbon, *Cadmium, Radioisotope tracers, Food, Growth, Shells, Carbon radioisotopes, Cadmium isotopes, Metabolism, Water pollution effects.

The influence of six different food rations on carbon assimilation and net incorporation, and on shell and soft body growth in Mytilus edulis was determined over a 75-d period, starting in 1981. Using a triple tracer technique, interrelationships between carbon net incorporation (C-14) and cadmium accumulation from food (Cd-109) and seawater (Cd-115m) were investigated. With decreasing food rations there was an exponential increase of the carbon assimilation efficiency from 35 to 76% while the net incorporation efficiency increased approximately linearly, ranging from 15 to 32% at the highest and lowest food supply levels respectively. The carbon assimilation efficiency adapted to new conditions within 1 to 2 d while the adaptation of the net incorporation efficiency took about one month. Shells kept growing, even when the soft body lost weight. Within a 42-d elimination period, when the soft body lost 58% of the incorporated carbon, nothing was released from the shells. Cadmium accumulation from food was closely interrelated with carbon net incorporation and exhibited the same uptake kinetics. No homogeneity was found between carbon net incorporation and cadmium accumulation from seawater, and between the elimination of carbon and cadmium. (Author's abstract)
W85-06521

EFFECT OF ENVIRONMENTAL PARAMETERS ON LYSOSOMAL MARKER ENZYMES IN THE TROPICAL BLOOD CLAM ANADARA GRANOSA,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
S. Patel, and B. Patel.
Marine Biology, Vol. 85, No. 3, p 245-252, March, 1985. 4 Fig, 6 Tab, 30 Ref.

Descriptors: *Clams, *Enzymes, *Bioindicators, Animal physiology, Water pollution effects, Seasonal variation, Salinity, Temperature effects, Indicators.

The lysosomal marker enzymes, arylsulfatase and acid phosphatase, in a tropical burrowing arcid clam Anadara granosa L. have been found to exhibit seasonal variations. The activity of both enzymes decreased with increase in ambient temperature and fell with increase in salinity. Lysosomal latency for these enzymes, however, was not significantly affected by environmental parameters, including salinity, temperature, nutritional status, breeding season, etc. The physico-chemical characteristics of the habitat were found to induce reversible changes in the lysosomal latency and enzyme activity. Exposure to elevated temperature (Delta T = 7 to 8 C), towards the upper limit of its physiological tolerance, was found to labilize the lysosomes. The biochemical methods optimized for the demonstration of lysosomal stability under exposure to environmental stressors could also be extended to quantify the impact of various pollutants, including heavy metals, radionuclides, etc. at the subcellular level. (Author's abstract)
W85-06522

LEAD IN WATER, INFANT DIET AND BLOOD: THE GLASGOW DUPLICATE DIET STUDY,
Water Research Centre, Marlow (England).
R. F. Lacey, M. R. Moore, and W. N. Richards.
Science of the Total Environment, Vol. 41, No. 3, p 235-257, March, 1985. 6 Fig, 9 Tab, 11 Ref.

Descriptors: *Glasgow, *Scotland, *Drinking water, *Lead, *Water pollution effects, Blood, Infants, Public health, Heavy metals, Water quality, Plumbing.

The Glasgow Duplicate Diet Study was a study of the concentration of lead in the blood of Glasgow babies in relation to their predominant source of dietary lead, water drawn through domestic plumbing. The aim of the study was to offer guidance on the allowable concentration of lead in drinking water. The statistical analysis of the data yielded several consequences. It confirmed the overall consistency of the water and diet-lead samples and the harmonization of the two analytical laboratories involved in that work. The contribution of lead from the solid component of baby foods was statistically detectable but of negligible proportion compared with water-lead. The results gave scaling factors which may be useful in comparing this work with studies based on other types of sample. It was possible to screen the data for individual anomalies which might otherwise have distorted later results. Estimates of the coefficient of variation for sampling variability were made available for later use. While more information than had even been available before is presented concerning the relationship between ingested water lead and blood lead for infants of around 3 months of age, this information still has a large amount of unexplained variation which leaves uncertainty not only in the quantitative estimates of the parameters of the relationship but also in its qualitative form. (Baker-IVI)
W85-06548

DNA DAMAGE BY BENZO(A)PYRENE IN THE LIVER OF MOSQUITO FISH GAMBUSIA AFFINIS,
Institut Rudjer Boskovic, Rovinj (Yugoslavia). Centar za Istrazivanje Mora.
R. Batel, N. Bihari, B. Kurelec, and R. K. Zahn.
Science of the Total Environment, Vol. 41, No. 3, p 275-283, March, 1985. 2 Fig, 2 Tab, 32 Ref.

Descriptors: *Mosquito fish, *DNA, *Water pollution effects, *Benzo(a)pyrene, Fish, Aromatic compounds, Hydrocarbons, Enzymes,.

Specimens of a laboratory population for the mosquito fish Gambusia affinis raised in charcoal-filtered tap water at 23 C with 1.5-2.0 g body weight and a liver weight up to 1.5 mg were exposed to 0.1 mg/ml benzo(a)pyrene (BaP) in methanol. In order to establish possible differences in the basal activity of benzo(a)pyrene monooxygenase (BPMO) between sexes, three groups of fish were analyzed: males, females and pregnant females. Exposure of fish to BaP-polluted water produced an increase in BPMO activity with a maximum after 48 hr. This increase in the groups exposed to 1, 10, and 100 ppb BaP is significant. After 2 days of exposure to 1, 10, and 100 ppb BaP, G. affinis significantly increased its liver BPMO activity. Simultaneously, a statistically significant change in the lengths of DNA treated with nuclease S1 can be detected. The coexistence of microsomal MFO activities and of DNA damage indicates that: DNA damage accumulates by the production of damaging species originating from mixed function oxidases metabolism of BaP; and it mirrors a momentary situation in a dynamic stage during which BaP-derivatized electrophilic products are generated that alter DNA, and the DNA alterations are repaired at a different rate. (Baker-IVI)
W85-06550

RELATIONSHIP BETWEEN SERUM ENZYMES, HISTOLOGICAL FEATURES AND ENZYMES IN HEPATOPANCREAS AFTER SUBLETHAL EXPOSURE TO MALATHION AND PHOSPHAMIDON IN THE MURREL CHANNA STRIATUS (BL.),
Burdwan Univ. (India). Dept. of Zoology.
A. K. Sadhu, D. K. Chowdhury, and P. K. Mukhopadhyay.
International Journal of Environmental Studies, Vol. 24, No. 1, p 35-41, 1985. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Insecticides, *Fish, *Water pollution effects, *Toxicity, Malathion, Phosphamidon, Organic compounds, Agricultural chemicals, Pesticide toxicity, Enzymes.

The effects of 10 day pesticide exposure of Channa striatus at two sublethal levels (0.1 and 0.2 ppm for malathion; 2.5 and 5 ppm for phosphamidon) on the activities of phosphatases and transaminases in hepatopancreas and blood serum were investigated. Hepatic cells of the whole tissues exposed to 0.1 ppm malathion showed marked precipitation of both cytoplasmic and nuclear material in some cells and a few were completely vacuolated. Similar degeneration was noted in fish exposed to 2.5

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ppm phosphamidon with a lower degree of necrosis in the tissue structure. The extent of damage in the hepatopancreatic tissue was severe at higher concentrations. Acid phosphatase and alkaline phosphatase activity in fish following malathion and phosphamidon exposures show marked decrease in their activities in hepatopancreas with concomitant increase in their activities in the blood serum. Phosphamidon exposure resulted in insignificant changes both in hepatopancreas and serum at low doses, while at higher dose increase in enzyme activities were noted. (Baker-IVI)
W85-06557

FISH COMMUNITIES OF MIDWESTERN RIVERS: A HISTORY OF DEGRADATION,
Smithsonian Tropical Research Inst., Balboa (Panama).
J. R. Karr, L. A. Toth, and D. R. Dudley.
BioScience, Vol. 35, No. 2, p 90-95, February, 1985. 4 Fig, 1 Tab, 33 Ref. EPA grants G00513, R-806391, CR-810745, and CR-807677.

Descriptors: *Fish, *Water pollution effects, *Water quality control, *Illinois River, *Maumee River, Fish populations, Water quality, Water resources management, Conservation, Habitats.

As human populations have grown, water resource quality has declined. Since 1850, 67% of the fish species from the Illinois River and 44% from the Maumee River have become less abundant or have disappeared. Reversing such trends demands innovative approaches to water resource management. Such an approach must address the five primary variables and their components that affect the integrity of stream biota: energy source (allochthonous organic matter vs. primary production in the stream, particle size distribution of particulate organics); water quality (temperature, turbidity, dissolved oxygen content, soluble organics and inorganics, heavy metals, toxic substances); habitat structure (bottom type, water depth, current velocity, availability of appropriate habitats for diverse needs); flow regime (water volume, temporal distribution of water availability, flood frequency); and biotic interaction (competition, predation, disease, and parasitism). (Baker-IVI)
W85-06565

ACID TOLERANCE IN AMPHIBIANS,
Baylor Univ., Waco, TX. Dept. of Biology.
B. A. Pierce.
BioScience, Vol. 35, No. 4, p 239-243, April, 1985. 1 Tab, 38 Ref.

Descriptors: *Amphibians, *Acidity, *Water pollution effects, Acid rain, Frogs, Salamanders, Immature growth stages, Seasonal variation.

Amphibian acid tolerance is a multifaceted phenomenon influenced by taxonomic, geographic, environmental, ecological, and genetic factors. Amphibians as a group appear to be relatively acid tolerant, with many species capable of surviving in acidic solutions of pH 4-4.5. But some species, like the spotted salamander and the leopard frog, are much more sensitive to acid conditions. Acidity can slow growth and produce developmental abnormalities at much higher pH. Thus some amphibian populations will likely be severely damaged by increases in environmental acidity, increases that may occur through atmospheric acid deposition or other anthropogenic sources. Those species that breed in naturally more acidic conditions appear to be more resistant to acid, suggesting that natural selection has shaped these interspecies differences. Those species breeding in alkaline environments would appear then to be particularly vulnerable to any acidification of their habitats. Fertilization is the developmental stage most sensitive to acidity, and toxic effects of low pH are also important in embryonic stages. Larvae tolerate acidity better than embryos, and tolerance increases with age. Since the ability to withstand low pH depends on age and developmental stage, seasonal changes in acid deposition must be considered in assessing effects of acidification on natural populations. (Baker-IVI)
W85-06566

EFFECTS OF FORESTRY ON WATER QUALITY AND FISH IN WELSH RIVERS AND LAKES,
Welsh Water Authority, Powys (Wales).
J. H. Stoner, and A. S. Gee.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 1, p 27-45, February, 1985. 8 Fig, 6 Tab, 53 Ref.

Descriptors: *Water quality, *Forestry, *Fisheries, *Wales, Lake Syfydrin, River Camddwr, Lake Craig y Pistyll, River Tywi, Seasonal variation, Sulfates, Nitrates, Calcium, Chlorides, Environmental effects, Acidification, Land use.

Processes affecting water acidification are described and the current water quality and fishery status of some upland streams, rivers and lakes in Wales are considered. Chloride concentrations, derived almost exclusively from the sea, were elevated by 11.71% in afforested streams and lakes compared with equivalent moorland catchments. Sulfate concentrations were elevated by 19% in the river Tywi and catchments, Sulfate concentrations were elevated by 19% in the river Tywi and 106% in Lake Syfydrin compared with the unafforested river Camddwr and Lake Craig y Pistyll. Mean annual excess sulfate concentrations of 102 micro equiv/l in the river Tywi and 265 micro equiv/liter in Syfydrin were elevated by 21% and 117% respectively compared with those in their adjacent moorland catchments. No significant difference was found beween sulfate or excess sulfate levels in the afforested Blaenmelindwr and Pendam lakes compared with Thosgoch. Nitrate concentrations typically showed summer minima and winter maxima, but sulfate showed no consistent seasonal trend. Concentrations of calcium varied little with season, but aluminium and hydrogen ion levels were significantly elevated in the winter months in afforested systems. Apart from chloride, the major anions in both lakes and streams were sulfate and nitrate. Elevation in hydrogen and aluminium are therefore likely to be governed by concentrations of these anions and the availability of calcium and magnesium. At calcium concentrations below 100 micro equiv/liter and pH levels in the range 4.5-5.5 elevated aluminium concentrations prevent adequate ionic regulation by the gills leading to death from ionic stress and asphyxia. (Baker-IVI)
W85-06574

SYNERGISTIC EFFECTS OF ACIDITY AND ALUMINUM ON FISH (GOLDEN SHINERS) IN LOUISIANA,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
J. W. Robinson, and P. M. Deano.
Journal of Environmental Sciences and Health, Vol. A20, No. 2, p 193-204, February, 1985. 8 Fig, 6 Ref.

Descriptors: *Shiners, *Aluminum, *Acidity, *Synergism, *Louisiana, Mortality, Water pollution effects, Toxicity, Clay, Aluminum silicate, Decomposition, Leaves.

The effects of acidity on the mortality of fish (golden shiners) was studied at pH 3.7, 4.5, 5.0, 7.0, and 7.8, under controlled laboratory conditions. Results showed at pH 3.7 all fish died rapidly. As the acidity decreased, the rate of loss of fish decreased. At pH 4.5 they lived about 3 weeks and they survived pH 5.0. Aluminum was added to freshwater tanks as Al2(SO4)3 and the pH of the tank adjusted slowly as necessary to avoid localization of the acid. The tanks were then allowed to equilibrate and 20 fish placed in each tank. At pH 4.5 and 5.0 plus 100 ppm aluminum, all fish died within a few hours. With total aluminum concentrations of 10 ppm and 100 ppm and pH 4.5 and pH 5.0 it appeared that the aluminum and the acid had a synergistic toxic effect. Visual inspection of the fish showed the aluminum interacted with the gills, which may have caused suffocation. It is possible that some chemical forms of aluminum are more toxic than others. Suspended clay (aluminum silicate) does not appear to be toxic, but in acid solution aluminum ion is released which may be toxic. In other studies using nuclear magnetic resonance, data suggested an interaction of the decomposition products of leaves with aluminum in aqueous media possibly neutralizes the toxic form. These preliminary observations indicate the feasibility of eliminating aluminum toxicity and invite further studies. (Author's abstract)
W85-06599

ROAD SALT CONTAMINATES WELL, CAUSES HEALTH HAZARD,
For primary bibliographic entry see Field 5B.
W85-06611

EFFECT OF ACID PRECIPITATION ON SOIL MICROBIAL ACTIVITY: I. SOIL CORE STUDIES,
Florida Univ., Gainesville. Lab. of Environmental Microbiology.
G. Bitton, and R. A. Boylan.
Journal of Environmental Quality, Vol. 14, No. 1, p 66-69, January/March, 1985. 3 Tab, 29 Ref.

Descriptors: *Acid rain, *Soil microbial activity, Acid precipitation, Water pollution effects, Hydrogen ion concentration, Soil chemistry, Enzymes, Soil respiration, Carbon dioxide, Nitrogen fixation.

The effect of acid precipitation on selected microbial processes was studied in soil cores. Candler, Pomona and Apopka soils were used in the short-term column study. Three different soils were used in the long-term study: two sandy soils (Eustis and Candler) and a histosol (Okeechobee). Following short-term (92 d) exposure of soil cores to acid rain at pH 3.7 and 3.0, no alteration in enzyme activities was observed. The effect on soil respiration was dependent on soil type. Acid precipitation did not significantly affect soil respiration in Candler soil. Dinitrogen fixation was reduced only in Apopka soil by the rain at pH 3.0. Following long-term (690 d) exposure to acid rain, alterations in enzyme activities and CO2 evolution were dependent on the soil type. There was no difference in the pH of treated and control Okeechobee soils, but a reduction in pH between the control and acidified soils was observed in both Eustis and Candler soils. No reduction in adenosine triphosphate (ATP) content or N2 fixation were observed. (Moore-IVI)
W85-06618

EFFECT OF ACID PRECIPITATION ON SOIL MICROBIAL ACTIVITY: II. FIELD STUDIES,
Florida Univ., Gainesville. Dept. of Environmental Engineering.
G. Bitton, B. G. Volk, D. A. Graetz, J. M. Bossart, and R. A. Boylan.
Journal of Environmental Quality, Vol. 14, No. 1, p 69-71, January/March, 1985. 3 Tab, 22 Ref.

Descriptors: *Acid rain, *Soil microbial activity, Lake McCloud, Florida, Acid precipitation, Enzymes, Microorganisms, Nitrification, Soil chemistry, Water pollution effects, Soil respiration.

A field study on the impact of acid rain upon microbiological processes was carried out near Lake McCloud, Florida. The study site was composed of three transects, each including three plots. Each transect was spray-irrigated with lake water at pH 3.0, 3.7, or 4.6 (the lake water has a natural pH of 4.6). The soil of the lake watershed was Candler, a Typic Quartzipsamment. Acid rain did not significantly reduce dehydrogenase, phosphatase, or urease activity; protease activity was decreased. Soil respiration was not altered by acid rain of pH 3.7 or 3.0. Acid rain significantly reduced nitrification at both pH levels. Nitrification in soil was the most sensitive to acid precipitation under field conditions at a Florida site. (Moore-IVI)
W85-06619

OXYGEN CONCENTRATION OF WATERS OF THE FELDBERGER LAKE DISTRICT ON THE BASIS OF SELECTED SUMMER DEPTH PROFILES FROM 1924 THROUGH 1962. PART 2: ZANSEN, WOOTZEN, CARWITZER LAKE, DREETZ AND KRUSELIN (ZUM SAUERSTOFFHAUSHALT DER GEWASSER DER FELDBERGER SEENPLATTE AN HAND AUSGEWAHLTER SOMMERLICHER TIEFEN-

PROFILE SEI 1924 BZW. 1962. TEIL 2: ZANSEN, WOOTZEN, CARWITZER SEE, DREETZ UND KRUSELIN),
Bonito A.G., Osterburg (German D.R.).
For primary bibliographic entry see Field 2H.
W85-06652

CLASSIFICATION OF WATER COMPONENTS ACCORDING TO THEIR POTENTIAL TOXICITY TO WATER ORGANISMS (DIE KLASSIFIZIERUNG VON WASSERINHALTSSTOFFEN NACH IBREM TOXIZITATSPOTENTIAL GEGENUBER WASSERORGANISMEN),
Bezirksinstitut fuer Veterinarwesen Karl-Marx-Stadt (German D.R.). Abt. Fischkrankheiten.
K. Grahl.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 137-143, 1983. 4 Tab, 12 Ref.

Descriptors: *Toxicity, *Classification, *Water pollution effects, Growth stage, Fish, Water chemistry.

A new system of classification is presented to describe the potential toxicity of substances contained in water to water organisms; it is based on the concept of EC50, in which E means effect, so that EC50 is the concentration of a substance in mol/l which has the same toxic effect on an organism at the same stage of development under defined test conditions. The use of mol/l results in very small measurements, so for the sake of clarity, the negative log of EC50 is used to describe toxic potential (pEC50). This system allows components of water to be classified according to increasing toxicity in the form of an open-ended scale beginning at zero: pEC50 values from 0 to 3 mean that the substance is non- or slightly toxic; values > 5 signify danger to aquatic organisms; while values of $>$ or $= 7$ indicate extreme toxicity. The system seems to eliminate the relatively great spread of toxicity measurements resulting from biological testing when such testing is not carried out with completely consistent boundary conditions. pEC50 values are not constants, but are species-specific in the context of given test conditions. Verbal descriptions of toxicity that are customary in other classification systems become unnecessary with the pEC50 system. Rounding of pEC50 values to one decimal point is recommended when toxic potential has been measured under varying test conditions for a species or a group of species, e.g., sensitive fish; rounding to two points is recommended for different substances under approximately similar test conditions for one species at the same developmental stage and for testing of one substance under similar conditions for a species at various development stages. Tables are given showing the results of these types of testing. A tabular comparison of the pEC50 scale with previously published classification systems is also presented. (Collier-IVI)
W85-06657

ACUTE TOXICITY OF CARBAMIDE AND ITS LONG TERM EFFECTS ON THE GROWTH OF FINGERLINGS OF A TROPICAL FRESH WATER TELEOST, COLISA FASCIATUS (BLOCH AND SCH.),
Gorakhpur Univ. (India). Dept. of Zoology.
K. Pandey, and J. P. Shukla.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 145-149, 1983. 2 Tab. 20 Ref.

Descriptors: *Toxicity, *Carbamide, *Fish, Growth, Water pollution effects, Fish behavior, Mortality, Organic compounds.

Normal, healthy Colisa fasciatus fingerlings were exposed to LC0, LC50 or LC100 values of carbamide (urea) for 24, 48, 72, or 96 hr. The safe concentration of carbamide for a long term exposure was 2.5 mg/l. The toxic tolerance range of carbamade was 3.0 to 4.5 mg/l. The behavioral response of fingerlings toward carbamide was grossly dependent on concentration and length of exposure. When fingerlings were exposed to higher concentrations of carbamide, hyperexcitability and increased air-gulping were observed. Fingerlings were often observed swimming fast. Mucus secretion was also increased with increased exposure. The closer examination of dead fingerlings showed open opercula, sometimes bent bodies and whitish gills with copious mucus. The growth of the fingerlings showed no appreciable change in urea stress till the 11th day, while a gradual fall in their weight became obvious only from the 12th day. A significant decline in length was noted after the 7th day. (Baker-IVI)
W85-06658

TOXICITY OF SIMPLE AND COMPLEXED CYANIDE TO AQUATIC ORGANISMS (ZUR TOXIZITAT EINFACHER UND KOMPLEXER CYANIDE GEGENUBER WASSERORGANISMEN),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
M. Tscheu-Schluter.
Acta Hydrochimica et Hydrobiologies, Vol. 11, No. 2, p 169-179, 1983. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Toxicity, *Cyanide, *Aquatic life, Heavy metals, Cyanide compounds, Guppies, Chlorophyta, Photolysis, Hydrogen ion concentration, Water pollution effects.

The toxic effects of alkali cyanide, complex cyanide-containing heavy metal salts (of iron, cadmium, copper, nickel and mercury) were investigated according to standard methods with the aid of the test organism Poecilia reticulata (guppy) as well as the green alga Ankistrodesmus falcatus (beta- to alpha-mesosaprobic). Since various complex compounds can be photolytically decomposed, discontinous light-dark phases were also used. As discussed equilibrium calculation have shown, inter alia also the pH-value is important in the fish organism used, with different reactions to ions and molecularly dissolved compounds. The results are summarized in tables and graphic representations, the substances investigated being classified into groups by the strength of the toxic actions. (Author's abstract)
W85-06660

INFLUENCE OF TEMPERATURE ON THE TOXICITY OF PHENOL AND ITS CHLORO- AND NITRO-DERIVATIVES TO THE FISH NOTOPTERUS NOTOPTERUS (PALLAS),
S. Gupta, R. C. Dalela, and P. K. Saxena.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 2, p 187-192, 1983. 3 Tab, 21 Ref.

Descriptors: *Toxicity, *Fish, *Water pollution effects, *Phenols, Temperature effects, Pentachlorophenol, Dinitrophenol, Organic compounds.

Active and healthy specimens of Notopterus notopterus exhibited four phases of intoxication on exposure to phenols: pronounced motor activity, loss of equilibrium, convulsions, total loss of locomotor activity followed by death attributable to nerve poisoning and paralysis. Fish also secreted an excessive mucus from the skin, possibly to minimize the irritating effects of the chemicals. With decreasing temperature, the toxicity of the individual substances decreased by 6.5 to 22%, that of the mixtures by 10 to 87%. With rising temperature, the toxicity increased by 38-747% and 75 to 744%, respectively. The safety limits at 23 C lie between 0.3 micro-g/l for a synergistically acting mixture and 0.9 mg/l for an antagonistically acting one. For the individual substances this range is 3.5 micro-g/l to 0.5 mg/l. (Baker-IVI)
W85-06661

SEDIMENT AND NUTRIENT EXPORT IN RUNOFF FROM BURNED AND HARVESTED PINE WATERSHEDS IN THE SOUTH CAROLINA PIEDMONT,
Clemson Univ., SC. Dept. of Forestry.
For primary bibliographic entry see Field 5B.
W85-06714

LABORATORY INVESTIGATION OF LEACHATE CHEMISTRY FROM SIX APPALACHIAN FOREST FLOOR TYPES SUBJECTED TO SIMULATED ACID RAIN,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 2K.
W85-06721

EFFECT OF SOME COAL GASIFICATION AND TAR SAND PROCESS WATERS ON THE VIABILITY OF INDICATOR BACTERIA OF FECAL CONTAMINATION,
Wyoming Univ., Laramie. Div. of Microbiology and Veterinary Medicine.
J. C. Adams.
Journal of Environmental Quality, Vol. 14, No. 2, p 261-264, April/June, 1985. 6 Tab, 26 Ref.

Descriptors: *Tar sand, *Coal gasification, *Industrial wastewater, *Indicators, *Bacteria, *Water pollution effects, Coliforms, Streptococci, Wastewater.

The detrimental effects of coal gasification and tar sand process waters on the numbers of indicator bacteria in receiving waters was studied. The objectives were (i) to determine the effect of mixing process waters with 'natural' waters on the numbers of fecal coliforms and fecal streptococci after storage of these mixtures at 4 and 20 C, (ii) to determine if the growth phase at the time of exposure was important to the survival of Escherichia coli, and (iii) to determine the importance of pH in the toxicity of a process water. Addition of 10% (vol/vol) of one coal gasification water to river water resulted in approximately 90% reduction in numbers of fecal coliforms within 5 h of storage at 4 C, whereas there was a 65% reduction during this time when storage was at 20 C. An additional coal gasification water and two tar sand process waters were not toxic to fecal coliforms. Survival of fecal streptococci was not adversely affected in any of the waters. Stationary phase cells of E. coli were killed within 5 h of exposure to a 10% concentration of Hanna IV B-1 coal gasification water, whereas lag and exponential phase cells were unaffected during this exposure time. Further, after 24 h of exposure, 40% of the lag phase cells were viable, while live cells from the other two phases of growth were reduced by 99.9%. There was a 12% reduction in viable cells of E. coli after 120 h of exposure to a 10% concentration of Hanna IV B-1 process water adjusted to pH 7.0. In contrast, during this same time period there was a 5 log reduction in viable cells that were exposed to the process water (pH 8.6), which had not been neutralized. (Author's abstract)
W85-06725

SEDIMENT, SEASON, AND SALINITY EFFECTS ON PHOSPHORUS CONCENTRATIONS IN AN ESTUARY,
Agricultural Research Service, Beltsville, MD.
H. M. Kunishi, and D. E. Glotfelty.
Journal of Environmental Quality, Vol. 14, No. 2, p 292-296, April/June, 1985. 7 Fig, 2 Tab, 14 Ref.

Descriptors: *Sediments, *Seasonal variation, *Salinity, *Phosphorus, *Estuarine environment, *Wye River, *Maryland, *Water pollution effects, Nonpoint pollution sources, Nutrients, Best management practices, Agricultural runoff, Runoff.

A 4-yr study was made to better understand nonpoint-source inputs of P into the Wye River - a shallow, well-mixed estuary of the Chesapeake Bay. Water and sediment samples were taken periodically from along the length of the river and from the main freshwater tributary. Phosphorus forms and concentrations in solution were measured and P sorption isotherms were determined from sediment samples. Molybdate-reactive P concentrations were highest during the summer in the uppermost reaches of the river under tidal influence and decreased with increasing salinity downstream. Molybdate-reactive P concentrations in the river thus appeared to depend on the season and to indicate that increasing temperatures promote P release from sediment and P mineralization by benthic and other marine organisms. In additon, molybdate-reactive P in the river was released from sediment when fresh water from a tributary diluted the divalent cation concentration of the brackish water. Best-management farm practices to reduce the loss of P by runoff would not be

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expected to markedly lower the concentration of molybdate-reactive P in the river. (Author's abstract)
W85-06727

AVAILABILITY OF CADMIUM TO PERFUSED RAINBOW TROUT GILLS IN DIFFERENT WATER QUALITIES,
Uppsala Univ. (Sweden). Inst. of Zoophysiology.
P. Part, O. Svanberg, and A. Kiessling.
Water Research, Vol. 19, No. 4, p 4127-434, 1985. 6 Fig, 2 Tab, 37 Ref.

Descriptors: *Cadmium, *Trout, *Water properties, *Toxicity, *Heavy metals, Hardness, Chemical properties, Gills, Alkalinity, Salinity, Acidity, Osmolarity, Metabolism, Metals.

Cadmium uptake in freshwater fish occurs mainly via the gills, the the toxicity of Cd for fish is dependent on the water quality. The uptake of cadmium in perfused gills from rainbow trout was studied in different water qualities. The transfer of Cd and retention of the metal in gill tissue is, at constant hardness, related to the cadmium ion activity in the water. Inorganic Cd complexes appear less available than the free ion. The Cd transfer is strongly dependent on the hardness of the water. Hardness acts by a biological mechanism probably by changing gill permeability for Cd. Cd transfer through the gills and Cd retention in gill tissue appeared to be two separate processes. The Cd content of gill tissue did not necessarily reflect the real availabiliy of Cd to fish in different water qualities. (Baker-IVI)
W85-06729

INFLUENCE OF SURFACTANTS ON GILL PHYSIOLOGY AND CADIUM UPTAKE IN PERFUSED RAINBOW TROUT GILLS,
Uppsala Univ. (Sweden). Inst. of Zoophysiology.
P. Part, O. Svanberg, and E. Bergstrom.
Ecotoxicology and Environmental Safety, Vol. 9, No. 2, p 135-144, March, 1984. 2 Fig, 4 Tab, 32 Ref. National Swedish Environmental Protection Board grant 5340052-9.

Descriptors: *Trout, *Toxicity, *Surfactants, *Cadmium, *Gills, Water pollution effects, Zinc, Water pollution effects, Fish.

Cadmium, in the concentrations tested, had no measurable effect on gill viability during 45 or 60 min of perfusion. The vascular resistance and the oxygen transfer remained stable and did not differ significantly from the control. The Na(+) net flux was positive. The viability of the gills was severely affected in the presence of 100 micromol/liter linear alkylaryl sulfonate (LAS) or nonylphenol ethoxylate (NP-10EO). The vascular resistance increased gradually during the perfusion, followed by a concomitant decrease in oxygen transfer. The net flux of Na(+) over the epithelium was negative. The activity of Cd(2+) was reduced slightly in the presence of 100 micromole/liter LAS or NP-10EO. This indicates that part of the metal was bound by the detergents. There was no difference in the Cd binding between the anionic LAS and the nonionic NP-10EO. No significant impact on gill viability was observed in lower concentrations of metal and surfactant. LAS markedly reduced Cd transfer in the high dose combination of (100 microm/liter LAS + 8.1 micromol/liter Cd). The retention of Cd in perfused tissue was not affected. Unlike LAS, NP-10EO in the high dose mixture did not affect the Cd transfer through the gills. The tissue retention of the metal was doubled in the presence of the nonionic detergent. The mixtures of surfactants and Cd in the high dose experiments had basically the same effects on gill viability as the surfactants alone. The most prominent difference is that the Na(+) net flux was significantly more negative in the mixtures, especially in the presence of Np-10EO. No increase in vascular resistance was noted in the mixture Cd + LAS. (Baker-IVI)
W85-06741

CONTAMINATION AND EFFECTS IN FRESHWATER DITCHES RESULTING FROM AN AERIAL APPLICATION OF CYPERMETHRIN,
Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.
S. W. Shires, and D. Bennett.
Ecotoxicology and Environmental Safety, Vol. 9, No. 2, p 145-158, April, 1985. 5 Fig, 5 Tab, 8 Ref.

Descriptors: *Toxicity, *Water pollution effects, *Cypermethrin, *Insecticides, *Aquatic life, Zooplankton, Invertebrates, Fish, Pesticide residues, Pyrethroid insecticides.

Cypermethrin (Ripcord) was applied at 25 g ai/ha by fixed-wing aircraft to a large field (11.6 ha) of winter wheat bordered on three sides by drainage ditches. About 60% of the nominal application rate was deposited on the crop and about 6% was deposited over the water surface. The amount of spray drift deposited upwind declined sharply with increasing distance from the treated field. Downwind, the spray drift was small but occurred over a much greater distance. Relatively high spray deposits were found along the banks of the ditches adjacent to the crop (200 to 700 micro-g/sq m) and the deposits over the ditches themselves were obviously related to the close proximity of the waterways to the treated field and to the practice of respraying the field headlands. Analyses of subsurface water suggested that any spray drift reaching the ditches resulted in very low or undetectable residues of cypermethrin in the general water body. Any cypermethrin residues that were detected did not persist for significant periods and none were detected in samples taken later than 2 days after application. No serious affects were noted on zooplankton and macroinvertebrate fauna at the different sampling stations. The aerial application of cypermethrin adjacent to freshwater bodies resulted in limited contamination of the water, with consequently only minor short-term effects on a few sensitive forms of aquatic life. (Baker-IVI)
W85-06742

USE OF THE BIVALVE MYTILUS EDULIS AS A TEST ORGANISM FOR BIOCONCENTRATION STUDIES. 1. DESIGNING A CONTINUOUS-FLOW SYSTEM AND ITS APPLICATION TO SOME ORGANOCHLORINE COMPOUNDS,
National Swedish Environment Protection Board, Stockholm. Special Analytical Lab.
L. Renberg, M. Tarkpea, and E. Linden.
Ecotoxicology and Environmental Safety, Vol. 9, No. 2, p 171-178, April, 1985. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Bivalves, *Mytilus, *Bioconcentration, *Organochlorine compounds, Trichlorobiphenyl, Methoxychlor, Pentachlorobenzene, Lindane, Pesticides, Water pollution effects, Bioaccumulation.

Most bioconcentration studies have previously been carried out using fish as a test organism. Equally important is the use of bivalves for this purpose, from both an ecological and an economic point of view. A continuous-flow system has thus been designed for use also with extremely hydrophobic substances and evaluated using 2,4',5-trichlorobiphenyl, methoxychlor, pentachlorobenzene, and lindane. The variation of the uptake in the individuals after 3 weeks' exposure was quite small (relative standard errors varied from 10.1 to 15.3% depending on the test substance), indicating a high degree of reproducibility. The bivalves, however, are known to close their valves under unfavorable conditions, which occasionally may bias the results. To overcome this disadvantage, it is suggested that an internal standard - i.e., a chemically defined compound - be added to the water simultaneously with the test substances. Athough there is a principal risk for interactive effects, unexpected variations in the uptake can thus be compensated for by relating the concentration of the test substance to the concentration of the internal standard in the organisms. Comparisons between continuous-flow systems and static systems have also been made. Continuous-flow systems are more suitable for studying hydrophobic compounds than static systems. (Author's abstract)
W85-06743

COMPARISON OF PHYSIOLOGICAL CHANGES IN CARP, CYPRINUS CARPIO, INDUCED BY SEVERAL POLLUTANTS AT SUBLETHAL CONCENTRATIONS. I. THE DEPENDENCY ON EXPOSURE TIME,
Karlsruhe Univ. (Germany, F.R.). Dept. of Zoology II.
G. Gluth, and W. Hanke.
Ecotoxicology and Environmental Safety, Vol. 9, No. 2, p 179-188, April, 1985. 6 Fig, 26 Ref.

Descriptors: *Animal physiology, *Fish, *Carp, *Water pollution effects, Blood physiology, Toxicity, Aldrin, Pesticides, Atrazine, DDT, Dieldrin, Endrin, Hexachlorbenzene, Lindane, Methanol, Phenols, Toluene.

Carp were exposed to 10 different pollutants at sublethal concentrations for 6, 24, or 72 hr. Blood, liver, and white muscle samples were taken after the exposure time together with samples of control handled fish. Serum concentrations of glucose, cortisol protein, and cholesterol were determined. Similarly, the liver and muscle glycogen contents were measured. The effects of the following pollutants were examined: aldrin (100 micro g/liter), atrazine (100 micro g/liter), DDT (50 micro g/liter), dieldrin (20 micro g/liter), endrin (2 micro g/liter), hexachlorbenzene (100 micro g/liter), lindane (100 micro g/liter), methanol (1 ml/liter), 4-N-phenol (100 micro g/liter), toluene (100 micro l/liter). The rises in serum glucose and cortisol were the most frequent changes occurring after exposure to the pollutants. A decline in plasma protein and cholesterol content was also often observed. Liver glycogen concentration increased first in most cases and was reduced after longer exposure. Muscle glycogen was affected differently, sometimes reduced by exposure to the pollutants. The experimental design allows for the gradual increase in toxicity of the pollutants used regarding the applied concentrations. The test for proof of toxicity of those chemicals was evaluated. The determination of serum glucose and cortisol levels can be proposed as mostly useful. The clearest changes in all parameters were found after treatment with 100 micro g/liter atrazine and 50 micro g/liter DDT. When serum glucose and cortisol concentrations were quickly elevated, signs for exhaustion could be seen after 72 hr of exposure. (Author's abstract)
W85-06744

EFFECTS OF LEAD ON DELTA-AMINOLEVULINIC ACID DEHYDRATASE ACTIVITY, GROWTH, HEMOGLOBIN CONTENT, REPRODUCTION IN DAPHNIA MAGNA,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
R. Berglind, G. Dave, and M. L. Sjobeck.
Ecotoxicology and Environmental Safety, Vol. 9, No. 2, p 216-229, April, 1985. 10 Fig, 2 Tab, 39 Ref.

Descriptors: *Lead, *Water pollution effects, *Aminolevulinic acid dehydratase, *Hemoglobin, *Reproduction, *Daphnia, Toxicity, Heavy metals, Crustaceans, Animal physiology, Enzymes.

The effects of continuous exposure to lead for various periods and recovery in clean water on delta-aminolevulinic acid dehydratase (ALA-D) activity, hemoglobin content, growth, and reproduction were studied in Daphnia magna. Steady-state inhibition of ALA-D activity was reached within 2 days in 16, 64, and 256 micro-g Pb/liter, but restoration in clean water was prolonged in relation to previous exposure. Inspite of the inhibition of ALA-D activity hemoglobin content increased after 2 days in 16 and 24 micro-g Pb/liter. Furthermore, hemoglobin content in previously exposed animals increased during recovery in clean water. Maximum hemoglobin content (2.9 times control value) was found after 2 days recovery of animals exposed to 64 micro-g Pb/liter. These findings suggest that some enzyme(s) other than ALA-D in the biosynthetic pathway of hemoglobin formation is (are) more sensitive to lead. Growth, in contrast to reproduction, was stimulated by low concentrations of lead (< 64 micro-g Pb/liter), although in 256 micro-g Pb/liter growth was also significantly impaired. After 19 days the 16 and 50% reproductive impairment concentrations were < or = 1 and 10 micro-g Pb/liter, respectively. (Collier-IVI)

W85-06745

BIOACCUMULATION OF SOME FORESTRY PESTICIDES IN FISH AND AQUATIC PLANTS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
W. L. Lockart, D. A. Metner, B. N. Billeck, G. P. Rawn, and D. C. G. Muir.
ACS Symposium Series, Vol. 238, p 298-315, 1984. 6 Fig, 5 Tab, 27 Ref.

Descriptors: *Pesticides, *Bioaccumulation, *Fish, *Aquatic plants, Organic compounds, Fenitrothion, Aminocarb, Permethrin, Fluorene, Hydrocarbons, Trout, Larvae, Duckweed.

Bioaccumulation of some pesticides (fenitrothion, aminocarb, permethrin) with real or potential application in forestry in Canada has been examined in lab experiments using larval rainbow trout and common duckweed. Since some of the formulations of forest pesticides also contain solvents of petroleum distillates, experiments were also carried out with a hydrocarbon, fluorene, which is a component of fuel oil. Accumulations of fluorene in fish were higher than any of the pesticides. Calculations were made of uptake and depuration rate constants which were used to predict residue accumulations under various exposure conditions. In spite of the limitations on values produced by simple lab experiments as reported here (use of radioactivity to indicate a compound, single exposure concentrations, steady state assumptions, lack of allowance for growth dilution, first order depuration kinetics), the rate constants derived have given a surprisingly good estimate both of some published field biconcentration measurements and of other predictions based on larger amounts of data. (Baker-IVI)
W85-06772

EFFECTS OF HEATING ON GROWTH AND CONDITION OF PIKEPERCH (LUCIOPERCA LUCIOPERCA) IN LOWLAND PONDS CREATED BY SAND EXTRACTION,
Katholieke Univ. Leuven (Belgium). Lab. for Ecology and Fauna Management.
D. Draulans, J. van Vessem, and A. F. De Bont.
Hydrobiologia, Vol. 122, No. 3, p 213-217, March, 1985. 3 Fig, 6 Tab, 7 Ref.

Descriptors: *Thermal pollution, *Pikeperch, *Water pollution effects, Belgium, Growth, Fish, Ponds, Seasonal variation, Artificial ponds, Effluents, Powerplants.

The growth rates and condition of pikeperch (Lucioperca lucioperca) originating from two lowland ponds at Mol (north Belgium) were compared. One pond, the Lagune (65 ha, depth 4-12 m), receives heated effluent from two power plants; the other, Plas Leblanc (10 ha, depth 2-8 m) receives no effluent. Scalimetry and operculometry were used to measure growth. Growth rates were slightly higher in the Lagune, whereas no differences in overall condition of fish from the two ponds were seen. There were neither significant differences between sexes with one pond, nor for one sex between the two ponds. There were, however, strong seasonal differences in condition between the ponds. At the Plas Leblanc, condition increased toward summer, in which it reached a peak of 1.29. For the Lagune, condition was minimal in summer, and increased from then on until spring, when it reached a maximum of 1.23. Summer temperatures in the heated pond probably were above the optimum for pikeperch. (Rochester-IVI)
W85-06788

INFLUENCE OF A METAL-CONTAMINATED TRIBUTARY ON THE INVERTEBRATE DRIFT FAUNA OF THE KING RIVER (TASMANIA, AUSTRALIA),
Tasmania Univ., Hobart (Australia). Dept. of Zoology.
R. Swain, and R. W. G. White.
Hydrobiologia, Vol. 122, No. 3, p 261-266, March, 1985. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Metals, *Water pollution effects, *Invertebrates, *Aquatic drift, *King River, *Tasmania, *Australia, Mayflies, Nymphs, Animal behavior, Behavior.

Drifting invertebrates were collected upstream of, at, and downstream of the input of metal contaminated water into the previously unpolluted King River in western Tasmania. In the upstream section the drift fauna showed characteristics similar to those observed by other workers with a marked nocturnal peak. Changes in drift rates at the site of input were observed and it is hypothesized that mayfly nymphs, and possibly other animals, respond to the change in water quality by leaving the water column and randomly searching the substrate for clean water. Most nymphs re-enter the drift in a current of clean water which was displaced towards the opposing bank by the entry of contaminated water. This re-entry of animals into the drift occurs some four hours after the main nocturnal peak in drift rates. (Author's abstract)
W85-06790

ACCELERATED EUTROPHICATION IN A NEW ZEALAND LAKE: LAKE ROTOITI, CENTRAL NORTH ISLAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 2H.
W85-06794

EFFECTS OF SODIUM AND POTASSIUM CHLORIDES ON THE GROWTH AND ACCUMULATION OF MINERAL IONS BY CYPERUS INVOLUCRATUS ROTTB,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
R. J. Hocking.
Aquatic Botany, Vol. 21, No. 3, p 201-217, March, 1985. 7 Fig, 5 Tab, 25 Ref.

Descriptors: *Sodium chloride, *Potassium chloride, *Cyperus, *Wastewater treatment, *Plant growth, *Ions, Salts, Salinity, Calcium, Magnesium, Plant physiology.

The response of the large emergent aquatic plant Cyperus involucratus Rottb. to NaCl and KCl salinities was studied under glasshouse conditions. Growth was not affected greatly by 50 mM NaCl or 100 mM KCl, but plants treated with 110 mM NaCl or 200 mM KCl were stunted and showed symptoms of salt toxicity. NaCl salinity was more detrimental than KCl, and Cl was more damaging to plant growth than K, but less damaging than Na. Salinity had no effect on plant succulence. NaCl and KCl treatments caused a decrease in concentration of Ca and Mg in plant tissue, and NaCl-stressed plants accumulated nitrate-N. Na was largely excluded from leaves, whereas K was not. Concentrations up to 4% Cl, 8% K and 2.3% Na (dry wt. basis) were recorded in above-ground plant organs. C. involucratus is potentially a useful plant for inclusion in aquatic plant filters to treat wastewaters, and harvestable parts of the plant (culms and leaves) had over 60% of the total plant K, Na and Cl. The results are discussed with respect to the use of C. involucratus in systems for wastewater reclamation. (Author's abstract)
W85-06803

SUBMERSED MACROPHYTE COMMUNITIES OF ADIRONDACK LAKES (NEW YORK, U.S.A.) OF VARYING DEGREES OF ACIDITY,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W85-06804

EFFECTS OF INSECTICIDES ON THE BENTHIC COMMUNITY IN A MODEL STREAM,
National Inst. for Environmental Studies, Tsukuba (Japan).
M. Yasuno, Y. Sugaya, and T. Iwakuma.
Environmental Pollution (Series A), Vol. 38, No. 1, p 31-43, 1985. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Insecticides, *Benthos, *Water pollution effects, *Streams, Pesticides, Toxicity, Zoobenthos, Algae, Midges, Organophosphorus pesticides, Temephos, Chlorphoxim.

The benthic community in an outdoor model stream was exposed to the organophosphorus insecticide temephos, at a concentration of 5 mg/liter for 30 min, or chlorphoxim at 2 mg/liter for 3 h. Three species of chironomids were predominant in this stream in the first experiment, together with Hydropsychodes brevilineata in the second experiment. Both insecticides killed the majority of the zoobenthos, and resulted in a bloom of epilithic algae. The extent of grazing pressure by chironomids on algae was assessed. The chironomid populations recovered quickly but the trichopteran larvae recovered slowly. There were some differences in the toxicity between the two insecticides. Paracyclops fimbriatus and Procladius sp. were affected only by chlorphoxim. (Author's abstract)
W85-06815

TWENTY-FIVE YEARS OF PHYTOPLANKTON ON THE WEST FORK AND MAIN STEM OF THE WHITE RIVER: 1958-1982,
Indiana State Board of Health, Indianapolis.
For primary bibliographic entry see Field 2H.
W85-06849

EFFECTS OF ENVIRONMENTAL GRADIENTS CONCERNING WATER QUALITIES ON THE STRUCTURE OF THE PHYTOPLANKTON COMMUNITY IN THE COASTAL SEA,
Hiroshima Univ. (Japan). Inst. of Environmental Chemistry.
For primary bibliographic entry see Field 2L.
W85-06853

FIELD AND LABORATORY STUDIES OF ION BALANCE AND GROWTH RATES OF RANID TADPOLES CHRONICALLY EXPOSED TO LOW PH,
Pennsylvania State Univ., University Park. Dept. of Biology.
J. Freda, and W. A. Dunson.
Copeia, No. 2, p 415-423, 1985. 5 Fig, 2 Tab, 28 Ref.

Descriptors: *Ion balance, *Growth rate, *Tadpoles, *Frogs, *Hydrogen ion concentration, Water pollution effects, Animal physiology, Sodium, Chloride, Ponds, Growth stages.

The effect of sublethal, chronic exposure of tadpoles to low environmental pH under natural conditions was investigated by making weekly measurements of various physiological variables. Rana sylvatica tadpoles from a low pH pond (pH 4.05 - 4.90) had lower body sodium, chloride and water concentrations in comparison with tadpoles from a nearby high pH pond (pH 5.74-6.37). Tadpoles from both ponds placed in the low pH pond also underwent higher sodium efflux than when placed in the high pH pond. These observations parallel similar studies on fish and demonstrate the effects of low environmental pH on larval anuran ionic regulatory mechanisms. Survival times of field-collected R. sylvatica tadpoles placed at pH 3.0 (H_2SO_4) did not change with age nor were there any differences between tadpoles from high and low pH ponds. However, survival times of laboratory-raised R. pipiens tadpoles did increase with age, and animals raised at pH 4.4 grew slower than siblings at pH 5.8. (Author's abstract)
W85-06859

PHYTOPLANKTON OF LAKE SIMCOE DURING THE ICE-FREE PERIODS OF 1980-82 AND POTENTIAL RESPONSE TO REDUCED PHOSPHORUS LOADINGS,
Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 2H.
W85-06860

MORTALITY OF ZOOPLANKTON RESULTING FROM TEMPERATURE REGIMENS EN-

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COUNTERED IN ONCE-THROUGH COOLING SYSTEMS,
Ontario Hydro, Toronto. Research Div.
J. K. Kwik, and T. G. Dunstall.
Journal of Great Lakes Research, Vol. 11, No. 1, p 26-33, 1985. 6 Fig, 1 Tab, 18 Ref.

Descriptors: *Zooplankton, *Heated water, *Cooling water, *Temperature effects, Thermal stress, Water pollution effects, Water temperature, Rotifers, Diacyclops, Crustaceans.

The crustacean zooplankters Diacyclops bicuspidatus thomasi and Bosmina longirostris and the rotifers Polyarthra spp. and Keratella spp. were subjected to thermal regimens simulating entrainment through condenser cooling water systems of generating stations to determine their thermal tolerance. Animals collected from Lake Ontario at lake water temperatures ranging from 8.0 to 19.5 C were exposed to temperature increases of 5, 10, 15, 20, and 25 C. All four taxa tolerated larger temperature increases as ambient temperature decreased. Predictive models indicated that mortality due to thermal stress would be under 10% for all taxa tested providing lake water temperature after heat addition does not exceed 29 C. Acclimation of the animals did not influence the total temperature tolerated following exposure to lethal temperatures. (Author's abstract)
W85-06862

DISTRIBUTION OF OLIGOCHAETES IN LAKE MICHIGAN AND COMMENTS ON THEIR USE AS INDICES OF POLLUTION,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5A.
W85-06866

NOTE ON EUTROPHIC CHARACTERISTICS OF TWO FRESHWATER BODIES OF KURUKSHETRA, INDIA,
Kurukshetra Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W85-06868

MINERAL CONTENT OF CANADA GOOSE EGGS AND IMPLICATIONS FOR ENVIRONMENTAL SURVEILLANCE ALONG THE COLUMBIA RIVER,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
For primary bibliographic entry see Field 5A.
W85-06873

FACTORS AFFECTING TRACE METAL ACCUMULATION BY ESTUARINE OYSTER CRASSOSTREA VIRGINICA,
District of Columbia Univ., Washington. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W85-06878

ADAPTIVE BEHAVIOR OF EURYHALINE PHYTOPLANKTON COMMUNITIES TO ARSENIC STRESS,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
J. G. Sanders, and S. J. Cibik.
Marine Ecology - Progress Series, Vol. 22, No. 2, p 199-205, March, 1985. 7 Fig, 3 Tab, 24 Ref.

Descriptors: *Water pollution effects, *Arsenic, *Phytoplankton, Productivity, Population dynamics, Biomass, Species composition, Diatoms, Algal growth.

Long-term experiments performed with large column continuous cultures of natural phytoplankon assemblages exposed to low levels of arsenate (1 to 10 x ambient concentration) have shown that arsenate is differentially inhibiting to some phytoplankton species. This observed variance in sensitivity is sufficient to cause a marked change in species composition and succession of dominant species in arsenic-treated assemblages with a potential for impact upon carbon transfer between trophic levels, even though estimates of community biomass and productivity indicate no change. A common response to arsenic dose in this study was replacement of dominant algae by species that were taxonomically similar. Although similar taxonomically, the replacement species varied greatly in size or shape from the original dominant. The replacement of relatively large centric diatoms by smaller species within a phytoplankon community can be of important ecological significance. Diatoms appeared either to be turned off or turned on in arsenic-dosed cultures. Flagellates exhibited a somewhat different response. Flagellates that were affected by arsenate did not exhibit the abrupt declines in population densities seen in affected diatoms. While growth rates of the species were depressed somewhat, the species continued to react to environmental cues such as changing light intensities or nutrient concentrations. (Baker-IVI)
W85-06879

PARTICULATE LOAD OF THE RED RIVER, ST. IVES BAY: ITS GEOCHEMICAL COMPOSITION AND THE EFFECT OF ITS DISCHARGE PLUME ON THE BEHAVIOUR OF A RESIDENT WILD DOLPHIN,
Institute of Oceanographic Sciences, Wormley (England).
R. J. Morris, M. L. McCartney, C. Lockyer, and R. Hoborn.
Marine Pollution Bulletin, Vol. 16, No. 3, p 106-108, March, 1985. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Dolphins, *Water pollution effects, *Particulates, *Metals, *St. Ives Bay, *Red River, *England, Behavior, Water analysis, Antimony, Arsenic, Copper, Zinc, Clay.

A solitary, male bottlenosed dolphin has in recent years become a resident of the area around Godrevy Head and Godrevy Island, England. Field observations indicate that the normal swimming range of this dolphin is influenced by the discharge plume of the Red River which empties into St. Ives Bay. A detailed geochemical analysis was made of the solid material in the river's discharge. The Red River was found to have a high particulate load (30 g/l dry matter) mostly composed of very finely divided material which stays in suspension in seawater for some time. Clays (illite and kaolinite) and quartz were the major components of the river particulates. Organic carbon and carbonates were minor components. In addition to SiO2 and Al2O3, Fe2O3 was the other major component comprising nearly 10% of the particulate matter. A number of other metals were present as significant components including Sn (2000 ppm), As (1000 ppm), Cu (992 ppm), Zn (150 ppm), and Zn (190 ppm). The dolphin's behavior may be brought about due to the presence of a dense cloud of finely divided metal particulate which would impeed the functioning of its delicate sensory system or it may be able to detect the presence of high levels of potentially toxic metals such as Sn, As, Cu, and Zn. (Baker-IVI)
W85-06880

COMPARISON OF AVOIDANCE RESPONSES OF AN ESTUARINE FISH, FUNDULUS HETEROCLITUS, AND CRUSTACEAN, PALAEMONETES PUGIO, TO BIS(TRI-N-BUTYLTIN)OXIDE,
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
A. E. Pinkney, L. W. Hall, M. J. Lenkevich, D. T. Burton, and S. Zeger.
Water, Air and Soil Pollution, Vol. 25, No. 1, p 33-40, May, 1985. 2 Fig, 27 Ref.

Descriptors: *Estuarine environment, *Avoidance response, *Animal behavior, *Fish, *Crustaceans, *Butyltin oxide, Mummichog, Shrimp, Water pollution effects, Antifoulants, Organic tin, Tin.

Avoidance responses of an estuarine fish, mummichog (Fundulus heteroclitus), and a crustacean, grass shrimp (Palaemonetes pugio), to the antifoulant bis(tri-n-butylin)oxide (TBTO) were evaluated. Four out of six groups of mummichogs tested at 1.0 micro g total organic Sn/L showed avoidance. Total organic Sn concentrations > or = 3.7 micro g/L were avoided by this fish species in all cases. Higher concentrations of total organic Sn did not result in greater avoidance responses. Grass shrimp did not avoid total organic Sn concentrations between 2.3 and 30.0 micro g/L. Response data at 2.3 and 30 micro g/L were similar. Mummichogs and grass shrimp differed greatly in their abilities to avoid potentially adverse concentrations of total organic Sn. Since mummichogs are major predators of grass shrimp, these behavioral responses may have important implications for tidal marsh ecosystems. (Author's abstract)
W85-06887

TRACE ELEMENT CONCENTRATIONS IN THE DORSAL MUSCLE OF WHITE SUCKERS AND BROWN BULLHEADS FROM TWO ACIDIC ADIRONDACK LAKES,
Department of Energy, New York. Environmental Measurements Lab.
M. Heit, and C. S. Klusek.
Water, Air and Soil Pollution, Vol. 25, No. 1, p 87-96, May, 1985. 8 Tab, 26 Ref.

Descriptors: *Trace elements, *Fish, *Suckers, *Bullheads, *Acid lakes, *New York, *Trace metals, *Water pollution effects, Lake sediments, Sediments, Silver, Arsenic, Cadmium, Chromium, Copper, Mercury, Nickle, Lead, Antimony, Selenium, Tin, Teliurium, Vanadium, Zinc, Fish physiology.

Concentrations of 14 elements (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, Tl, V, and Zn) were measured in the dorsal muscle of omnivorous white suckers and brown bullheads, fish likely to ingest sediment while feeding. The fish were collected in two acidic Adirondack lakes known to have elevated concentrations of several of these elements in their surface sediment. Trace element concentrations in the muscle of the while suckers and brown bullheads were compared with government guidelines for edible fish and survey data for concentrations present in commercial species. Only the largest white sucker exceeded the U.S. Food and Drug Administrations's guidelines for Hg in food of 1 ppm (wet wt). Concentrations of all the other elements measured were at low or innocuous levels in the edible muscle. A significant positive correlation was found between body weight and Hg concentrations in both species. Zinc was negatively correlated for the same parameters in white suckers. With the possible exception of Hg, elevated levels of potentially toxic elements in the surface sediment of the two acidic Adirondack lakes are not reflected in the edible muscle of the omnivorous bottom feeding fish present in these systems. (Author's abstract)
W85-06889

EFFECT OF SIMULATED ACID RAIN ON MYCORRHIZAL INFECTION OF PINUS STROBUS L.,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
H. F. Stroo, and M. Alexander.
Water, Air and Soil Pollution, Vol. 25, No. 1, p 107-114, May, 1985. 4 Tab, 22 Ref.

Descriptors: *Acid rain, *Water pollution effects, *Mycorrhizae, *Soil fungi, *Root development, *Pine trees, Fungi, Trees, Roots, Hydrogen ion concentration, Sulfates, Nitrates, Seedlings.

Mycorrhizal infection but not growth of white pine seedlings was reduced by application of simulated rain at pH 3.5 at 3 times ambient rates to plants grown in steamed Mardin soil inoculated with Pisolithus tinctorius. In unsteamed Mardin soil, the simulated acid rain at 3 times ambient rates had no effect on mycorrhizal infection or growth of pine seedlings if the rain was applied to the plants and soil or to only the soil before planting, except that nitrate-containing acid rain increased growth, infection and N content. In limed Mardin soil, the simulated acid rain reduced mycorrhizal infection if applied to the plants and soil as the seedlings were growing but not if applied to the soil before planting. Application of pH 3.5 rain at ambient rates had no detectable influence on mycorrhizal infection in 6 of 9 soils tested, but it

stimulated infection in 3 soils if the simulated rain contained only sulfate and in 1 soil if it had both sulfate and nitrate. (Author's abstract)
W85-06890

FIELD EVALUATION OF TWO ENDOTHALL FORMULATIONS FOR MANAGING HYDRILLA IN GATUN LAKE, PANAMA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 4A.
W85-06900

HANDBOOK ON THE BISCAYNE AQUIFER WATER MANAGEMENT, WATER CONSERVATION HEALTH AND COST OF DRINKING WATER.
Environmental Coalition of Broward County, Inc., Fort Lauderdale, FL.
For primary bibliographic entry see Field 6D.
W85-06906

CALCIUM OXIDE AND HYDROXIDE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario). Environmental Protection Programs Directorate.
For primary bibliographic entry see Field 5A.
W85-06935

OPTIMIZING SALINITY CONTROL STRATEGIES FOR THE UPPER COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. G. Evans, W. R. Walker, and G. V. Skogerboe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-136143. EPA-600/2-82-077, November 1982. Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma. 210 p, 37 Fig, 14 Tab, 220 Ref, 4 Append. Contract/Grant No. R-806148.

Descriptors: *Salinity, *Salinity control, *Cost-benefit analysis, *Optimization, Systems analysis, Colorado River.

Salinity is the most serious water quality problem in the Colorado River Basin. The impact, felt largely in the Lower Basin, is acute because the basin is approaching conditions of full development and utilization of all available water resources. Current estimates indicate that each mg/l increase in concentration at Imperial Dam results in $450,000 annual damages. Therefore, in order to offset salinity caused by the development of the vast energy supplies and to allow the seven Colorado River Basin states to fully utilize their allocation of Colorado River water, it is necessary to implement cost-effective salinity control programs in the basin. A simple multi-level nonlinear optimization procedure was utilized to formulate the most cost-effective array of salinity control strategies for the Upper Colorado River Basin. The results qualitatively indicated the anticipated salt load reduction and expected annual costs of each salinity reduction increase for any preselected level control. Costs and salinity contributions associated with various alternatives were generated using January, 1980, estimated conditions. Marginal cost analysis based on current damage estimates indicate that the optimal cost-effective salinity control program in the Upper Basin would cost about $30 million annually and remove about 1.2 million megagrams of salt/yr. Optimal salinity control programs are presented for the individual alternatives, for individual areas or projects, for the states of Colorado and Utah and the Upper Colorado River Basin.
W85-06960

EVALUATION OF WASTEWATER DISINFECTION ALTERNATIVES,
Ontario Ministry of the Environment, Toronto. Wastewater Treatment Section.
For primary bibliographic entry see Field 5D.
W85-06963

ACUTE LETHAL TOXICITY OF PRUDHOE BAY CRUDE OIL AND COREXIT 9527 TO ARCTIC MARINE FISH AND INVERTEBRATES,
LGL Ltd., Toronto (Ontario).
M. G. Foy.
EPS 4-EC-82-3, July 1982. Department of the Environment, Ottowa (Ontario). 62 p, 19 Fig, 14 Tab, 66 Ref.

Descriptors: *Water pollution effects, *Dispersants, *Toxicity, *Marine animals, *Oil, *Crustaceans, *Fish, *Bioassays, Oil pollution, Amphipods, Copepods, Ecological effects, Hydrocarbons, Oily water.

The toxicities of Prudhoe Bay crude oil, the dispersant Corexit 9527 and mixtures of these, to several arctic marine amphipods, one arctic marine copepod and one arctic marine fish were studied in semi-static 96 hr bioassays in which exposure concentrations were measured by fluorescence spectroscopy. In general, sensitivities of all species were remarkably similar for any one toxicant. The 96 hr LC50 values ranged from 28 to 66 mg/L for sodium lauryl sulfate (a reference toxicant), from 104 to 175 mg/L for Corexit, from 45 to 196 microfilters/L for Prudhoe Bay crude oil dispersed with Corexit 9527, and from 32 to 73 microliters/L for Prudhoe Bay crude oil dispersed mechanically. Mortality in oil-Corexit-water mixtures was much higher than in oil-water mixtures of the same nominal oil concentration. This was thought to be due to the higher concentrations of oil in the water column to which the organisms were exposed when the disperant was used. Based on measured hydrocarbon concentrations in the water column, the toxicity of the oil-Corexit-water mixtures was less than that found for the oil-water mixtures. This was attributed to the smaller ratio of dissolved hydrocarbons to total measured hydrocarbons in the oil-Corexit-water mixtures, than that in the oil-water mixtures.
W85-06970

SUBLETHAL EFFECTS OF DISPERSED OIL ON AN ESTUARINE ISOPOD,
Environmental Sciences Ltd., Vancouver (British Columbia).
W. S. Duval, L. A. Harwood, and R. P. Fink.
Report EPS 4-EC-82-1, June 1982. Environmental Protection Service, Ottawa, Ontario. 72 p, 12 Fig, 7 Tab, 44 Ref, 1 Append.

Descriptors: *Dispersants, *Oil spills, *Chemical analysis, *Sublethal effects, *Estuarine isopods, Oil slicks, Estuaries, Toxicity, Physiological ecology, Oil, Isopods.

The sublethal effects of physically and chemically (Corexit 9527) dispersed Prudhoe Bay crude oil on the physiology and behavior of the estuarine isopod, Gnorimosphaeroma oregonensis were examined in a minicomputer controlled flow-through system. Test organisms received oil concentrations approximating 0, 3 and 20% of the calculated 48 hr LC50 for periods of 24 and 48 hours for each dispersion type. The effects of exposure concentration, exposure duration and dispersed oil type on both critical and subcritical sublethal parameters were investigated, as well as the rate and extent of recovery responses. In general, exposure to both physically and chemically dispersed oil caused a significant increase in oxygen consumption of treated isopods and a concomitant decrease in carbon assimilation rates and efficiencies. In addition, isopods exposed to oil dispersions accumulated naphthalenes in their tissues, and in some cases showed altered moulting patterns and mating responses. The magnitude and persistence of sublethal effects were usually dependent upon oil concentration and exposure duration. In most cases, exposure to chemically dispersed oil resulted in more pronounced sublethal effects than comparable treatments with physically dispersed oil. These sublethal effects, however, usually persisted < 48 hr beyond the end of the oil exposure. The significance of the sublethal effects and subsequent recovery responses observed in the test populations are discussed.
W85-06971

FIELD SURVEY OF HEAVY METAL UPTAKE BY NATURALLY OCCURRING SALTWATER AND FRESHWATER MARSH PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W85-06976

STREAM WATER QUALITY IN THE COAL REGION OF TENNESSEE,
Northeastern Forest Experiment Station, Berea, KY.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-122713. General Technical Report NE-77, 1982. 125 p, 40 Fig, 72 Tab, 8 Ref.

Descriptors: *Water quality, *Water pollution effects, *Baseline studies, *Hydrologic data collections, *On-site data collections, *Coal mining, *Small watersheds, *Ecological effects, Data collections, Trace elements, Discharge frequency, Suspended solids, Alkalinity, Acidity, Hydrogen ion concentration, Coal mine wastes, Coal mines, Nitrogen, Phosphorus, Turbidity, Specific conductivity.

Water quality data for 69 small streams sampled in 15 counties of Tennessee where coal is surface-mined was compiled to establish a data base for small first-order unmined and surface-mined watersheds throughout Appalachia. Criteria for stream selection in unmined watersheds stated that these watersheds were to be strictly unmined. The newly mined watersheds had to have no mining before January 1972, and the old mined watersheds had to have no mining or reclamation since January 1972. Most of the streams were sampled at approximately monthly intervals from June 1977 through August 1979 for the common ions, alkalinity, acidity, pH, 16 trace elements, 5 nitrogen and phosphorus species, specific conductance, suspended solids, turbidity, settleable matter, water temperature, and estimated discharge. The water quality data collected in this study of small reference watersheds should provide a basis for future studies and should be especially helpful in determining the probable hydrologic consequences of future mining operations.
W85-06980

METHODOLOGY FOR OVERLAND AND IN-STREAM MIGRATION AND RISK ASSESSMENT OF PESTICIDES,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W85-06989

EFFECT OF ACIDIFICATION DAMAGES ON THE ECONOMIC VALUE OF THE ADIRONDACK FISHERY TO NEW YORK ANGLERS,
Clarkson Univ., Potsdam, NY. Dept. of Economics.
J. K. Mullen, and F. C. Menz.
American Journal of Agricultural Economics, Vol. 67, No. 1, p 112-119, February, 1985. 2 Tab, 33 Ref.

Descriptors: *Fisheries, *Acid rain, *Acid precipitation, *Economic factors, *Adirondack Mountains, *New York, Model studies, Water pollution effects, Recreation, Sport fishing, Travel costs.

A travel cost model is used to estimate losses in the net economic value of the Adirondack recreational fishery resulting from damages caused by acidic deposition. The model used cross sectional data to estimate angling demand and economic value of the fishery. Acidification damages were assumed to cause the loss of certain ponded water angling sites, leading to changes in site use and reducing the fishery's value to anglers. While this approach has important limitations, the results represent an initial attempt to quantify one type of cost associated with acidic deposition. The relationship between angling demand and habitat availability was determined with data from a 1976 survey of licensed New York resident anglers. Annual losses to the anglers are estimated to be approximately $1 million per year in 1976 dollars. (Baker-IVI)

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W85-07034

VARIATIONS IN MELOSIRA ISLANDICA VALVE MORPHOLOGY IN LAKE ONTARIO SEDIMENTS RELATED TO EUTROPHICATION AND SILICA DEPLETION,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W85-07072

NOTE ON ANTIBIOTIC RESISTANCE IN THE BACTERIAL FLORA OF RAW SEWAGE AND SEWAGE-POLLUTED RIVER TIGRIS IN MOSUL, IRAQ,
Mosul Univ. (Iraq). Dept. of Biology.
M. M. Al-Jebouri.
Journal of Applied Bacteriology, Vol. 58, No. 4, p 401-405, April, 1985. 3 Tab, 26 Ref.

Descriptors: *Antibiotic resistance, *Bacteria, *Wastewater pollution, *River Tigris, *Iraq, *Mosul, Coliforms, Escherichia, Pseudomonas, Staphylococcus, Serratia, Micrococcus, Klebsiella, Streptococcus, Bacillus.

Polluted water samples collected from the River Tigris in the vicinity of a raw sewage outfall were examined for the incidence of antibiotic resistance among coliform bacteria on three occasions during 1983. Eighty percent or more of the coliform bacteria were resistant to one or more antibiotics. At the same time, raw sewage samples were examined for the incidence of antibiotic-resistant bacteria, and Escherichia coli, Pseudomonas spp. and Staphylococcus spp. were selected for sensitivity testing. Collectively, more than 90% of the 480 strains of the three organisms were resistant to one or more antibiotics. The minimal inhibitory concentration (MIC) of ampicillin for twenty-nine strains including coliforms, E. coli, Klebsiella sp., Serratia sp., Pseudomonas aeruginosa, Pseudomonas sp., Micrococcus sp., Staphylococcus aureus, Streptococcus faecalis and Bacillus sp. from raw sewage and polluted River Tigris water was determined and that for P. aeruginosa was 250 micro-g/ml. The high incidence of antibiotic-resistant bacteria in natural waters could be related to the widespread use of antibiotics in this locality. (Author's abstract)
W85-07087

HEAVY METALS IN FUCUS VESICULOSUS IN THE HUMBER ESTUARY,
Anglian Water Authority, Lincoln (England). Lincoln Div.
B. E. Barnett, and C. R. Ashcroft.
Environmental Pollution (Series B), Vol. 9, No. 3, p 193-213, 1985. 6 Fig, 6 Tab, 41 Ref.

Descriptors: *Humber Estuary, *England, *Heavy metals, *Fucus, Algae, Cadmium, Chromium, Copper, Iron, Manganese, Nickel, Lead, Zinc, Estuaries, Suspended sediments, Particulate matter, Path of pollutants.

Samples of brown seaweed Fucus vesiculosus from the south bank of the Humber Estuary (England) have been analyzed for Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn. Distribution of Cd, Cu, Ni and Zn along the estuary are represented graphically. Cd and Ni are conservative, but the plots for Cu and Zn suggest inputs of these metals in the lower estuary. Elevated Fe levels are considered to result from contamination by suspended sediment, but concentrations at one site in the lower estuary are indicative of an input of soluble iron. All Pb and Cr results can be accounted for entirely by particulate contamination. Data from the Humber is compared with figures available in the literature. Concentrations of Cd, Cu and Zn are much greater than 'background' levels and compare with contaminated conditions elsewhere, while Ni concentrations include the highest values reported for any location. It is concluded that Fucus vesiculosus in the Humber exhibits substantially elevated levels of heavy metals. (Author's abstract)
W85-07105

MEASUREMENT OF THE EFFECT OF AROCLOR 1254 ON THE RESPIRATION OF GAMMARUS USING POTENTIOMETRIC RESPIROMETRY,
New York Univ. Medical Center, NY. Inst. of Environmental Medicine.
J. M. O'Connor, J. H. Samuelian, K. J. Salamon, and J. C. Pizza.
Water Research, Vol. 19, No. 5, p 639-643, 1985. 1 Tab, 22 Ref. National Inst. of Environmental Health Sciences grant ES0026.

Descriptors: *Polychlorinated biphenyls, *Toxicity, *Amphipods, *Respirometry, *Potentiometry, Aquatic animals, Gammarus, Crustaceans, Aroclor 1254, Respiration.

Exposure of aquatic organisms to contaminants at sublethal concentrations should result in a rapid response directed either toward compensation for the stress imposed, or toward repair of the damage caused by the contaminant. Such responses require an expenditure of energy, which would be reflected in a change in oxygen consumption. The effect of exposure to the polychlorinated biphenyl (PCB) Aroclor 1254 on the respiration rate of single Gammarus was determined using potentiometric respirometry. Respiration rate decreased in all samples after PCB exposure, with a mean reduction of 0.0364 micro-mol oxygen/hr. Similar statistical conclusions are obtained when metabolic rates are compared. The simplicity of the potentiometric method relative to manometric studies justifies selection of the potentiometric technique over differential manometric methods. Since individual organisms could be tested, even subtle changes in respiration associated with a contaminant-related stress were detectable without the complication of population variance. (Baker-IVI)
W85-07122

EFFECTS OF SUBACUTE CADMIUM EXPOSURE ON A HARDWATER MOUNTAIN STREAM MICROCOSM,
Utah Water Research Lab., Logan.
D. A. Selby, J. M. Ihnat, and J. J. Messer.
Water Research, Vol. 19, No. 5, p 645-655, 1985. 3 Fig, 7 Tab, 22 Ref.

Descriptors: *Cadmium, *Water pollution effects, *Microcosms, *Streams, Toxicity, Invertebrates, Periphyton, Bioaccumulation, Water pollution effects, Food chain, Aquatic plants.

Open stream microcosms in the RIFFLE (Research Installation for Fate and Effects in Lotic Environments) facility were exposed to 22 micro-g/l cadmium for 21 days. This exposure resulted in accumulation of less than 0.3% of the metal passing through the system. Most of the cadmium accumulated in the Aufwuchs communities growing on cobble in the riffles or on macrophytes in the pools probably in response to photosynthetically induced CdCO3 precipitation. The cadmium appears to have been transferred, in part, up the food chain through grazers and collectors, apparently by ingestion of CdCO3-frosted periphyton and detritus, but adsorption to external surfaces also appears to be significant, and differential absorption through gill surfaces of the various species cannot be ruled out. Predators showed little tendency to concentrate cadmium. Community structure studies were somewhat surprising in light of the cadmium accumulation data. Collector-gatherers exhibited significantly greater increases in the pools in the microcosms treated with cadmium relative to the controls, and predators increased significantly in the riffles of treated systems. There was no apparent effect on periphyton community structure or on grazers, despite the relatively high Cd accumulation in these trophic groups. This experiment demonstrates both strengths and weaknesses of the open microcosm approach. (Baker-IVI)
W85-07123

EFFECT OF FECAL POLLUTION ON VIBRIO PARAHAEMOLYTICUS DENSITIES IN AN ESTUARINE ENVIRONMENT,
Rhode Island Univ., Kingston. Dept. of Microbiology.
W. D. Watkins, and V. J. Cabelli.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1307-1313, May, 1985. 7 Fig, 3 Tab, 29 Ref.

Descriptors: *Water pollution effects, *Narragansett Bay, *Rhode island, *Vibrio, *Zooplankton, *Bacteria, Estuaries, Public health, Bays, Human pathogens, Wastewater pollution, Particulate matter.

Field and laboratory studies were conducted to determine whether Vibrio parahaemolyticus responds to nutrient loading, specifically that from municipal sewage treatment plant effluents. Results of field studies categorically show an association of V. parahaemolyticus densities with fecal pollution in the Narragansett Bay estuary and suggest an association with the particulate matter in the water. The greater correlation of V. parahaemolyticus densities with net zooplankton rather than with phytoplankton levels in the bay is consistent with the findings of other investigators and suggests a more direct role of the zooplankters. In laboratory studies, growth of V. parahaemolyticus was noted only when zooplankters or chitin was added. Neither the decay nor the increase in V. parahaemolyticus densities in the lab investigations was affected by the addition of sewage. The effect of sewage on V. parahaemolyticus densities in Narraganset Bay is an indirect one, commencing with nutrient loading, probably mediated through the food chain and manifested at the zooplankton level. The higher densities of V. parahaemolyticus found in the near surface waters throughout the upper bay suggests a relationship to light. Nutrients in wastewater effluents resulting in biostimulation of phytoplankton may indirectly increase the zooplankton levels and, hence, V. parahaemolyticus densities. (Baker-IVI)
W85-07132

EFFECTS OF ENVIRONMENTAL FACTORS ON TOXICITY OF A CYANOBACTERIUM (MICROCYSTIS AERUGINOSA) UNDER CULTURE CONDITIONS,
Tokyo Metropolitan Research Lab. of Public Health (Japan).
M. F. Watanabe, and S. Oishi.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1342-1344, May, 1985. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Light intensity, *Temperature effects, *Nutrients, *Cyanophyta, Microcystis, Toxicity, Bacteria, Phosphorus, Toxins.

Blooms of the toxic blue-green algae Microcystis aeruginosa are commonly observed in highly eutrophic lakes. Effects of light intensity, temperature, and nutrients on the toxicity of M. aeruginosa were investigated, using a toxic strain which kills mice. Throughout the study a marked change in toxicity was observed in the light intensity experiments. Production of the toxin was suppressed under low light intensity. Similar LD50 values were estimated for cells grown under 30.1 and 75.3 micro-E/sq m/s. This means that light intensity is the primary important factor for the production of the toxin, but high toxin production can occur at relatively low light intensity. Only slight changes were noted to be due to temperature changes and phosphorus deficiency. (Baker-IVI)
W85-07134

IMPACT OF NITROGEN AND PHOSPHORUS ON (14C)-LIGNOCELLULOSE DECOMPOSITION BY STREAM WOOD MICROFLORA,
Oregon State Univ., Corvallis. Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W85-07136

TRACE-METALS AND CHLORINATED HYDROCARBONS IN BIRDS' EGGS FROM THE DELTA OF THE DANUBE,
Dipartimento di Biologia Ambientale, Univ. de Siena, Italy.
For primary bibliographic entry see Field 5B.
W85-07146

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ACCUMULATION OF LEAD IN FISH FROM MISSOURI STREAMS IMPACTED BY LEAD MINING,
Missouri Dept. of Conservation, Columbia.
J. M. Czarnezki.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 736-745, May, 1985. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Lead, *Water pollution effects, *Mine wastes, *Missouri, *Big River, Streams, Rivers, Mining operations, Fish, Public health, Heavy metals, Suckers, Bass, Sunfish.

The possibility of elevated levels of lead ocurring in the edible tissue of fish inhabiting Missouri streams affected by lead mining was investigated. Fish collected from Big River, located in the Old lead Belt, contained the highest concentrations of lead found in fish during this study. Concentrations of lead in 83% of the black redhorse, 96% of the golden redhorse, and 74% of the northern hog suckers collected from sites 3 to 8 (3 miles to 75 miles below a ruptured dam) exceeded the WHO limits of 0.3 ppm for safe consumption. Lead levels in longear sunfish followed a similar pattern to the suckers, but were in general lower overall. Smallmouth bass contained lower concentrations of lead than both suckers and longear sunfish. There was no apparent relationship between lead concentration in smallmouth bass and distance downstream from the mining area. Current mining operations in the New Lead Belt are adversely affecting Missouri streams, but not to the extent that streams are being degraded in the abandoned mining areas in the Old Lead Belt. Big River sediments contain high concentrations of lead, (1,400-2,200 ppm) as does the organic detritus (800-7,000 ppm). Bottom feeding fish like the sucker are continually ingesting lead contaminated sediment and detritus while feeding in Big River. Based on these findings it was recommended that suckers caught in the 40-mile section of Big River downstream from the ruptured Desloge tailings pond dam not be consumed. (Baker-IVI)
W85-07151

SWIMMING PERFORMANCE OF CHANNEL CATFISH (ICTALURUS PUNCTATUS) AFTER NITRITE EXPOSURE,
North Texas State Univ., Denton. Dept. of Biological Sciences.
D. E. Watenpaugh, and T. L. Beitlinger.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 754-760, May, 1985. 1 Fig, 1 Tab, 25 Ref.

Descriptors: *Water pollution effects, *Nitrites, *Catfish, *Fish behavior, Toxicity, Swimming, Fish, Behavior modification, Methemoglobin.

The effects of nitrite exposure on the prolonged swimming performance of channel catfish was investigated and the extent that methemoglobinemia resulting from nitrite exposure correlates with performance was also considered. A reduction in prolonged swimming performance was noted in channel catfish exposure to nitrite. This was probably due in part to methemoglobin formation. Methemoglobin in blood reduces delivery of oxygen to tissues by making hemoglobin unavailable for oxygen transport and by shifting the oxygen dissociation curve to the left. Such a shift increases the affinity of hemoglobin for oxygen, thereby making it less able to unload oxygen to the tissues. Channel catfish with larger percentages of their hemoglobin oxidized to methemoglobin by nitrite must rely more heavily on anaerobic glycolysis than aerobic metabolism to fuel locomotor activity. Reduced aerobic metabolism of channel catfish with methemoglobinemia should limit prolonged swimming performance. (Baker-IVI)
W85-07153

LONG-TERM EFFECTS OF 1,2,4-TRICHLOROBENZENE ON FRESHWATER PLANKTON IN AN OUTDOOR-MODEL-ECOSYSTEM,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
J. P. Lay, W. Schauerte, A. Muller, and F. Korte.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 761-769, May, 1985. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Water pollution effects, *Trichlorobenzene, *Plankton, Industrial wastes, Organic compounds, Benzenes, Chlorinated hydrocarbons,.

The effects of 1,2,4-trichlorobenzene (TCB) on a natural freshwater plankton community were measured in a natural pond, rich in Daphnia and phytoplankton species. The pond was divided into discrete compartments by the use of 50 cm diameter tubes, pressed into the sediment. The chemical was highly toxic to the daphnids population present causing a significant reduction. The mean number of daphnids counted in the treated tubes during the post-application period was 10% of the controls. A regeneration phase seemed to begin on day 21, when the TCB-concentration in the water was 50-100 micro-g per liter. The low oxygen concentration did not affect the population dynamics. As to the physico-chemical behavior of the test chemicals, a lower water solubility and a marked reduced volatility from water phase was noted in the field experiments compared with laboratory testing. There was always a significantly higher sensitivity of the daphnids to the pollutants as compared with the EC-50 laboratory values. The effective toxic concentrations were lower to a factor of a hundred as compared with literature. These findings should be considered in the context of predicting the hazards of chemicals from screening tests to the real environment. (Baker-IVI)
W85-07154

AVOIDANCE OF SUSPENDED SEDIMENTS BY SMELT AS DETERMINED BY A NEW 'SINGLE FISH' BEHAVIORAL BIOASSAY,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Fisheries Research Branch.
D. J. Wildish, and J. Power.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 770-774, May, 1985. 3 Tab, 4 Ref.

Descriptors: *Water pollution effects, *Smelt, *Fish behavior, *Suspended solids, *Bioassay, Dredging, Sedimentation, Bottom sediments, Fish, Estuarine environment.

The possibility that smelt are capable of avoiding suspended sediments and hence may avoid fixed nets in the estuary where high levels of suspended sediment are present as a result of dredging and dumping has been investigated. The experiments did provide indirect evidence that smelt could avoid areas high in suspended solids. Because of the apparatus-specific nature of the results and the multiplicity of environmental and innate behavioral factors operating in field conditions, extrapolation from laboratory results directly to the field is problematical. An apparent threshold of about 20 mg suspended sediment/liter for the smelt avoidance response to occur was determined. This is higher than that found for herring (about 10 mg/l) in differently structured tests. These results indicate the need for field studies of smelt behavior where other behavioral drives such as migration and escape movements may overide the avoidance movements observed in these laboratory tests. (Baker-IVI)
W85-07155

TOXICITY OF ENDRIN AND MALATHION MIXTURES TO FLAGFISH (JORDANELLA FLORIDAE),
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
R. O. Hermanutz, J. G. Eaton, and L. H. Mueller.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 307-314, May, 1985. 1 Fig, 7 Tab, 12 Ref.

Descriptors: *Endrin, *Malathion, *Toxicity, *Flagfish, Fish, Pesticide toxicity, Mortality, Interactions, Reproduction, Organophosphate pesticides, Chlorinated hydrocarbons.

Individual endrin and malathion concentrations and mixtures of the concentrations were tested concurrently with flagfish in both chronic and acute exposures. The joint action of mixtures on mortality in chronic exposures consisted of enhanced effects at the higher concentrations not causing death when the pesticides were tested individually. Chronic effects of mixtures on growth followed a simple additive effects model. Malathion did not alter the endrin effects on egg production, and in a separate test it did not affect the uptake or elimination of endrin. Joint action on mortality in acute exposures occurred at 48 and 72 hr but not at 10 and 24 hr. (Author's abstract)
W85-07156

SHORT-TERM INTERACTIONS BETWEEN DDT AND ENDRIN ACCUMULATION AND ELIMINATION IN MOSQUITOFISH (GAMBUSIA AFFINIS),
Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
M. S. Denison, J. E. Chambers, and J. D. Yarbrough.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 315-320, May, 1985. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *DDT, *Endrin, *Mosquitofish, *Interactions, *Bioaccumulation, Toxicity, Pesticide toxicity, Insecticides, DDE, Aldrin, Dieldrin.

Experiments were conducted to determine whether interactions in disposition between two insecticides might occur within the first few hours of exposure. Levels of both (C-14)endrin and (H-3)DDT were monitored in serum, gall bladders, and whole bodies during pre- and post-exposures to each compound or analogs, as well as during concurrent exposures in mosquitofish (Gambusia affinis). Prior exposure to DDT for four hr generally reduce endrin accumulation in serum, gall bladders and whole bodies, whereas prior exposure to endrin exerted little effect on DDT accumulation. Simultaneous exposure to DDT and endrin reduced DDT accumulation in the gall bladder at all times and in the whole body during the first two hr; endrin accumulation was generally reduced in the gall bladder and whole body. Endrin levels in fish exposed subsequently to only DDT or DDE were significantly higher in the gall bladder at all times after 0.5 hr and were reduced in the whole body at all times tested, compared to fish exposed subsequently only to uncontaminated water. While endrin post-treatment had no effect on DDT levels in the gall bladder, aldrin and dieldrin exposure resulted in significantly higher gall bladder levels of DDT compared to fish exposed subsequently only to uncontaminated water. The insecticide interactions observed may be the result of competition for and/or displacement of insecticides from mutual binding sites. (Author's abstract)
W85-07157

EFFECTS OF DIESEL OIL AND OIL DISPERSANTS ON GROWTH, PHOTOSYNTHESIS, AND RESPIRATION OF CHLORELLA SALINA,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
K.-Y. Chan, and S. Y. Chiu.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 325-331, May, 1985. 4 Tab, 37 Ref.

Descriptors: *Oil pollution, *Dispersants, *Water pollution effects, *Chlorella, *Photosynthesis, *Algal growth, Biomass, Chlorophyll a, Estuarine environment, Algal respiration, Phytotoxicity, Oil spills.

Low concentrations of BP light diesel (0.05%) and the oil dispersant BP1100X (0.005%), either alone or in mixture, stimulated the growth rate, biomass yield, chlorophyll a level and photosynthesis of the estuarine green alga Chlorella salina CU-1, while the same concentrations slightly inhibited algal respiration. The increase in the level of chlorophyll a may be one of the factors leading to elevated photosynthesis. BP light diesel and BP1100X at higher concentrations, as well as the oil dispersants BP1100WD and Shell Oil Herder at all the tested concentrations, reduced growth, chlorophyll a

level, photosynthesis, and respiration of the algal cells. The inhibitory action of BP light diesel and the oil dispersants was concentration-dependent. Although both algal photosynthesis and respiration were reduced by BP light diesel and the oil dispersants, the effect on respiration was less severe when compared with that on photosynthesis. Shell Oil Herder, either alone or in combination with BP light diesel, were most toxic among the three oil dispersants tested. In general, mixtures of BP light diesel and any one of three oil dispersants were more toxic than the diesel oil or the oil dispersants alone. However, the stimulatory effect exerted by the mixture of 0.05% BP light diesel and 0.005% BP1100X was greater than those by the same concentrations of BP light diesel and BP1100X alone. (Author's abstract)
W85-07158

EFFECTS OF HEAVY METAL CONTAMINATION OF THE AQUATIC BIOTA OF BUTTLE LAKE AND THE CAMPBELL RIVER DRAINAGE (CANADA),
Victoria Univ. (British Columbia). Dept. of Biochemistry and Microbiology.
M. Roch, R. N. Nordin, A. Austin, C. J. P. McKean, and J. Deniseger.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 347-362, May, 1985. 7 Fig, 5 Tab, 51 Ref.

Descriptors: *Heavy metals, *Aquatic life, *Water pollution effects, *Buttle Lake, *Campbell River, *British Columbia, Zinc, Copper, Species diversity, Phytoplankton, Periphyton, Crustaceans, Zooplankton, Trout, Toxicity, Mining.

Concentrations of zinc and copper in a series of large oligotrophic lakes on Vancouver Island, Canada, have been increasing since mining operations began near the south end of Buttle lake in 1966. Declines in species diversity of both phytoplankton and periphyton have occurred since the beginning of mining activity with the disappearance of metal sensitive forms such as Asterionella and Rhizosolenia. Cladoceran and calanoid copepod numbers and species diversity increase as the metal concentrations decline downstream from the mine. Bioassays carried out with Daphnia pulex show increasing toxicity downstream. Metal concentrations in zooplankton and metallothionein concentrations in rainbow trout liver are correlated to metal concentrations in the water. The water was not acutely toxic to rainbow trout in laboratory simulations of Buttle Lake conditions or during in situ exposures (1 month). Specific sublethal deleterious effects have not been determined. (Author's abstract)
W85-07160

NATIONAL CONTAMINANT BIOMONITORING PROGRAM: CONCENTRATIONS OF SEVEN ELEMENTS IN FRESHWATER FISH, 1978-1981,
Fish and Wildlife Service, Columbia, MO.
For primary bibliographic entry see Field 5B.
W85-07161

5D. Waste Treatment Processes

USE OF OZONATION IN TREATMENT OF SEWAGE,
Ecole Nationale Superieure de Chimie de Rennes (France). Lab. de Chimie des Nuisances et Genie de l'Environnement.
M. Elmghari-Tabib, H. Benmoussa, A. Laplanche, G. Martin, and B. Langlais.
Ozone: Science and Engineering, Vol. 6, No. 3, p 197-206, 1984. 9 Fig, 8 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Chemical reactions, Ozone, Activated sludge proces, Sludge, Oxygen consumption, Flocculation.

Injection of ozone released during disinfection, or from any other source in activated sludge tanks, at the rate of about 0.2 to 1 mg O3/g SS/hr, considerably improves the settling properties of the sludge, thereby confirming the flocculating effect of ozone. At the present time, it is not possible to conclude about the effect of residual ozone injection on the purification efficiency. Such a process could be considered to remove the need to release or destroy residual ozone resulting from disinfection of sewage. These investigations tie in with current research into forms of ozone action on microorganims. (Baker-IVI)
W85-06213

BIOLOGICAL TREATABILITY OF M-AMINOPHENOL PLANT WASTEWATER CONTAINING STRUCTURAL ISOMERS OF BENZENE WITH DIFFERENT SUBSTITUENTS,
National Environmental Engineering Research Inst., Nagpur (India).
S. D. Deshpande, T. Chakrabarti, P. V. R. Subrahmanyam, and B. B. Sundaresan.
Water Research, Vol. 19, No. 3, p 293-298, 1985. 3 Fig, 5 Tab, 15 Ref.

Descriptors: *Aminophenol, *Wastewater treatment, *Industrial wastewater, Resorcinol, Nitrobenzene sulfonate, Metanilic acid, Activated sludge process, Biodegradation.

Bench scale studies on treatability of combined wastewater from an m-aminophenol (m-AP) manufacturing plant using acclimated activated sludge and an organic loading of 0.12 kg BOD/kg MLVSS/day resulted in removal of around 96% BOD and 59% TOC. Analysis of raw and treated wastewaters by HPLC revealed that resorcinol and m-AP present in the wastewater were completely removed, while m-nitrobenzene sulfonate (m-NBS) removal was only partial. However, in a batch system, preferential utilization of m-NBS was observed when a mixture of m-NBS and resorcinol was fed to m-NBS acclimated activated sludge. Electrolytic respirometric studies showed that oxygen uptake rate of m-NBS acclimated activated sludge with m-NBS as the substrate was not affected in the presence of resorcinol. Also m-AP and metanilic acid (m-AA) had no effect on either resorcinol or m-NBS removal by respective acclimated activated sludges. The incomplete removal of m-NBS from combined wastewater may probably be attributed to the metabolic interaction between m-NBS and an unidentified compound which appeared in the HPLC chromatograms of the raw and treated wastewaters. (Author's abstract)
W85-06220

ASPECTS OF THE DETERMINATION OF COMPLEXATION PARAMETERS FOR METAL-PARTICULATE COMPLEXES IN ACTIVATED SLUDGE,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
R. M. Sterritt, and J. N. Lester.
Water Research, Vol. 19, No. 3, p 315-321, 1985. 6 Fig, 2 Tab, 34 Ref.

Descriptors: *Activated sludge, *Complexation, *Copper, *Lead, *Particulates, Metals, Conditional stability, Ion selective electrodes.

The conditional stability constants and complexation capacities for complexation of copper and lead by activated sludge solids have been determined by titration. The methods used were direct determination of free metal ion using ion selective electrodes and separation of the solids by membrane filtration prior to determination of the free metal in the filtrate. The complexation parameters thus obtained were compared and the importance of several factors, including residual metal concentrations in the sample prior to titration, interferences and the disturbances of complex equilibria during sample manipulation were examined and their potential effects on the calculated values of the complexation parameters were considered. (Author's abstract)
W85-06223

MATHEMATICAL ANALYSIS OF OXYGEN AND NITRATE CONSUMPTION IN DEEP MICROBIAL FILMS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W85-06227

ENVIRONMENTAL INTERVENTION ANALYSIS: WISCONSIN'S BAN ON PHOSPHATE DETERGENTS,
Technical Univ. of Denmark, Lyngby. Inst. of Mathematical Statistics and Operations Research.
L. Pallesen, P. M. Berthouex, and K. Booman.
Water Research, Vol. 19, No. 3, p 353-362, 1985. 6 Fig, 1 Tab, 12 Ref, 3 Append.

Descriptors: *Intervention analysis, *Detergents, *Phosphates, *Wisconsin, Wastewater treatment, Waste load, Time series.

Intervention analysis is a method of assessing the effect of a deliberate change to a system when the data record is a time series. A statistical analysis that assumes fixed mean levels before and after the intervention often is inappropriate for environmental time series, because typically environmental systems display some random drift in level over time, unrelated to the intervention itself. A reliable estimate of the effect of the intervention must take into account such drift. The method presented does this by using suitably weighted averages of observations before and after the intervention; also it can allow for a gap in time over which the intervention gradually realizes its full effect. The method has been used to estimate the decrease in total phosphorus load on the two large wastewater treatment plants in Milwaukee, WI, caused by the ban on phosphate laundry detergents that went into force on July 1, 1979. The estimated effect was equivalent to 0.506 kg P per capita per year. The result of this ban being lifted in 1982 was also estimated; the increase in total P loading was equivalent to 0.187 kg P per capita per year. (Author's abstract)
W85-06228

OXYGEN UPTAKE RATES FOR DETERMINING MICROBIAL ACTIVITY AND APPLICATION,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang, M. D. Cheng, and J. T. Mueller.
Water Research, Vol. 19, No. 3, p 373-381, 1985. 9 Fig, 4 Tab, 17 Ref. EPA grant R808201.

Descriptors: *Activated sludge process, *Oxygen uptake, *Microorganisms, Wastewater treatment, Solids retention time, Viability, Respiratory activity.

The method presented involves using the oxygen uptake rates of activated sludges for determining the microbial activity and viability. The microbial activity correlates well with substrate reduction first order rate constant, K1, determined in batch operations, and with the specific substrate utilization rate, q, of steady state operations. The microbial viability determined based on respiratory activity would result in slightly higher values than other means such as plate counting, since some of the respiratory activity is contributed by nonviable yet active cells. The extent of respiratory activity attributed to the nonviable cells increases as the biological solids retention time increases (or net growth rate decreases). Since the loss of ability of multiplication is not necessarily associated with loss of biochemical activity, the viability determined by the respiratory activity would represent more realistically the activity of microbes and thus is suggested as the preferred technique. (Author's abstract)
W85-06230

INDUSTRIAL WASTEWATER ANALYSIS BY LIQUID CHROMATOGRAPHY WITH PRECOLUMN TECHNOLOGY AND DIODE-ARRAY DETECTION,
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W85-06257

BIOLOGICAL-CHEMICAL METHOD FOR EXAMINATION OF THE INHIBITION OF DECOMPOSITION AND ELIMINATION OF WASTEWATER ORGANIC MATTER (BIOLOGISCH-CHEMISCHES VERFAHREN ZUR PRUFUNG DES ABBAU- UND ELIMINIERUNGSVERHALTENS ORGANISCHER ABWASSERINHALTSSTOFFE),
Forschungszentrum fuer Wassertechnik, Dresden (German D.R.).
V. Peukert.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 319-327, 1983. 3 Fig, 9 Ref.

Descriptors: *Wastewater treatment, *Decomposition, *Activated sludge process, Inhibition, Organic matter, Biomass, Substrate.

After checking for toxic inhibition of degradation, degradation behavior at concentrations below the toxicological threshold value should be tested. For this, activated sludge with 1.5-2 g/l organic dry weight in special reaction vessels with stirring and aeration equipment as well as electrochemical oxygen measurement is used. The adaptation is effected by a repeated change of the aqueous phase with the test substance as the single carbon source. Measurements are carried out in three vessels: control, experimental vessel and another experimental vessel of the makeup of volume at sampling. The increase of biomass and the consumption of substrate are determined from samples. Determination of totals as COD and/or organic carbon is recommended, since the determination of the pure substrate only allows analysis of the persistence, but not the full degradation. The technique, represented with the schematic diagram and examples of application, can be automated easily. (Author's abstract)
W85-06262

POSSIBILITY OF TREATMENT OF WASTEWATER FROM ARTIFICIAL LEATHER PRODUCTION WITH THE HELP OF ALGAE (MOGLICHKEITEN DER NACHREINIGUNG VON ABWASSERN AUS DER KUNSTLEDERPRODUKTION MIT HILFE VON ALGEN),
Vysoke Uceni Technicke, Gottwaldov (Czechoslovakia). Technologicka Fakulta.
J. Chromek, J. Kupec, P. Marvan, and M. Mladek.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 329-338, 1983. 4 Fig, 21 Ref.

Descriptors: *Artificial leather industry, *Biological wastewater treatment, *Algae, Wastewater treatment, Dimethylformamide, Dimethylamine, Decomposition, Aeration, Carbon dioxide, Ammonia, Combined treatment, Municipal wastewater.

In the production of a special artificial leather (BAREX) in Czechoslovakia, wastewaters containing dimethylformamide (DMF) and dimethylamine (DMA) are produced. Investigations have shown that cultures of algae (Scenedesmus quadricauda) are able to use the two substances as a nitrogen nutrient source after a period of adaptation. During the course of decomposition reactions, the pH-value plays an important part, since at increased values ammonia is released, which has a temporarily inhibitory effect on the production of algae masses and daughter cells. This detrimental effect can be considerably reduced by aeration with air containing carbon dioxide (3%). Since the production of algal biomass is restricted by a phosphorus deficiency, a combined treatment with municipal sewage is very advantageous, according to the results from investigations. (Author's abstract)
W85-06263

PLANNING EFFECTIVE INDUSTRIAL LIQUID WASTE CONTROLS IN DEVELOPING NATIONS,
Democritus Nuclear Research Center, Athens (Greece).
For primary bibliographic entry see Field 6A.
W85-06287

ULTRASOUND CATALYZED OZONE PRETREATMENT TO REDUCE ORGANIC FOULING OF REVERSE OSMOSIS MEMBRANES,
Arizona Univ., Tucson. Dept. of Civil Engineering.
R. A. Sierka.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-161453/AS, Price codes: A07 in paper copy, A01 in microfiche. Project Completion Report OWRT/RU-82/3, Sept 1982. 125 p, 34 Fig, 43 Tab, 52 Ref, Project No. OWRT C-00067-R (1), Contract/Grant No. 14-34-0001-0456.

Descriptors: *Pretreatment of water, *Reverse osmosis, *Ozone, *Membrane fouling, Humic acids, Ultrasonics, Arizona.

An evaluation was made of an ozone-ultrasound pretreatment process to reduce fouling tendencies of reverse osmosis membranes by organics (humic, fulvic acid), organics interacting with inorganic colloids (silicon dioxide) and biological matter (secondary treated and clarified domestic wastewater). The untreated and treated samples were characterized by various physical and chemical parameters such as pH, temperature, turbidity, and total organic carbon, while the reduction in fouling potential was evaluated with the use of a newly developed mini-plugging factor test.
W85-06299

FEASIBILITY OF USING FOREST VEGETATION TO RENOVATE SEPTIC TANK EFFLUENT IN THE NEW JERSEY PINE BARRENS,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
J. G. Ehrenfeld.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157634/AS, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, May 1984. 83 p, 10 Fig, 39 Tab, 22 Ref, Project No. OWRT B-082-NJ (1), Contract/Grant No. 14-34-0001-1245.

Descriptors: *Nutrient removal, *Nitrogen, *Phosphorus, *Plant growth, Water pollution prevention, Transpiration, Septic tanks, Pervious soils, Root distribution, Groundwater pollution, *New Jersey Pine Barrens, Pine forest.

A study was undertaken of nutrient and water use by upland woody plants of the New Jersey Pine Barrens in order to determine if these plants can prevent groundwater contamination by septic tank leachate. Matched sets of plots of oak-pine and pine-scrub oak forest were situated over septic tank leach fields and in undisturbed forest. Total above-ground biomass (50-60 Mt) was most strongly affected by the disturbance history of the stand; stand biomass in turn was the most important factor determining nutrient uptake in net primary production (44-73 kg N/ha/yr, and 3-10 kg P/ha/yr), and nutrient storage in perennial woody tissues (50-93 kg N/ha and 5-10 kg P/ha). Although some species showed increased tissue nutrient concentrations on septic tank plots, there was insufficient increase in uptake over the control plots to account for the nutrient input in leachate. Similarly, xylem water potential and leaf diffusion in the six major tree and shrub species showed only sporadic evidence of increased water use on septic tank plots. Studies of root distribution and soil moisture with depth also suggested that septic tank leachate in not available to the 83% of the roots located in the top 30 cm of soil. The results do not support the use of vegetation to renovate septic tank leachate in these soils, and it is suggested that nutrient uptake be removed from groundwater quality models used in regulating housing development in the region.
W85-06310

ADSORPTION OF ANIONIC AND CATIONIC METALS BY NON-IONIC POLYMERIC RESINS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
A. J. Rubin, and W. F. Wargo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157659/AS, Price codes: A05 in paper copy, A01 in microfiche. Ohio Water Resources Center, Columbus, August 1984. 78 p, 14 Fig, 5 Tab, 65 Ref, Append, Project No. OWRT B-076-OHIO (1), Contract/Grant No. 14-34-0001-9090.

Descriptors: *Anion adsorption, *Cation adsorption, Cadmium, Chromium, Zinc, Polymeric resins, Wastewater treatment, Tertiary treatment, Metals, Adsorption.

Experiments were conducted to determine the effect of pH on the adsorption of cadmium and zinc cations and anionic chromate ion on six synthetic polymer resin absorbents. In general, the removal of Zn(II) and Cd(II) increased with increasing pH while the adsorption of chromate ion increased with decreasing pH. Of the six resins examined, Amberlite XAD-7 was the most effective for cations while Ambersorb XE-348 was the most effective for the metal anion. The adsorption of chromate was significantly more sensitive to the adsorbate concentration than the adsorbent dose. Adsorption maxima shifted to a lower pH as the resin dose was decreased. Chromate adsorption was best described by an equation in the form of the BET isotherm. Both the Langmuir and Freundlich equations were successful in fitting the cation adsorption data. Comparison of the Langmuir parameters obtained for the adsorption of Zn(II) and Cd(II) by Amberlite XAD-7 with those of other adsorption systems suggests that the non-ionic polymeric resins are relatively ineffective adsorbents for simple unhydrolyzed cations. Further study is required with chromate ion although the results suggest that its adsorption by carbonaceous resins may be economically feasible.
W85-06312

REVIEW OF THE MUNICIPAL POLLUTION ABATEMENT PROGRAMS IN THE GREAT LAKES BASIN.
International Joint Commission-United States and Canada, Windsor (Ontario). Municipal Abatement Programs Task Force.
For primary bibliographic entry see Field 5B.
W85-06330

EVALUATION OF WASTES FROM THE EAST ST. LOUIS WATER TREATMENT PLANT AND THEIR IMPACT ON THE MISSISSIPPI RIVER,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5C.
W85-06343

SULPHURIC ACID AND OLEUM, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
Envirotips manuals, February 1984. 132 p, 30 Fig, 11 Tab, 192 Ref.

Descriptors: *Water pollution control, *Sulfuric Acid, *Aquatic Life, Environmental quality, Pollutants, Oleum, Spills, Chemical spills, Cleanup, Sludge, Contaminants, Food chains, Acidity, Bioaccumulation.

Technical and environmental information concerning handling and preventing problems spills from sulphuric acid and oleum are presented. Sulfuric acid is a colorless, odorless oily liquid. Its synonyms include: battery acid, fertilizer acid, oil of vitriol, hydrogen sulfate, sulfuric acid spent, and acide sulphurique. It is neither flammable nor combustible. Hydrogen gas may be formed on contact with metal. It is harmful to aquatic life in some species, in concentrations as low as 6 mg/l primarily due to its acidity. There is no potential for bioaccumulation or food chain concentration. For spill control, access to the spill site needs to be restricted. A warning of corrosive should be issued and authorities and the manufacturer need to be notified. It is important to keep the contaminated water from entering sewers or watercourses. For emergency control procedures in water, contain with spill with weirs, damming with gravel, earth, or by diversion. Then, the sulfur can be neutralized and the sludge removed. Oleum is colorless, oily liquid with a choking odor. Its synonyms are fuming sulfuric acid, disulfuric acid, dithionic acid,

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and pyrosulfuric acid. It is neither flammable nor combustible. Hydrogen gas formed by reaction of the acid with metal may accumulate inside tanks regardless of strength. Oleum is very reactive with many substances and reacts violently on contact with water. It is harmful to aquatic life in some species, in concentrations as low as 6 mg/l, primarily due to its acidity. There is no potential for bioaccumulation or food chain concentration. A spill requires a corrosive warning and countermeasures are the same as for sulfuric acid.
W85-06355

SULPHUR, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
Envirotips manuals, March 1984. 69 p, 9 Fig, 5 Tab, 163 Ref.

Descriptors: *Water pollution control, *Sulfur, *Aquatic Life, Environmental quality, Pollutants, Problem spills cleanup, Hazardous materials, Toxicity, Contaminants, Dredging.

Technical and environmental information for the management of problem spills of sulfur are presented. Sulfur as a solid is yellow powder, slates, granules, lumps, or prills. As molten, it is yellow to orange-red/brown liquid (temperature dependent). Its synonyms include Bensulfoid, Colloidal-S, Colsul, Crystex, Brimstone, Flowers of Sulfur, and Sulphur. Sulfur is combustible. It produces toxic sulphur dioxide gas during combustion. The dusty may explode if there is an ignition source. It may react violently in contact with oxidizing agents or powdered metals. Fire hazard is increased if hydrogen sulfide is present. Sulfur may be harmful to aquatic life in high concentrations as a suspended solid. Elemental sulfur may pose a serious hazard in high concentrations especially in colloidal form. Covering of the bottoms of water bodies may also cause problems. Molten sulfur will solidify, sink to the bottom and similarly pose a threat to bottom life. There is no potential for accumulation or food chain concentration. Elemental sulfur will undergo slow oxidation in water, generating acidic conditions (probably a mixture of sulfurous and sulfuric acids). Immediate action for spill control includes: issuance of warning 'combustible' and notifying both the fire department and the supplier. Emergency control procedures in water include the containment of discharge by damming or water diversion and the removal of the solidified material and precipitate from the bottom, with suction hoses or mechanical dredges.
W85-06356

BENZENE, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
Envirotips manuals, March 1984. 107 p, 26 Fig, 8 Tab, 210 Ref.

Descriptors: *Water pollution control, *Benzenes, *Aquatic life, Environmental quality, Pollutants, Problem spills cleanup, Hazardous materials, Toxicity, Skimming, Contamination, Bioaccumulation, Sewers, Weirs.

Environmental and technical information for handling and prevention of problem spills of benzene are presented. Benzene is a colorless liquid with a gasoline-like odor. Its synonyms include Benzole, Benzol, Phene, Benzin, Benzine, Benzolene, Bicarburet of Hydrogen, Carbon Oil, Coal Naphtha, Cyclohexatriene, Mineral Naphtha, Motor Benzol, Nitration Benzene, Phenyl Hydride, and Pyrobenzol. Benzene is a flammable liquid. Its vapor forms explosive mixtures with air. Flashback may occur along the vapor trail. Benzene is toxic to aquatic life. It is harmful to some species at concentrations as low as 5 mg/l. Benzene may be bioaccumulative in living organisms, but has no food chain concentration potential. There is a cycling of benzene between the atmosphere and water. For spill control, access to the spill site has to be restricted. Warnings of 'flammable' should be issued. The fire department needs to be called and the manufacturer notified. Sources of ignition have to be eliminated including traffic and equipment. Contact with the liquid spill and its vapors have to be avoided and the contaminated water has to be kept from entering sewers or watercourses. Emergency control procedures in water include containment with booms, weirs or natural barriers. Skimming equipment or suction hoses can be used to remove slick, followed by the application of sorbents. The equipment needs to be explosion-proof.
W85-06357

ULTRAVIOLET DISINFECTION FOR MUNICIPAL WASTEWATER,
Tennessee Eastman Co., Kingsport.
B. F. Severin, and M. T. Suidan.
Chemical Engineering Progress, Vol. 81, No. 4, p 37-44, April, 1985. 8 Fig, 2 Tab, 74 Ref.

Descriptors: *Disinfection, *Drinking water, *Ultraviolet light, Wastewater treatment, Pilot plants, Economic aspects, Maintenance, Effluents.

Recent research efforts in the area of ultraviolet (UV) disinfection for municipal wastewater address fundamental problems such as rapid and complex inactivation kinetics, estimation of light intensity in UV reactors, light absorption and dispersion by the wastewater menstruum, physical and biological protection of the microorganisms, effects of temperature, and effects of mixing on disinfection efficiency. Advances in each of these areas are briefly considered. The future of UV light as a disinfectant for wastewater effluents appears good. Increased knowledge of the design criteria is needed for the full growth capacity of the industry to be realized. Several discouraging notes have also appeared which discuss the unexpected number of shutdowns, leaks, and high maintenance costs incurred in pilot systems for the disinfection of drinking water. (Baker-IVI)
W85-06430

PURIFICATION AND TERTIARY TREATMENT OF AMINE-CONTAINING SEWAGE BY MEANS OF AQUATIC PLANTS (OCHISTKA I DOOCHISTKA AMINOSODERZHASHCHIKH STOCHNYKH VOD C POMOSHCHYU VODNYKH RASTENII),
N. F. Kashina.
Gidrobiologischeski Zhurnal, Vol. 20, No. 3, p 96-100, 1984. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Tertiary treatment, *Amines, *Biological wastewater treatment, *Aquatic plants, Macrophytes, Benzidine, Enzymes, Biomass, Oxidation, Charophyta, Elodea, Aromatic compounds.

Hydrophytes promote a more intensive decrease of xenobiotic concentration than autooxidation. The basic part of eliminated benzidine is subjected to oxidative transformations under effect of enzymatic macrophyte systems. It is found that hydrophyte utilization rate of xenobiotics depends on the plant biomass and abiogenic factors. Half-production tests confirm an expediency of Charophyta and Elodea biofilter application for purification and tertiary treatment of sewage containing aromatic amines. (Author's abstract)
W85-06477

DESIGN OF SMALL TO MEDIUM SIZE COOLING SYSTEMS,
Carter Industrial Products Ltd., Croydon (England).
E. J. Pring.
Chemical Engineer, Vol. 412, p 23-25 and 27, March, 1985. 4 Fig, 2 Tab.

Descriptors: *Cooling towers, *Design criteria, Water reuse, Water supply, Cooling water, Water treatment, Site selection.

Cooling towers nowadays are available in all sorts of shapes, sizes and materials. From a heat transfer point of view they may be either counterflow or crossflow. The design approach is sometimes to choose the minimum size of heat exchanger and select a tower from quotations obtained from various manufacturers. The problems of selection, type and siting are comparatively simple if one takes them logically without external influence and realize the importance of a correct choice. The cooling tower is the end of the chain. It must be able to reject the right amount of heat at the water temperature required to achieve satisfactory process operations. The available site often determines the type of tower. For any given re-cooled temperature from a cooling tower, the selection of the design air wet bulb temperature has a considerable effect on tower size. Factors affecting choice of design air wet blub temperature are considered. Noise, drift loss, plume formation, cooling tower packing, recycled cooling systems, cooling system contamination, water treatment and filtration, maintenance, and comparative costs are also considered. (Baker-IVI)
W85-06556

ENGINEERING-ECONOMIC SIMULATION MODEL FOR REGIONAL WASTEWATER TREATMENT COST FUNCTIONS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
C. M. Macal.
Journal of Environmental Management, Vol. 19, No. 2, p 107-118, September, 1984. 5 Fig, 13 Ref.

Descriptors: *Wastewater treatment, *Costs, *Simulation, Economic aspects, Municipal wastewater, Planning, Water management, Cost analysis, Model studies, Wastewater treatment facilities.

A methodology is described for developing wastewater treatment cost functions that combines concepts from economic theory with engineering relations. The regional cost functions are developed by combining representative cost functions for the individual processes that make up treatment systems at existing plants. The methodology consists of a model of wastewater treatment technology and a cost simulation procedure. A model of the treatment plant operator's decision problem regarding technology modification is an intergral part of the cost simulation procedure. The method was applied to the Dupage River Basin. The costs of two alternative treatment plant location schemes were studied. One was a regionalized plan consisting of a few consolidated plants and the other, a non-regional plan in which all existing treatment plants would continue to operate indefinitely. Treatment plant operations were simulated to the year 2000 for both configurations. Another use of the methodology was to estimate the incremental cost of treating an additional pollutant, total phosphorus, when the technology was already in place for treating BOD5 and suspended solids to levels of 10 mg/l and 12 mg/l, respectively. (Baker-IVI)
W85-06602

EFFECT OF SOIL DEPTH ON WASTEWATER RENOVATION,
City Coll., New York. Dept. of Civil Engineering.
R. M. Khanbilvardi, and D. A. Long.
Journal of Environmental Health, Vol. 47, No. 4, p 184-188, January/February, 1985. 12 Fig, 2 Tab, 10 Ref.

Descriptors: *Wastewater renovation, *Soil depth, *Percolation, *Limestone, Hardness, Soil properties, Chemical oxygen demand, Ammonia, Nitrogen, Nitrates, Acidity, Alkalinity.

A soil column study was conducted to gather information concerning the renovation of percolated wastewater at various depths of limestone soil. The major concern was the effect of such disposal practices on the groundwater quality. In order to determine this effect, information on the variation in the quality of wastewater during percolation through limestone soil columns was obtained from a laboratory study. In the field, the hydraulic and geological properties of the drainage system are important factors in the percolation process and, hence, the results of this lab study only are indications of what might be expected in the field. Deep soil did not affect the pH and alkalinity of the percolated wastewater significantly. The calcium and magnesium hardness increased with increasing limestone soil depth. Reduction of COD in the limestone based soil generally is independent of soil depth. The same conclusions were reached for

the removal of organic nitrogen, nitrite and nitrate nitrogen. The amount of ammonia nitrogen observed in the applied wastewater and percolated effluent from the six-foot (1.83 m) soil column indicated that no removal of ammonia nitrogen occurred in the six-foot depth of limestone soil although some transformation of the ammonia nitrogen did occur. (Baker-IVI)
W85-06609

SWINE LAGOON EFFLUENT APPLIED TO 'COASTAL' BERMUDAGRASS: II. EFFECTS ON SOIL,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
L. D. King, P. W. Westerman, G. A. Cummings, M. R. Overcash, and J. C. Burns.
Journal of Environmental Quality, Vol. 14, No. 1, p 14-21, January/March, 1985. 11 Fig, 2 Tab, 22 Ref.

Descriptors: *Wastewater irrigation, *Soil chemistry, *Grasses, Wastewater disposal, Effluents, Wastewater lagoons, Animal wastes, Nitrates, Phosphorus, Calcium, Magnesium, Nutrients, Groundwater pollution, Sodium, Potassium, Ammonia.

Effluent from animal waste lagoons can degrade water quality if allowed to discharge into surface waters. To determine the feasibility of using swine (Sus scrofa domesticus) lagoon effluent as a source of water and nutrients for crop production, effluent was applied via sprinkler irrigation to Coastal bermudagrass (Cynodon dactylon (L.) Pers.) on Norfolk and Wagram soils (Paleudults) at rates to supply 335, 670, and 1340 kg N/ha/yr for 6 yr. Soil nitrate concentrations to a depth of 300 cm showed significant differences in the order high > medium = low rate. At the high rate, 56% of the applied N could not be accounted for by crop removal or increased N content of the soil to a depth of 210 cm. Evidence of P movement to a depth of 60 cm was obtained. Calcium and Mg concentrations in the topsoil were reduced due to relatively high rates of application of Na(+), K(+), and NH4(+). Soil pH was correspondingly reduced. Soil nitrate data suggest that groundwater pollution by nitrate would result from the high rate and possibly from the medium rate. (Author's abstract)
W85-06612

SWINE LAGOON EFFLUENT APPLIED TO 'COASTAL' BERMUDAGRASS: III. IRRIGATION AND RAINFALL RUNOFF,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
P. W. Westerman, M. R. Overcash, R. O. Evans, L. D. King, and J. C. Burns.
Journal of Environmental Quality, Vol 14, No. 1, p 22-25, January/March, 1985. 4 Tab, 26 Rf.

Descriptors: *Wastewater irrigation, *Runoff, *Grasses, Wastewater disposal, Water pollution sources, Animal wastes, Wastewater lagoons, Effluents, Nitrogen, Phosphorus, Chloride, Infiltration, Nutrients.

In moisture excess regions, irrigation of lagoon effluent to land is generally required to prevent water pollution from lagoon overflow. However, the land area receiving lagoon effluent then becomes a potential nonpoint source of pollution, especially if effluent is applied at high rates. The quantity and quality of rainfall runoff were determined for 6 yr from plots of 'Coastal' bermudagrass (Cynodon dactylon (L.) Pers.) on typical Coastal Plains soils that received weekly irrigations of swine (Sus scrofa domesticus) lagoon effluent during the growing season. Three application rates supplied an average of 335, 670, and 1340 kg N/ha/yr; 90, 180, and 360 kg P/ha/yr; and 200, 400, and 800 kg Cl/ha/yr. The soil-crop characteristics promoted high infiltration of rainfall and the plots were not irrigated during the nongrowing season, when runoff is usually highest. Thus, both runoff volume and nutrient mass transport were low, but nutrient concentrations were relatively high compared with typical concentrations in cropland runoff. Average annual arithmetic mean concentrations ranged from 7 to 13 mg/L for total N and from 3 to 6 mg/L for total P in the three treatments. Treatment differences were usually significant for the high-rate treatment, but not significant between the low- and medium-rate treatments. For this soil-crop system, NO3(-)-N movement to groundwater and P accumulation in the soil for the high- and medium-rate treatments would likely be of more concern than the pollution of rainfall runoff. (Author's abstract)
W85-06613

EFFECT OF FEEDLOT RUNOFF ON A SOUTHERN ILLINOIS FORESTED WATERSHED,
Illinois Univ. at Urbana-Champaign. Dept. of Forestry.
R. H. Pinkowski, G. I. Rolfe, and L. E. Arnold.
Journal of Environmental Quality, Vol. 14, No. 1, p 47-54, January/March, 1985. 3 Fig, 5 Tab, 43 Ref.

Descriptors: *Feedlot runoff, *Forested watersheds, *Land disposal, *Illinois, Wastewater treatment, Nutrient removal, Drainage water, Water pollution sources, Potassium, Phosphorus, Nitrogen, Calcium, Magnesium, Soil properties, Species composition, Animal wastes.

Beef (Bos taurus) feedlot runoff was applied to an oak-hickory (Quercus-Carya) forested watershed to evaluate the effectiveness of the forest in removing and utilizing the added nutrients. Application followed the normal precipitation pattern and was, thus, variable in intensity throughout the year. Feedlot effluent additions averaged 261.1 cu m/ha over the 4-yr study period. High percentages of total nutrient additions were retained by the watershed, but drainage water quality declined over the study period. An average of 99.8% of the added K, 99.4% of the PO4(-3)-P, 99.2% of the Na, and 98.4% of the Ca and Mg were retained by the watershed. Nitrate-N was the only nutrient showing a net loss, averaging 276% of the added NO3(-)-N. In the watershed runoff, NO3(-)-N increased form a baseline mean of 0.83 mg/L to a treatment mean of 12.27 mg/L. Phosphate-P also increased from a baseline mean of 0.02 mg/L to a treatment mean of 0.88 mg/L. Soil physical and chemical properties also changed as a result of the feedlot runoff input. Soil exchangeable cations and anions in the top 7.5 cm increased and bulk density decreased from 1.15 mg/cu M to 1.03 mg/cu M. Maximum soil changes occurred within 30 m of the effluent discharge point. Both tree and herbaceous plant species composition of the watershed also changed during the study period. Plant species composition became more similar to moist-site communities and plant numbers decreased overall. Species characteristic of dry sites decreased in growth rate, while moist site species increased in growth. Results of the experiment indicate that (i) a gravity flow system is an efficient and economical means of dispersing feedlot runoff through a forested watershed, (ii) feedlot effluent can be utilized as a nutrient supplement, and (iii) the vegetation of the oak-hickory forest was an effective biological filter. (Author's abstrct)
W85-06617

EFFECTS OF ANAEROBICALLY DIGESTED POULTRY MANURE ON SOIL PHOSPHORUS ADSORPTION AND EXTRACTABILITY,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. A. Field, R. B. Reneau, Jr., and W. Kroontje.
Journal of Environmental Quality, Vol. 14, No. 1, p 105-107, January/March, 1985. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Manure, *Land disposal, *Phosphorus, *Soil chemistry, Adsorption, Anaerobic digestion, Animal wastes, Effluents, Fertilizers, Langmuir equation.

Research in the past has indicated that large additions of animal manures to soil can reduce soil P adsorption and increase P extractability. However, application rates used in many studies are unrealistic with respect to crop fertilization and land disposal due to the excessive quantities of N applied with the manures. The objective of this study was to evaluate effluent from a poultry manure anaerobic digester applied to a Hayesville loam soil (clayey, oxic, mesic, Typic Hapludult) on soil P adsorption and extractability after three incubation periods (0, 30, and 90 d). Effluent solids were applied at rates corresponding to 753 through 7530 mg N/kg soil. Langmuir equation parameters (from least square fitted data; R sq > 0.98) were used as a basis to compare the influence of treatments on P adsorption properties of the soil. The P adsorption maxima parameter was not influenced by any of the effluent treatments. The parameter related to P bonding energy of the soil was reduced 33 and 41%, respectively, by mid and high rate effluent applications. A similar reduction was not observed for the low rate treatment, which corresponded to fertilizer application of 100 mg N/kg soil. Extractable soil P increased in a predictable manner with increased effluent solids application for all three incubation periods. These increases in extractable P could be described by linear regression equations. The slopes of these lines indicated that a 1-g addition of effluent solids to 1-kg soil accounts for increases in extractable P of 3 to 6 mg/kg. (Author's abstract)
W85-06622

IRRIGATION OF FORAGES WITH RENDERING PLANT WASTEWATER: FORAGE YIELD AND NITROGEN DYNAMICS,
Department of Agriculture, Lethbridge (Alberta). Research Station.
J. B. Bole, and W. D. Gould.
Journal of Environmental Quality, Vol. 14, No. 1, p 119-126, January/March, 1985. 11 Tab, 25 Ref.

Descriptors: *Wastewater irrigation, *Rendering plant wastewater, *Crop yield, *Nitrogen, *Forage, Nutrients, Phosphorus, Carbon, Grasses, Alfalfa, Fertilizers, Denitrification.

Wastewater from an animal by-product rendering plant containing N, P, and biochemical oxygen demand (BOD) at greater than 500, 60, and 500 mg/L, respectively, was applied to irrigated forages to study the suitability of forage species and the fate of applied nutrients. Applications of 10 and 20 cm/yr supplied the nutrients at rates in excess of crop requirements. The treatments were compared with irrigation water and with water supplemented with either fertilizer N and P or C as sugar at rates similar to those in the wastewater. Reed canarygrass (Phalaris arundinacea L.) yields were doubled by the application of 10 cm/yr of wastewater as compared with irrigation water treatments, but alfalfa (Medicago sativa L.) yields were not significantly affected. Doubling the wastewater application rate or adding comparable rates of N and P fertilizer did not further increase yields. The wastewater-irrigated alfalfa contained NO3(-)-N levels of 1500 to 1600 mg/kg plant material, while reed canarygrass contained about 3000 to 3400. Both these levels would be considered potentially unsafe for livestock feed. There was an accumulation of soil NO3(-)-N levels of up to 30 to 40 mg/kg soil throughout the surface 120 cm of soil after 5 yr of irrigation with 10 cm/yr of wastewater and two to three times this level with 20 cm/yr of wastewater. Higher levels of NO3(-)-N were observed in the soil when N was applied as fertilizer. Soil NH4(+)-N levels were not greatly affected. A nitrogen balance over 6 yr at the high application rate suggested plant uptake, soil NO3(-)-N, and losses accounted for 30, 25, and 45% of wastewater N and 29, 39, and 32% of fertilizer N. A 1-yr N-15 balance after 3 yr of irrigation indicated uptake, soil NO3(-)-N, and unaccounted-for N was about 10, 19, and 71% for wastewater and 15, 33, and 52% for fertilizer N. The greater losses of wastewater N compared with fertilizer N were attributed to enhanced denitrification due to oxidizable C in the wastewater. Attempts to simulate this effect with C as sugar were not effective. (Author's abstract)
W85-06623

OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS THROUGH MINIMIZING THE VOLUME OF ACTIVATED SLUDGE AND FINAL CLARIFICATION TANKS (OPTIMIER-

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UNG DES BELEBUNGSVERFAHRENS DURCH MINIMIERUNG DES VOLUMENS VON BELEBUNGS- UND NACHKLARBECKEN),
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
F. Tucke, J. Kaeding, and H.-J. Walther.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 125-136, 1983. 7 Fig, 9 Ref.

Descriptors: *Activated sludge process, *Optimization, *Tanks, Settling, Sludge thickening, Aeration tanks, Clarification, Wastewater treatment.

Volumes of aeration tanks and final clarification tanks can be minimized through a separate examination of the processes of settling and thickening of activated sludge. Initial quantities are given of wastewater quantity, inflow and outflow concentrations of BOD5, wastewater temperature and reflux ratio of activated sludge. Three parameters of the thickening behavior of activated sludge as well as a parameter for the bioactivity of sludge, which are to be determined in an experimental plant, are provided. The optimum concentration of the activated sludge in the aeration tank is calculated from these givens. At the optimum concentration the total of volumes for aeration tank and final clarification tank becomes a minimum. The process is carried out numerically through use of an example. (Baker-IVI)
W85-06656

COLOUR REMOVAL FROM TEXTILE EFFLUENTS USING HARDWOOD SAWDUST AS AN ABSORBENT,
Minya Univ. (Egypt). Dept. of Chemical Engineering.
H. M. Asfour, M. M. Nassar, O. A. Fadali, and M. S. El-Geundi.
Journal of Chemical and Biotechnology, Vol. 35 A, No. 1, p 28-35, January, 1985. 11 Fig, 19 Ref.

Descriptors: *Color removal, *Textile mill wastes, *Wastewater treatment, *Sawdust, Dyes, Adsorbents, Temperature, Activation energy, Wood, Particle size.

Textile mills engaged in the finishing of cotton goods discharge highly colored wastewater. Biological treatment processes, which are generally efficient for biochemical oxygen demand and suspended solids removal, are largely ineffective for removing color from the wastewater. Wood has high absorptive capacites for dyes and is relatively cheap, and so may have potential for use in color removal. Decolorization of a dilute solution of a basic dyestuff (Astrazone Blue) was carried out by using hardwood sawdust as adsorbent. Hardwood contains higher percentage of hemicellulose and lignin and consequently contains mor acidic groups than soft wood, and therefore may have more affinity towards the adsorption of basic dyes. At 80 C, 85% decolorization occurred within 100 min at an inital concentration (Co) of 200 mg/cu dm. As the wood particle size decreased, the amount of dye adsorbed increased. There was a 44% reduction in contact time when the temperature was raised from 25 to 80 C. The activation energy of the process was 9.83 kJ/mol which shows that the rate controlling step is intraparticle diffusion. (Moore-IVI)
W85-06659

MAIN DIRECTIONS IN PROTECTING WATERS FROM POLLUTION,
I. M. Kutyrin.
Hydrotechnical Construction, Vol. 18, No. 9, p 451-453, September, 1984. 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 56-57, September, 1984.

Descriptors: *Water pollution control, *Industrial wastewater, *Wastewater renovation, Wastewater treatment, Refineries, Water reuse.

The introduction of closed-cycle water-supply systems at industrial enterprises, having ecological and economic virtues, is a complex process requiring the development and persistent introduction of new technological processes and equipment or their improvement. One of the universal methods in organizing a closed-cycle water supply is the wide use of a recycled water supply, which markedly reduces the use of fresh water and its consumption per unit product, thus reducing the volume of wastewaters formed. An essential measure ensuring the normal operation of recycled water-supply system is treatment of the water for these systems: suspended solids, slag, organic and other specific substances, for example, oil, are subject to removal from process, waste, and other waters. In all cases when converting to a closed-cycle system it is necessary to group watstewaters with consideration of the specific characteristics of their pollutants, to discharge and treat them separately, and also to increase general production efficiency and especially to eliminate all losses owing to faulty equipment. A considerable reduction of water pollution in the future seems possible by industrial wastewater producers through the use of recycled water supply systems at enterprises and introduction of closed-cycle technological processes of the main types of industry. (Baker-IVI)
W85-06712

PERCOLATION TESTS, SOIL TEXTURE, AND SATURATED HYDRAULIC CONDUCTIVITY IN LACUSTRINE SOILS IN NORTH DAKOTA,
Virginia State Dept. of Health, Richmond.
For primary bibliographic entry see Field 2G.
W85-06717

MODEL FOR AUTOTHERMIC AEROBIC DIGESTION, EFFECTS OF SCALE DEPENDING ON AERATION EFFICIENCY AND SLUDGE CONCENTRATION,
Politecnico di Milano (Italy). Ist. di Ingegneria Sanitaria.
R. Vismara.
Water Research, Vol. 19, No. 4, p 441-447, 1985. 6 Fig, 23 Ref.

Descriptors: *Wastewater treatment, *Aerobic digestion, Sludge, Temperature, Model studies, Oxygenation, Sludge thickening, Efficiency.

A single stage stabilization process is proposed with an 8 day retention time and diffused aeration for the sole purpose of good sludge stabilization. The effect of variations in the efficiency of the aerators is negligible in winter conditions with small reactors and solid concentrations below 2%. The effect of scaling up is considerable for soil concentrations less than 2% and is appreciable for solid concentrations of 5% and reactor volumes of less than 5 cu m. Even in winter conditions and solid concentrations of below 2%, a reactor temperature of 20 degrees is obtained with ordinary aeration systems. Higher temperatures can be reached by using particular aeration systems available on the market with oxygenation efficiencies around 20%. It is essential both to thicken the sludge and to have an efficient oxygenation if higher temperatures and more ambitious objectives are to be reached. Satisfactory oxygenation can be obtained only with tandem blowing or aspiration in submerged mixers, or with the latest systems of external aeration with ejectors and recirculation pumps. A check of the validity of the model with the experimental results obtained has shown an extremely good correlation between the calculated figures and the experimental results. (Baker-IVI)
W85-06731

SELECTION OF GROWTH RATE MODEL FOR ACTIVATED SLUDGES TREATING PHENOL,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich, A. F. Gaudy, Jr., and P. C. D'Adamo.
Water Research, Vol. 19, No. 4, p 481-490, 1985. 4 Fig, 8 Tab, 27 Ref.

Descriptors: *Activated sludge processes, *Phenols, *Wastewater treatment, Activated sludge, Organic compounds, Model studies, Kinetics.

A series of batch growth studies using biomass seeds from different heterogeneous populations were performed using phenol as the sole carbon source. When the fits of the five inhibition functions to the data were compared, it was determined that all five functions gave equivalent fits. Two of the functions contained four fittable constants. The inclusion of a fourth biokinetic constant exacerbates the task of fitting the data, so these additional equations were eliminated from further consideration. Two other equations contain terms which exponentiate S. The incorporation of these growth rate expressions into biological reactor mass balance equations produces unwieldy predictive equations, causing these two equations to be also eliminated. The Haldane function which contains only three fittable constants and produces relatively simple predictive equations when incorporated into reactor mass balance equations, was selected as the growth rate function for heterogeneous populations metabolizing phenol. Examination of the values of the biokinetic constants shows a singificant degree of variability; despite this variation, the results of the batch growth study tests provided a reasonable assessment of the value of mu* for the continuous flow chemostat fed phenol. By performing a series of batch growth studies it appears possible to estimate the critical operating parameters for biological treatment systems dealing with toxic or inhibitory wastes, and it seems reasonable to recommend that the approach taken using phenol should be tried on more complex phenolic wastes. (Baker-IVI)
W85-06735

ADSORPTION OF VARIOUS POLLUTANTS FROM AQUEOUS SOLUTIONS ON TO ACTIVATED CARBON,
Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
G. McKay, M. J. Bino, and A. R. Altamemi.
Water Resources, Vol. 19, No. 4, p 491-495, 1985. 10 Fig, 3 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Adsorption, *Activated carbon, Organic compounds, Phenol, Chlorophenol, Mercury, Chromium, Sodium dodecyl sulfate, Particle size.

The capacity of activated carbon for a certain type of pollutant is important for designing adsorption contacting systems. The ability of activated carbon, Filtrasorb 400, to adsorb pollutants from aqueous solutions was studied for the pollutants phenol, p-chorophenol, sodium dodecyl sulfate, mercuric ions and chromic(III) ions. Equilibrium isotherm analyses were undertaken using Langmuir and Freundlich equations. The Langmuir monolayer adsorption capacities for phenol, p-chlorophenol, sodium dodecylsulfate, mercuric ions and chromium ions onto carbon are around 213, 434, 361, 138 and 35 mg/g, respectively. The capacities show a small particle size dependence possibly due to the fact that the solute molecules cannot completely penetrate all the pores within the carbon particles. (Baker-IVI)
W85-06736

TREATMENT OF PESTICIDE-LADEN WASTEWATER BY RECIRCULATION THROUGH ACTIVATED CARBON,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
E. A. Kobylinski, W. H. Dennis, and A. B. Rosencrance.
ACS Symposium Series, Vol. 259, p 125-151, 1984. 10 Fig, 8 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Pesticides, *Activated carbon, Filtration, Recirculation, Model studies, Mathematical models, Thin layer chromatography.

The Carbolator 35B, a recirculatory carbon filtration system, successfully treated pesticide wastes in both pilot-scale and field tests. In pilot-scale tests, the system was challenged with 400 gallons of water containing 20, 60 and 100 mg/L of each of seven pesticides: baygon, dimethoate, diazinon, ronnel, malathion, dursban, and 2,4-D. The pesticide waste was pumped through the Carbolator and returned to the waste holding tank. The tank contents were analyzed by gas chromatography

and thin layer chromatography (TLC). A TLC method was developed to perform pesticide analysis in the field. A simple lab recirculating system using 4 liters of waste was also built to simulate the Carbolator system. A mathematical model was developed to predict the disapperance of the pesticides from the waste holding tank. The Carbolator carbon filtration system offers an economical and dependable means by which small waste generators can effectively treat their pesticide laden wastewater. The system is portable and can be assembled from commercial items with a capital cost of about $3,000. The system is simple to operate and with the aid of TLC it is easy to monitor. (Baker-IVI)
W85-06781

TREATING PESTICIDE-CONTAMINATED WASTEWATER; DEVELOPMENT AND EVALUATION OF A SYSTEM,
Purdue Univ., Lafayette, IN.
J. C. Nye.
ACS Symposium Series, Vol. 259, p 153-160, 1984. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Pesticides, *Pesticide applicators, Flocculation, Coagulation, Activated carbon, Adsorption.

A two-stage system was developed for removing pesticides from wastewater resulting when commercial pesticide applicators must wash application equipment after use. The first step in the treatment process is flocculation/coagulation using alum (aluminum sulfate) with the anionic polymer Watcon 1255. The flocculant is be superior in tests which demonstrated that 500 mg/l alum could reduce the concentration of metribuzin in water from 2,000-3,000 mg/l to about 1,000 mg/l. The final polishing step in treatment is passage of supernatant through Filtrasorb 300 (Calgon) activated carbon. The apparatus used for testing on the premises of commercial pesticide applicators employed a 55 gallon drum for flocculation and sedimentation followed by two carbon adsorption columns made from 4-8 inch diameter polyvinyl chloride sewer pipes. Two commercial pesticide applicators used the system for purifying water used to wash their equipment after use in aerial spraying of a wide variety of chemicals. Studies continued for two seasons at both sites, with all the washwater being collected after treatment and analyzed. The procedure developed effectively reduced the volume of waste that must ultimately be disposed of by a factor of 100 (5,000 gallons of wastewater to 50 gallons of sludge). At both sites, vegetation became established in areas that had been assumed to be sterile because of previous pesticide contamination. (Rochester-IVI)
W85-06782

NITROGEN AND PHOSPHORUS IN ROTORUA URBAN STREAMS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 5B.
W85-06796

ANAEROBIC WASTEWATER TREATMENT AND ITS POTENTIALS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
G. Lettinga.
European Water and Sewage, Vol. 89, No. 1067, p 22-27, January, 1985. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, Industrial wastewater, Economic aspects, Organic compounds, Reviews, Sludge, Biological wastewater treatment.

The anaerobic wastewater treatment alternative offers tremendous potentials for treating industrial liquid wastes, low strength as well as high strength. One of the main benefits of the process is its feature that energy is produced from the organic pollutants, whereas the energy needs of the process are nil. The loading potentials of an anaerobic wastewater treatment system are primarily dictated by the amount of viable sludge which can be retained in the anaerobic reactor and the amount of contact which can be achieved between the incoming waste water and the sludge. All modern high rate processes are based on some mode of bacterial sludge immobilization, namely: the formation of highly settleable sludge aggregates, combined with early gas separation and internal sludge settling; bacterial attachment to high density particulate carrier materials or to immobile support structures supplied to the reactor; or entrapment of sludge aggregate between packing material supplied to the reactor. Currently available high rate anaerobic treatment systems include the upflow anaerobic sludge blanket, the upflow anaerobic filter, the stationary anaerobic fixed film reactor, the anaerobic fixed film expanded bed, and the anaerobic fluidized bed reactor. Differences betweeen these processes are explored. The current use of high rate anaerobic wastewater treatment is reviewed along with the potentials and costs of such treatment. (Baker-IVI)
W85-06812

EXTRA EFFORT WINS WATER QUALITY PAYOFFS,
Wisconsin Dept. of Natural Resources, Madison.
J. Smoller.
EPA Journal, Vol. 11, No. 3, p 14-15, April, 1985. 1 Fig.

Descriptors: *Wastewater treatment facilities, *Wisconsin, *Economic aspects, Legislation, Wastewater treatment, Water quality control.

Even with very active water quality control programs through the early 1970s, Wisconsin was still short of its water quality goals. In 1978 the legislature passed the Wisconsin Fund, a tax-supported grants program to bring municipal wastewter treatment systems into compliance with the Clean Water Act's July 1, 1983 deadline. There is general agreement today that the progress toward the 1983 goals made by most Wisconsin communities, and the progress still being made, would not have been possible without the Wisconsin Fund. With public support the Wisconsin Fund Point Source Program was enacted with little difficulty. The program parallels the federal grant program and covers up to 60% of the cost of constructing or upgrading wastewater treatment facilities. Brief examples of the use of the fund are offered. (Baker-IVI)
W85-06817

VERSATILE COMPUTER-CONTROLLED FERMENTOR FOR THE SIMULATION OF WASTEWATER TREATMENT SYSTEMS,
Leeds Univ. (England). Dept. of Civil Engineering.
N. J. Horan, C. R. Eccles, and D. D. Mara.
Process Biochemistry, Vol. 20, No. 1, p 13-16, February, 1985. 4 Fig, 8 Ref.

Descriptors: *Fermentors, *Wastewater treatment, *Computers, *Simulation, Activated sludge processes, Model studies, Anaerobic conditions.

A simple and inexpensive example of the interfacing of a microcomputer to a commercially available fermentor is presented. The system will allow the simulation of numerous wastewater treatment systems by fitting the appropriate data with an orthogonal polynomial. Software and hardware are discussed along with several practical applications in wastewater research. These applications include work in activated sludge processes, anaerobic digestion processes, and other processes involved in the treatment of wastewater. (Baker-IVI)
W85-06837

PRETREATMENT PLANT UNDER EVERY LAWN,
Clarida Consulting Engineering Services, Marion, IL.
G. Clarida.
Water Engineering and Management, Vol. 132, No. 4, p 22-25, April, 1985. 2 Fig.

Descriptors: *Wastewater treatment, *Pretreatment, *Sewer systems, Lake of Egypt, Illinois, Wastewater collection, Pumps, Grinder pumps.

A low pressure wastewater collection system using an individual grinder pump station located at each household or business site provided an economical and efficient wastewater collection system for Lake of Egypt, Illinois. The sewage is ground into small particles and then pumped through small-diameter plastic pipe. Individual pumping systems were purchased as complete packages. Each station includes a Piranha grinder pump, galvanized steel piping with check valve, union and gate valve, a junction box with three level sensors, reinforced plastic basin with a bolted steel cover and a remote enclosed control panel with alarm lamp. Each grinder station package includes a control panel which includes full magnetic short circuit and overload protection, start and run capacitors, and signal lights indicating pump on, seal failure, and high water level. The wastewater treatment plant is very basic and consists of two 12-ft deep ponds in series, followed by a polishing filter. The primary pond has three surface aerators, and the secondary pond has two, all of which are used intermittently. Effluent discharge into the South Fork of the Saline River meets the state's standards of 10 mg/l BOD and 12 mg/l suspended solids. (Baker-IVI)
W85-06840

HEXAVALENT CHROMIUM REMOVAL IN A FOAM FLOTATION PILOT PLANT,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
S.-D. Huang, and D. J. Wilson.
Separation Science and Technology, Vol. 19, No. 8/9, p 603-611, July/August, 1984. 1 Fig, 5 Tab, 20 Ref.

Descriptors: *Wastewater treatment, *Chromium, *Industrial wastes, *Foam flotation, Pilot plants, Adsorption, Chemical reactions.

Chromium in industrial wastes often occurs in the hexavalent form as chromate and dichromate. Hexavalent chromium was removed from dilute simulated wastewater in a continuous flow pilot scale foam flotation plant. For direct discharges, the 30-day averaged standard for Best Practicable Control Technology Currently Available (BPT)-equivalent control technology is 1.0 ppm for chromium. The Best Available Technology Economically Achievable (BAT) provides a more stringent standard of 0.50 ppm. Removal of Cr(VI) by adsorbing colloid flotation in a continuous-flow pilot plant is described. Hexavalent chromium is reduced to Cr(III) with FeSO4, and the resulting mixed precipitate is removed by flotation with sodium lauryl sulfate. Effluent Cr concentrations below 0.3 mg/L were routinely obtained by this technique. (Baker-IVI)
W85-06842

USE OF VOLATILE CHLOROORGANICS AS A MEASURE OF THE REHABILITATION OF THE ST. LOUIS RIVER AND BAY,
Minnesota Univ., Minneapolis. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W85-06867

RESIDUE LEVELS OF ORGANOCHLORINE INSECTICIDES IN SEWAGE PLANT EFFLUENT,
Biological Research Center, Baghdad (Iraq). Dept. of Environmental Pollution.
For primary bibliographic entry see Field 5B.
W85-06875

CHEMICAL CLARIFICATION METHODS FOR CONFINED DREDGED MATERIAL DISPOSAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
P. R. Schroeder.
Technical Report D-83-2, Final Report, July 1983. 147 p, 35 Fig, 21 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Dredging, *Suspended solids, *Sediments, *Clarification, *Flocculation, Polymers, Chemical treatment, Polyamines, Effluents, Turbidity, Settling basins.

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Thirty-five chemicals were screened in the laboratory to determine which types of polymer were most effective in clarifying suspensions of fine-grained, freshwater sediments involved in dredging. The moderately high molecular weight, highly cationic polyamines performed well on the suspensions tested (concentrations 0.21-2.1 g per liter). The optimum technique, developed during field trials, was dispersion of a concentrated, low viscosity liquid polymer in the effluent at the weir of the primary containment area. The polymer was diluted in-line with supernatant from the containment area as it was being pumped to the weir. Mixing occurred in the weir. Settling and storage was provided in a small secondary containment area. Solids concentration was reduced from 2 g per liter to 50 mg per liter at a polymer dosage of 10 mg per liter. When polymer was injected into the dredge pipelines, the required dosage was much higher than when effluents were treated. Guidelines are given for designing the components of the treatment system.
W85-06914

FIELD INVESTIGATIONS OF OVERLAND FLOW TREATMENT OF MUNICIPAL LAGOON EFFLUENT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. E. Peters, C. R. Lee, and D. J. Bates.
Technical Report EL-81-9, September 1981. Final Report. 304 p, 41 Fig, 37 Tab, 52 Ref, 14 Append.

Descriptors: *Wastewater treatment, *Overland flow, *Wastewater renovation, *Lagoons, Advanced wastewater treatment, Effluents, Coliforms, Heavy metals, Metals, Land disposal, Wastewater disposal, Vegetation, Nutrient removal.

Overland flow to provide advanced treatment of municipal lagoon effluent was studied in a field environment near Utica, Mississippi. The field studies were conducted on slopes constructed at 2,4, and 8% and seeded with a mixture of four grass species. Wastewater from a facultative lagoon was applied to the surface in measured amounts, and surface runoff was collected and metered at the end of each plot. The effectivenees of overland flow to renovate municipal wastewater with respect to biochemical oxygen demand, total suspended solids, nutrients, fecal coliforms, and heavy metals was studied over approximately a 3-yr period. Samples of surface runoff and subflow were analyzed for several operational conditions with variable depths of wastewater application, period, and frequency of application per week. The roles played by soil, soil temperature, vegetative cover, and management in wastewater renovation by overland flow were also investigated. Because of interest in cost recovery from land treatment systems through marketing of the vegetative cover for animal feed, results of dry matter yield of grass for the various operational conditions were determined. Several specialized studies within the broader research goals were conducted to answer questions related to algae reduction, enhanced phosphorus removal by alum addition, characterization of stormwater runoff from overland flow systems, fecal coliform reduction, and nitrogen losses through volatilization of ammonia. Recommendations for the construction and operation of overland flow systems are given. (Author)
W85-06926

ACTIVATED SLUDGE PROCESS: FUNDAMENTALS OF OPERATION,
Weston (Roy F.), Inc., West Chester, PA.
R. Junkins, K. Deeny, and T. Eckoff.
Butterworth, Boston. 1983. 136 p.

Descriptors: *Wastewater treatment, *Activated sludge process, *Operations, Sewage bacteria, Microorganisms, Microbiology, Biochemical oxygen demand, Organic matter, Biological wastewater treatment, Nutrients, Detention time, Dissolved oxygen, Toxicity, Temperature, Hydrogen ion concentration, Mixing, Aeration, Flow rate, Plug flow, Oxidation ditches, Kraus process, Hatfield process, Monitoring, Chemical oxygen demand, Settleable solids, Sludge, Organic loading, Chemical treatment, Ammonia, Phosphoric Acid, Bulking sludge, Flocculation, Wastewater analysis, Mechanical equipment, Training.

This handbook on activated sludge process operation is written for operators, supervisors, and engineers. The process mechanics are explained, including the basic mechanism of the process, the formation of activated sludge, the growth and classification of microorganisms, and solids separation and return. Factors affecting operation are the raw wastewater strength, nutrients, dissolved oxygen, detention time, pH, toxicity, temperature, mixing, and flow rate. Several modifications of the process are available: plug flow, complete mix, contact stabilization, extended aeration, oxidation ditch, and others. Visual and analytical indicators are used for monitoring. For optimum performance the operator must consider plant loadings, the food/microorganism ratio, sludge age, sludge wastage rate control, sludge recycle rate control, and chemical feed rates. A general scheme for troubleshooting operating problem is given. Typical operating problems are low soluble BOD removal, organic loading, toxic or inhibitory substances, low temperatures, pH out of range, insufficient aeration time, insufficient mixed liquor volatile suspended solids, rising sludge versus bulking sludge, deflocculation, straggler floc, pin floc, and solids carryover. Pre-startup procedures include wastewater analysis, selection of seed microorganisms, equipment check, and familiarization and training. Actual startup begins with seeding of the microorganisms, followed by process monitoring, microscopic examination of the mixed liquor, settling tests, and post startup checklist. Some problems encountered during startup are foaming, settling problems, and low BOD removal.
W85-06932

WATER REUSE THROUGH GROUNDWATER RECHARGE IN NORTHEASTERN ILLINOIS,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
G. E. Stout, T. F. Naymik, T. H. Larson, and M. R. Schock.
Research Report No. 184, September 1984. 83 p, 41 Fig, 2 Tab, 52 Ref. Project No. Bu Rec R-0061, Contract/Grant No. 14-34-0001-7811 (1).

Descriptors: *Water reuse, *Wastewater treatment, *Artificial recharge, Sanitary plant effluent, Effluent characteristics, Effluent movement, Recharge pit, Aquifers, Filter media, Model simulation, Illinois, Mathematical models.

This study was designed to examine the advantages, disadvantages, and effects of artificial recharge, using sanitary plant effluent as recharge water. A numerical groundwater model was constructed for a site near Aurora, Illinois, and validated by simulating an aquifer test at a proposed pit location. Model simulations were also conducted to calculate the flow capacity of the system, the flow capacity of a pilot recharge pit, and the solute transport through and away from the pit. Based on the study's findings, a pilot pit should be constructed at the Aurora Site, and chemical quality of the water withdrawn from the operation would be the research aspect of a pilot pit. There may be some characteristics of the effluent, such as the total dissolved solids (TDS), that exceeds the background counts of the aquifer. A TDS of 100 mg/l, which is considered excessive for many water supply uses but neither is toxic nor creates a health hazard in the effluent, could be reduced through demineralization, but this is an additional cost. Furthermore, the sole purpose of this study was to evaluate the movement and changing characteristics of the high quality effluent from tertiary-treated wastewater which is primarily domestic in nature as this effluent moves through from a pit into the aquifer. Artifical recharge is a viable concept as shown by the calculations and model simulations of the Aurora site.
W85-06941

EVALUATION OF WASTEWATER DISINFECTION ALTERNATIVES,
Ontario Ministry of the Environment, Toronto. Wastewater Treatment Section.
F. A. Tonelli, K. W. Ho, and N. N. W. Schmidtke.
Research Report No. 106, 1981. 173 p, 29 Fig, 26 Tab, 7 Ref, 7 Append. Project No. 74-1-33, 74-3-17.

Descriptors: *Disinfection, *Chlorination, *Wastewater treatment, Chlorine, *Cost analysis, *Ozonation, *Toxicity, *Water pollution effects, Chlorine, Ozone, Chlorine dioxide, Coliforms, Dechlorination, Municipal wastewater, Comparison studies, Trout.

Small scale tests of the efficacy of chlorine, chlorine dioxide and ozone as disinfectants for three types of municipal wastewater effluents (non-nitrified, nitrified, and denitrified) were carried out under field conditions. All three disinfectants reduce the total coliforms to selected target levels of 2000 total coliforms/ml. Cost analyses showed that chlorine had the lowest projected use-cost. Ozone had a slightly higher projected use-cost than chlorine dioxide for low quality effluents at small treatment facilities, but improved effluent quality and larger treatment plant size made ozone more economical. Dechlorination can help to eliminate the acute toxicity of chlorinated wastewaters. Ozonation produced non-acutely toxic effluents and is recommended for use at oxygen-activated sludge plants. Effluents treated with chlorine dioxide were acutely toxic to juvenile rainbow trout. However, the cost of chlorine residual removal results in use-costs which are much higher than the cost of chlorine disinfection plus dechlorination.
W85-06963

PARASITES AND THE LAND APPLICATIONS OF SEWAGE SLUDGE,
Ontario Ministry of the Environment, Toronto. Pollution Control Branch.
H. J. Graham.
Research Report No. 110, 1981. 84 p, 7 Fig, 12 Tab, 97 Ref, 2 Append. Project No. 74-1-41.

Descriptors: *Sludge disposal, *Parasites, Land disposal, Domestic animals, Pastures, Cultivated lands.

A study was conducted to determine the incidence of parasites in Ontario sewage sludges and the length of time and the ova and/or cysts of these parasites remain viable. Parasite ova, mainly Ascaris and Toxocara, were recovered from many Ontario sewage sludges, and from sludged fields. These ova can survive on pasture for several years, are probably destroyed on bare soil within 1 yr. and possibly survive only a few weeks when the sludge is mixed with the soil. This information, together with the type of parasites present in Ontario and the numbers found in the digested sludge, make noticeable parasite transmission, via sludge spread on farmland, a remote possibility. The following recommendations are directed to personnel who actually apply the sludge to the farm fields: a) ingestion of, or food contamination with, liquid sludge should be prevented; b) food contamination with dry sludge should be avoided due to the probable presence of infective ova of Ascaris, Trichuris and Toxocara; and c) skin contact with sludge from a drying bed should also be avoided due to the possible presence of hookworm larvae. With respect to sludge applied to pasture, if subsurface-injection is used, and no sludge remains on the surface, there should be no restrictions on use of the pasture. The threat of parasitic infection from digested sludge to domestic animals is far less than that of acquiring infections in the normal farm environment. The exception is Taenia saginata which can only be transmitted to cattle by human fecal contamination. The parasite ova are unlikely to last longer than one year except in moist, shaded soil, where a two-year waiting period is necessary.
W85-06978

IRRADIATION AS AN ALTERNATIVE FOR DISINFECTION OF DOMESTIC WASTE IN THE CANADIAN ARCTIC.
International Environmental Consultants Ltd., Islington (Ontario).
Report SCAT-6, 1981. Environment Canada, Canada Mortgage and Housing Corporation,

Ottawa, Ontario. 101 p, 14 Fig, 31 Tab, 35 Ref, 2 Append.

Descriptors: *Disinfection, *Irradiation, *Domestic wastes, *Arctic, *Wastewater treatment, *Gamma radiation, Municipal wastes, Arctic zone, Wastewater, Capital costs, Operating costs, Environmental impact statement.

The purpose of this study was to evaluate the technical and economic feasibility of various methods for disinfecting wastewater in the Canadian Arctic with specific reference to gamma radiation. More conventional disinfection practices, such as chlorination, chlorination-dechlorination, and ozonation were compared to gamma radiation along with ultraviolet (UV) irradiation and lime (pH) disinfection. The quality of lagoon effluent, highly diluted (weak) sewage, holding tank wastes and honey-bag wastes, which are the typical waste types found in northern communities, was established from data available in the literature. Further literature reviews were undertaken to establish a data base for design and effectiveness of disinfection systems operated in cold climates. Capital and operating costs for all technically feasible disinfection process alternates were estimated based on historical cost data adjusted to 1977 for the construction and installation of similar systems in the north. The costs of equipment, chemicals, fuel, and electrical power were obtained from suppliers. The environmental impact of each of the disinfection processes was reviewed with emphasis on gamma irradiation. Safety and health aspects were also considered. The study concluded that gamma irradiation was capable of providing safe, reliable disinfection for concentrated honey-bag and holding wastes. Pilot-scale testing was recommended prior to construction of full-scale disinfection facilities. For lagoon effluents and weak sewage, gamma irradiation was not cost competitive with other alternates; rather chlorination-dechlorination was found to be the most cost-effective and environmentally acceptable alternative.
W85-06982

OPTIMIZATION OF BIOLOGICAL RECYCLING OF PLANT NUTRIENTS IN LIVESTOCK WASTE BY UTILIZING WASTE HEAT FROM COOLING WATER,
Tennessee Valley Authority, Muscle Shoals, AL. Div. of Agricultural Development.
J. J. Maddox, L. L. Behrends, D. W. Burch, J. B. Kingsley, and E. L. Waddell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-107763. EPA-600/7-82-041, May 1982. 141 p. 15 Fig, 34 Tab, 166 Ref, 1 Append. Contract/Grant No. IAG-DO-E721-BF and TV-41967A.

Descriptors: *Recycling, *Waste recovery, *Livestock wastes, *Waste heat, *Cooling water, *Anaerobic digestion, Aquaculture, Wastewater farming, Hydroponics, Fertilization.

This report presents results from a 5 yr study to develop aquatic methods which beneficially use condenser cooling water from electric generating power plants. A method is proposed which uses a system for aquatic farming. Livestock waste is used to fertilize planktonic algae production and filter-feeding fish are used to 'biologically harvest' the algae, condenser cooling water (simulated) is used to add 'water heat' to the system, and emergent aquatic plants are used in a flow through series as a biofilter to improve the water quality and produce an acceptable discharge. Two modes of operation were tested; one used untreated swine manure as the source of aquatic fertilizer and the other uses anaerobic digester waste as a means of pretreating the manure to produce an organic fertilizer. A set of operating conditions (temperature, retention time, fish stocking rate, fertilizer rates, land and water requirements, suggest fish and plant species, and facility design) were developed from these results. The integrated system allows continual use of power plant condenser cooling water from plants in the southeastern United States.
W85-06983

PROCEEDINGS OF STORMWATER AND WATER QUALITY MODEL USERS GROUP MEETING: JANUARY 27-28, 1983.
Environmental Protection Agency, Athens, GA.
For primary bibliographic entry see Field 5G.
W85-06999

WASTEWATER CHARACTERISTICS,
Helsinki Univ. of Technology, Espoo (Finland). Lab. of Pulping Technology.
N.-E. Virkola, and K. Honkanen.
Water Science and Technology, Vol. 17, No. 1, p 1-28, 1985. 15 Fig, 9 Tab, 33 Ref.

Descriptors: *Pulp and paper industry, *Wastewater treatment, *Water reuse, Biochemical oxygen demand, Color, Total organic carbon, Chemical oxygen demand, Toxicity, Suspended solids, Water pollution control.

One of the most common internal arrangements reducing pollution loads caused by pulp and paper mills has been the closure of water circulation systems. The decrease in pollution loads is not the only reason for closure. The consumption of raw materials and energy and effluent treatment costs also decrease. Total closure of water systems causes many problems and extra costs, so each mill must find its own solution for economical internal and external treatment of effluents. Various possibilities for reducing the bleaching discharges have been explored but no solution found as yet. One solution called for chlorine-free bleaching. This would allow the water systems of the bleachery to be closed effectively without the accumulation of salt in the pumping chemical recovery cycle. The toxicity of bleaching effluents would also decrease significantly. The pollution load from debarking accounts for a large proportion of the total pollution load, especially in a paper or board mill integrated with a mechanical pulp mill. In such an integrate, the mechanical pulp mill also accounts for a large part of the pollution load. The pollution load caused by the paper of board mill itself is minimal, but the effluent volume is usually great. In chemical pulp mills, the pollution load originates mainly from foul condensates of the digester room and the evaporation of spent cooking liquor and from bleaching effluents. About 50-60% of the total BOD7 load originates from the bleachery of the pulp mill. Active research and development is required to minimize the pollution loads of pulp and paper mills in the most efficient and economical way. (Baker-IVI)
W85-07001

CHARACTERISTICS OF PAPER/BOARD MILL WASTEWATERS RELEVANT TO ANAEROBIC TREATMENT,
Pira, Leatherhead (England).
L. J. Webb.
Water Science and Technology, Vol. 17, No. 1, p 29-38, 1985. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Pulp and paper industry, *Wastewater treatment, Acidity, Temperature, Anaerobic digestion, Economic aspects, Biodegradation, Sulfates.

The characteristics of papermaking wastewaters are wide-ranging, a reflection of the diverse range of products classified as paper and the range of additives used in their manufacture. In terms of biological treatment generally, the dissolved organic components of papermaking effluents are biodegradable. The major hazard in conventional aerobic treatment concerns poor housekeeping and/or spillages from the use of biocides. Additional factors are important in determining the suitability of a particular wastewater for anaerobic treatment, notably wastewater strength, temperature and sulfate concentration. It seems likely that the most suitable wastewaters will be generated by mills using a high proportion of wastepaper and/or starch, with a substantially closed water system, and using a synthetic neutral sizing system in preference to alum/rosin. Given a treatable wastewater, the economic vaiability of anaerobic treatment will depend on a mill's scale or operation, its existing treatment system and the effluent standard required for discharge. In most circumstances, anaerobic treatment is likely to be cheaper to install and operate than aerobic plants, giving pay-back periods of 2-3 years in the most favorable cases. (Baker-IVI)
W85-07002

ANAEROBIC BIOLOGICAL DECOMPOSITION OF MALODOROUS COMPOUNDS IN KRAFT PULPING WASTEWATER,
Ebara-Infilco Co. Ltd., Fujisawa (Japan). Research Center.
G. Endo, and Y. Tohya.
Water Science and Technology, Vol. 17, No. 1, p 39-52, 1985. 7 Fig, 6 Tab, 3 Ref.

Descriptors: *Anaerobic degradation, *Kraft mills, *Pulp and paper industry, Biological wastewater treatment, Odor control, Acidity, Temperature effects, Hydrogen sulfide, Methyl mercaptan, Dimethyl disulfide, Decomposition.

The capability and performance of anaerobic biological decomposition of malodorous coumpounds in kraft pulping waste stream drains were studied, and one of the most economical processes for both BOD removal and prevention of malodorous air pollution was developed. The experimental apparatus used was a bench scale semi-batch anaerobic contact process in which a digester vessel was operated in regular sequence as a stirred digester and a stationary sedimentation tank. The digesting anaerobic sludge could convert dimethyl disulfide (DMDS) to methyl mercaptan (MM) and that the latter was partially decomposed to hydrogen sulfide (H2S). To maintain this anaerobic biodegradation of sulfur-containing malodorous compounds, the concentration of hydrogen sulfide in digester mixed liquor was required to be kept below about 5 mg/L. The conditions of temperature of 50 degrees and pH of 6.5 were most suitable for the methane fermentation of the kraft pulping waste stream drainage and for the removal of the malodorous compounds. Scrubbing of the digester head space gas with the solution of sodium hydroxide removed not only H2S but also MM so that a high removal rate of DMDS and MM was achieved. Unfortunately, dimethyl sufide could not be decomposed biologically, but it could be removed easily with a simple air stripping process. (Baker-IVI)
W85-07003

ANAEROBIC WASTEWATER TREATMENT PROCESSES,
Helsinki Univ. of Technology, Espoo (Finland). Dept. of Forest Products.
R. K. Maatta.
Water Science and Technology, Vol. 17, No. 1, p 53-59, 1985. 5 Fig, 3 Ref.

Descriptors: *Wastewater treatment, *Finland, *Anaerobic digestion, *Pulp and paper industry, Biodegradation, Biological wastewater treatment, Kraft mills, Dairy industry.

The first biological waste water treatment plants in Finland for municipal sewage were anaerobic septic tanks. The first anaerobic reactor for industrial waste water was designed in Rajamaki in the 1930's for the treatment of effluents from an alcohol distillery. Three different types of anaerobic treatment plants exist in Finland today for the treatment of sugar wastewaters, dairy wastewater, and pulp bleaching wastewater. The biochemistry and process condition of anaerobic fermentation are reviewed. Anaerobic metabolism is regarded as a three step process: hydrolysis of suspended or soluble organics of high molecular weight, degradation of small molecules to various volatile fatty acids, and production of methane. The four metabolic groups which function in anaerobic fermentors include the hydrolytic bacteria which ferment different complex organic compounds into a broad spectrum of end products; the hydrogen producing acetogenic bacteria which include both obligate and facultative species that can ferment organic acids larger than acetic, and neutral compounds larger than methanol to hydrogen and acetate; the homoacetogenic bacteria which can ferment a very large number of multi or one carbon compounds to acetic acid; and the methanogenic bacteria which

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ferment H2/CO2, one carbon compounds and acetate into methane. In the treatment of sludge the biological and the hydraulic retention times are almost identical. (Baker-IVI)
W85-07004

APPLICATION OF THE UASB-REACTOR FOR ANAEROBIC TREATMENT OF PAPER AND BOARD MILL EFFLUENT,
Burhrmann-Tetterode N.V., Doetinchem (Netherlands).
L. H. A. Habets, and J. H. Knelissen.
Water Science and Technology, Vol. 17, No. 1, p 61-75, 1985. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Pulp and paper industry, *Wastewater treatment, Anaerobic digestion, Biological wastewater treatment, Netherlands.

In April of 1983 a 70 cu m practical scale USAB reactor was started up at a solid board mill at Ceres in the Netherlands. In October of 1983 a full scale plant was started up at Papierfabriek Roermond. This plant consists of a 1,000 cu m UASB reactor and a 70 cu m gas holder. It is used for pretreatment of effluent, in order to reduce the loading of the activated sludge plant. Besides energy savings on the oxygen input, about 1 million cu m/year of biogas is being generated and is used for steam production. Both plants are working satisfactorily. Investment costs appeared to be relatively low. At Ceres, payout time is 1.5 year, while at Papierfabriek Roermond wastewater treatment is cheaper than before, although capacity is doubled. Start-up can be completed in about 3 or 4 months. In case adapted granular sludge is available, start-up only lasts for several weeks. From the results achieved it is expected that application of anaerobic treatment in paper and board producing industries will greatly increase during the next few years. (Baker-IVI)
W85-07005

FLUIDIZED BED TECHNOLOGY IN THE ANAEROBIC TREATMENT OF FOREST INDUSTRY WASTEWATERS,
Helsinki Univ. (Finland). Dept. of Microbiology.
M. S. Salkinoja-Salonen, R. Hakulinen, L. Silakoski, J. Apajalahti, and V. Backstrom.
Water Science and Technology, Vol. 17, No. 1, p 77-88, 1985. 10 Fig, 4 Tab, 11 Ref.

Descriptors: *Fluidized bed process, *Wastewater treament, *Pulp and paper industry, Anaerobic conditions, Bleaching wastes, Industrial wastes, Sulfites.

Anaerobic treatment has been shown to be successfully applied to various wastewater streams from the pulp and paper industry. It alone removed 80 to 90% of BOD5 and also of COD-Cr unless the effluent in question contains lignin, which is slowly, if at all, biodegradable anaerobically over the periods of time that are applicable in industrial wastewater treatment. With bleaching wastewater, about 30% of the COD-Cr was biodegradable anaerobically, and a removal efficiency of about 50% could be obtained if aerobic post-treatment was applied. Anaerobic fluidized bed reactor removed 3 to 4 kg of COD-CrO2/cu m reactor volume/d from sulfite pulp evaporator condensate, thermomechanical pulp mill wastewater and bleaching wastewaters from sulfite pulping and displacement bleaching of kraft pulp. These results were obtained with a fluidized bed reactor, where much of the biomass is attached to a small sized support material. A biomass support is essential when high hydraulic loading is needed. With very high strength wastes, when a longer hydraulic retention can be permitted, similar COD removal is possible also with conventional large-scale digesters. (Baker-IVI)
W85-07006

ANAEROBIC TREATMENT OF WASTEWATER FROM THE PRODUCTION OF CHEMI-THERMOMECHANICAL PULP,
Lund Univ. (Sweden). Chemistry Centre.
T. Welander, and P.-E. Andersson.
Water Science and Technology, Vol. 17, No. 1, p 103-111, 1985. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Pulp wastes, *Chemi-thermomechanical pulp, *Anaerobic digestion, *Hydrogen peroxide, Anaerobic conditions, Pilot plants, Biological wastewater treatment.

In order to find a solution to the peroxide toxicity problem, the possibility of removing hydrogen peroxide from chemi-thermomechanical pulp, (CTMP) waste water by means of an acidogenic reactor was investigated. The acidification of CTMP wastewater containing various concentrations of peroxide was studied. The degradation of hydrogen peroxide in a continuously inoculated biocatalytic prestage was studied along with the use of the redox potential for process control. Initially the waste water was completely inhibitory to the methanogenic microflora, even after the removal of hydrogen peroxide. After several months of adaptation, though, an increase in methanogenic activity was obtained. Microscopic examination revealed that a dramatic change had occurred. The predominating acetoclastic methanogen in the inoculum, a filamentous rod, had disappeared and been replaced by large clusters of a Methanosarcina-type of organism. The anaerobic treatment of CTMP waste water was studied in a pilot plant at the CTMP Hill in Ostrand. The pilot plant consists of two anaerobic stages, followed by an aerobic polishing stage. The COD reduction in the anaerobic part of the treatment process has been 50-60% and the methane yield has been about 0.3 cu Nm/kg COD reduced. The loading rate has been low, though, due to poor sludge retention and a low bacterial growth rate. (Baker-IVI)
W85-07007

STUDIES OF ANAEROBIC TREATMENT OF SULFITE PROCESS WASTES,
Washington Univ., Seattle. Dept. of Civil Engineering.
J. F. Ferguson, and M. M. Benjamin.
Water Science and Technology, Vol. 17, No. 1, p 113-121, 1985. 4 Fig, 1 Tab, 8 Ref. OWRT project 145-01-11N-39943-3068 and EPA grant R-808675-01-1.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Sulfite liquors, *Pulp wastes, Toxicity, Biological wastewater treatment, Costs, Mathematical models, Organic compounds.

A series of lab studies of treatment of sulfite process wastes constitute a case study of application of high rate anaerobic biological treatment. Sulfite evaporator condensate (SEC) was evaluated in batch and continuous flow studies to find the efficiency of treatment that was possible and the conditions suitable for treatment. A great deal of effort was expended on understanding potential limitations of high-rate anaerobic treatment. The requirement for and the cost of neutralization was addressed through mathematical modeling, and eventually by treating caustic extraction stage bleaching wastes in combination with SEC. The possible effects of sulfur were identified as potential toxicity, increases in effluent COD loss of methane production, and increased neutralization requirement. Lab studies reviewed point to a suitable way to approach evaluation of anaerobic treatment at a particular pulp and paper mill. There are significant research questions about application of anaerobic treatment to waste streams containing chemically modified organic compounds. Each case must be met with careful examination. Lab studies with batch or small continuous reactors are suitable for dealing with questions of toxicity, treatability and neutralization of waste streams prior to undertaking pilot plant studies. (Baker-IVI)
W85-07008

OPERATIONAL EXPERIENCE WITH ANAEROBIC/AEROBIC TREATMENT SYSTEM FOR PAPER MILL WASTEWATER,
Inland Container Corp., Newport, IN.
C. J. Priest.
Water Science and Technology, Vol. 17, No. 1, p 123-132, 1985. 1 Fig, 7 Tab.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Pulp and paper industry, Settling basins, Aeration, Biomass, Methane, Biochemical oxygen demand.

Operation at a paper mill in Indiana began in 1975. The initial effluent treatment system consisted of aeration stabilization and settling basins. The Wabash River was the recipient for the waste system discharge. Primary solids from the clarifier were recycled to the mill. Secondary solids from the settling basins were applied to farm land. An anaerobic plant pilot study was conducted in 1978. The results of that study brought about the approved conversion of the Newport effluent treatment system to an anaerobic/aerobic system. In November 1978 one aeration basin was converted to an anaerobic cell. In May of 1979 the anaerobic pond was 80% BOD reduction. Total effluent system efficiency has averaged 98% over the past 3 years. Aerobic biomass generation has been reduced 80 to 90% as measured by settleable solids. (Baker-IVI)
W85-07009

TAMAN ANAEROBIC PROCESS - FOR WASTEWATER FROM MECHANICAL PULP AND PAPER PRODUCTION,
Tampella Oy A.B., Tampere (Finland).
S. Rekunen, O. Kallio, T. Nystrom, and O. Oivanen.
Water Science and Technology, Vol. 17, No. 1, p 133-144, 1985. 7 Fig, 5 Tab, 2 Ref.

Descriptors: *Pilot plants, *Anaerobic wastewater treatment, *Pulp and paper industry, Activated sludge process, Wastewater treatment.

The prospects for application of anaerobic technology in the treatment of wastewater from the pulp and paper industry is an important area of research, for the anaerobic method is one of the few in which a significant share of the operating costs can be covered with a by-product (biogas) generated in the process. Laboratory and pilot plant tests show that the anaerobic technique can be used to treat combined wastewater from mechanical pulp manufacture, paper manufacture and the debarking plant. The Taman multi-stage reactor yields better treatment results than the control reactors operating on the UASB and completely mixed principles. The operating costs of the anaerobic process are less than 10% of the corresponding costs from an activated sludge plant, while the investment is of the same magnitude. (Baker-IVI)
W85-07010

ANAEROBIC TREATMENT OF SULFITE PULP MILL EFFLUENTS,
Technische Univ., Vienna (Austria). Inst. fuer Wasserguete und Landschaftswasserbau.
H. Kroiss, K. Svardal, and H. Flekseder.
Water Science and Technology, Vol. 17, No. 1, p 145-156, 1985. 7 Fig, 4 Tab, 2 Ref.

Descriptors: *Sulfites, *Wastewater treatment, *Pulp and paper industry, Industrial wastes, Methanogenesis, Sulfur dioxide, Anaerobic wastewater treatment, Pulp wastes.

Sulfite pulping will still play an important role in Austria in the foreseeable future. Therefore, efficient and economic means of wastewater treatment have to be searched for. The experience gained with operating laboratory scale and semi-technical scale experiments for anaerobic treatment of condensates and the extraction stage effluent from two mills is presented. The main reason for the inhibition of methanogenesis in these mills was the varying and high concentration of sulfur dioxide in the raw condensate. Up to now the investigations have shown that the condensate of the mill can be treated by the anaerobic process with a possible reduction of the biodegradable COD of even more than 90%. Under technical conditions a series of problems arises (neutralization, solids retention, sulfur dioxide toxicity, start-up of the process) which must be solved technically and considered economically before the final decision about the application of the anaerobic process is made. The advantage of the anaerobic process in terms of

energy alone cannot be the basis for such a decision. (Baker-IVI)
W85-07011

ANAEROBIC FERMENTATION OF SULPHITE PULP MILL EFFLUENTS,
Technische Hochschule Darmstadt (Germany, F.R.). Fachgebiet Papierfabrikation.
A. Geller, and L. Gottsching.
Water Science and Technology, Vol. 17, No. 1, p 157-171, 1985. 9 Fig, 4 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Sulfites, *Pulp and paper mills, Anaerobic digestion, Fixed bed processes, Biological wastewater treatment, Pulp wastes, Bleaching wastes.

Despite internal measures, modern sulfite pulp mills are still releasing considerable amounts of effluents loaded with organic pollutants. The main sources are the spent liquor evaporator and the bleach plant. In the laboratory scale two anaerobic systems (stirred fermentation vessel and fixed bed reactor) were tested for the fermentation of effluents from a magnesium sulfite mill. The efficiency of the fixed bed reactor was substantially better than the efficiency of the fermentor. Upon treatment of evaporator condensates, COD removal exceeded 90% with corresponding BOD removal of 99% after a residence time of 36 hours, whereas the necessary residence time for the same results was about 16 days in the fermentor. The methane production increased with increasing loading, reaching a maximum at a COD loading rate of 7 kg/cu m/day. BOD elimination from bleaching effluents was better than 95% with fixed bed reactor, while COD removal remained below 50%. All experiments were run over a period of more than two years, exhibiting stability of the fixed bed filter, low needs for maintenance and negligible biomass generation. The results of the experiments clearly show the disadvantages of the free moving, homogenously mixed biological solids: very low acclimation time, unstable treatment efficiency, and poor tolerance against high organic loading. (Baker-IVI)
W85-07012

PROCESS CONTROL IN ANAEROBIC WASTEWATER TREATMENT,
AC Biotechnics A.B., Arloev (Sweden).
B. Frostell.
Water Science and Technology, Vol. 17, No. 1, p 173-189, 1985. 1 Fig, 8 Tab. 50 Ref.

Descriptors: *Anaerobic digestion, *Biological wastewater treatment, *Process control, *Reviews, Temperature effects, Hydrogen ion concentration, Solids retention time, Microorganisms.

The monitoring and control of anaerobic waste water treatment are discussed. Optimum biological conditions are given for anaerobic treatment. These include a nutritionally balanced waste water free from oxidants and toxicants, a temperature of 55-60 degrees C, and a pH of 6.8-8.0. Parameters for monitoring and control are discussed. Present system designs usually allow for the control of influent flowrate and temperature but not for the key parameter, solids retention time (SRT). SRT is equivalent to the sludge age in aerobic treatment and is the average time that the microorganisms remain in the reactor during the treatment. In principal there are very few parameters that need control in anaerobic treatment. The real problem is that there are limited possibilities to control the process in a true sense. This is due to the fact that a waste treatment plant has to take what is offered and to the low growth rates of the microorganisms. (Baker-IVI)
W85-07013

ANAEROBIC TREATMENT OF SULFITE EVAPORATOR CONDENSATE IN A FIXED BED LOOP REACTOR,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie.
A. Aivasidis.
Water Science and Technology, Vol. 17, No. 1, p 207-221, 1985. 10 Fig, 2 Tab, 5 Ref.

Descriptors: *Microbial degradation, *Anaerobic digestion, *Fixed bed reactors, *Pulp wastes, *Evaporator condensate, Biological wastewater treatment, Process control, Biomass retention.

A disadvantage of microbial anaerobic degradation processes in waste water pretreatment lies in the relatively long doubling times of anaerobic microorganisms which cause long residence times in a continuous stirred tank reactor. Because of the autocatalytic behavior of the microbial processes and the low carbon incorporation rate which results in low biomass concentrations, decoupling of residence times for substrate and biomass in continuously operated systems is necessary. In this way high space time yields can be achieved under anaerobic conditions as well. Immobilization by an inert support is thought to be an effective alternative. Experiments on anaerobic treatment of sulfite evaporator condensate by means of immobilized microoganisms were carried out in a 12 l fixed bed loop reactor. Porous sinter glass with a porosity of about 60% and a mean pore diameter of 60-100 micro-m served as carrier. The reactor was operated for several months under steady state conditions at different residence times using an iterative approach. At a residence time of 11 hr 84% of the chemical oxygen demand was eliminated at loading rates up to 10 kg COD/cu m a day. On line data acquisition and process control are recommended and easily realized by means of a digital computer, in order to increase selection stress on microorgansim population and optimize space time yield. Extremely satisfactory results have been obtained to date for anaerobic wastewater purification indicating that this technology is basically suitable for a low cost energy- and space-saving treatment of industrial waste water. (Baker-IVI)
W85-07014

TREATMENT OF DIFFERENT WASTEWATERS FROM PULP AND PAPER INDUSTRY IN METHANE REACTORS,
Helsinki Univ. of Technology, Espoo (Finland). Dept. of Forest Products.
P. K. Latola.
Water Science and Technology, Vol. 17, No. 1, p 221-230, 1985. 6 Fig, 3 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Pulp and paper industry, Methane production, Anaerobic digestion, Biological wastewater treatment, Anaerobic filters, Microorganisms.

A wastewater from an integrated paper mill with a COD of 1200 mg/cu dm was anaerobically treated in a multi-stage reactor. The BOD7 removal efficiencies of 60-75% were achieved at maximal loading rates of 5-6 kg COD/cu m/d and HRT of 4-6 hr due to the granular sludge. The BOD7/COD-Cr ratio of the paper mill wastewater was only 0.5 on average, indicating that there exists a lot of biologically undegradable material in the wastewater. Industrial sulfite evaporator condensates from Ca- and Na- processes were treated in anaerobic filters containing light gravel, plastic foam and power plant slag as filter media. The BOD7 removals of 78% on average were achieved at loading rates of 1.8-3.3 kg COD/cu m/day with Ca-process evaporator condensates and 80% BOD7 removals were achieved with Na-process condensates at loading rates of 3.5-4.1 kg COD/cu m/day. Acclimation of microbiological population to a certain type of pulp and paper wastewater seems to be an important factor. This procedure will shorten startup periods and also give more secure treatment results. (Baker-IVI)
W85-07015

ANAEROBIC TREATMENT OF VISCOSE WASTEWATER,
Technische Univ., Vienna (Austria). Inst. fuer Wasserguete und Landschaftswasserbau.
H. Kroiss, F. Plahl-Wabnegg, and K. Svardal.
Water Science and Technology, Vol. 17, No. 1, p 231-239, 1985. 3 Fig, 3 Tab, 3 Ref.

Descriptors: *Anaerobic digestion treatment, *Viscose production, *Sulfates, Neutralization, Zinc, Wastewater treatment, Sulfur bacteria, Activated sludge process.

A treatment process for viscose wastewater is presented which consists of anaerobic pretreatment of the neutralized waste water combining the removal of carbonaceous matter with zinc removal by sulfide precipitation. The organic pollution of the wastewater is used as a substrate for sulfate reducing bacteria present in the anaerobic reactor. The hydrogen sulfide produced precipitates the zinc as insoluble zinc sulfide. Lab scale experiments lasting several months resulted in stable zinc effluent concentration below 1 mg/l combined with a COD removal of about 40-50%. The labscale experiments performed showed that full treatment of the viscose waste water can be carried out by two phase biological treatment: zinc removal in an anerobic upflow reactor, and aerobic final treatment in an activated sludge unit. With this treatment system it is possible to reach very low zinc-concentrations and BOD5 concentrations below 10 mg/l. As the anaerobic process needs only a pH of 6, the neutralization can be performed with limestone instead of lime, which means a 50% cost reduction. Sulfate reduction seems limited by the availability of easily biodegradable COD. The gas produced consists of CO2 and H2S. The excess sludge from anaerobic treatment consists of about 16% organic material and 84% inorganic compounds, of which about 17% are zinc, the rest mainly calcium carbonate precipitated in the reactor. The recovery of the zinc from the sludge is possible but has not been investigated in detail up to now. (Baker-IVI)
W85-07016

COSTS OF ANAEROBIC PROCESSES IN THE PULP AND PAPER INDUSTRY,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
G. K. Anderson, and A. U. Senaratne.
Water Science and Technology, Vol. 17, No. 1, p 241-254, 1985. 2 Fig, 9 Tab, 15 Ref.

Descriptors: *Anaerobic digestion, *Pulp and paper industry, *Costs, Reviews, Wastewater treatment, Sulfur compounds, Capital costs, Operating costs.

The advantages of using anaerobic treatment processes for treating wastewaters from the pulp and paper industry are described. The wastewater characteristics are outlined and a brief description given of the various anaerobic systems which are available. Problems associated with the presence of sulfur compounds and their solution are discussed and an example is described of the method of evaluating overall capital and operating costs. The available information indicates that the anaerobic treatment of industrial wastewaters, including those from the pulp and paper industry is a feasible and economical solution to many of the problems encountered. Consequently, anaerobic systems may be applied to these industries in order to satisfy the following requirements: recovery of a useable form of energy, reduction in pollution load, a cost effective solution for the minimization of production costs and for a potential low cost expansion of existing aerobic treatment processes. (Baker-IVI)
W85-07017

COST COMPARISON OF AEROBIC AND ANAEROBIC WASTEWATER TREATMENT SYSTEMS,
Tampere Univ. of Technology (Finland).
P. Rantala, and P. Vaananen.
Water Science and Technology, Vol. 17, No. 1, p 255-264, 1985. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Cost analysis, *Wastewater treatment, *Anaerobic digestion, Aerobic digestion, Reviews, Economic aspects, *Pulp and paper industry, Activated sludge process, Biogas.

The costs of different types of aerobic, anaerobic and combined wastewater treatment systems are compared. The assumed BOD or COD-loads from typical forest industry processes form the basis of comparison. General cost curves for various waste treatment processes and some case examples are also presented. It was assumed that the wastewater is treated to the same effluent quality by using activated sludge, modified activated sludge and

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combination of anaerobic-aerobic treatment process. Different types of combinations are analyzed in the anaerobic-aerobic systems. The selection of the method or combination of methods must always be made case by case. In some cases the anaerobic-aerobic process combination is economically competitive. Competitiveness will increase if biogas can be used and a moderate price could be calculated for it. Activated sludge, and especially aerated lagoon processes, in some cases have a disadvantage of requiring larger treatment spaces. Poor soil conditions and long distances to lead effluent may significantly increase the cost of these aerobic treatment methods. The factors which may make anaerobic processes economically competitive are high concentrations of BOD and COD, the possibility of using biogas, the lack of suitable land in the neighborhood of the mill for treatment processes which need large areas, strict effluent standards and a high temperature of the wastewater owing to which wastewater cooling is needed prior to the aerobic processes, whereas in the anaerobic processes a thermophilic area can be used. (Baker-IVI)
W85-07018

FOREST INDUSTRY ANAEROBIC WASTEWATER TREATMENT AND ITS FUTURE DEVELOPMENT,
Ekono Oy, Helsinki (Finland).
J. Orivuori.
Water Science and Technology, Vol. 17, No. 1, p 265-270, 1985. 1 Tab, 7 Ref.

Descriptors: *Industrial wastes, *Wastewater treatment, *Pulp and paper industry, Anaerobic digestion, Reviews.

Reasons for the interest in anaerobic treatment are focused on in the light of recent developments in knowledge of the quality and quantity of forest industry wastewaters. Future wastewater characteristics and the possibility of anaerobic treatment to meet future demands are discussed. The need for cooperation between forest industry process engineers and wastewater treatment specialists is emphasized in order to optimize internal and external pollution control methods. Basic research should be carried out in the following main areas for future use: wastewater components, pure cultures of anaerobic bacteria, trace element role and need, and toxic compounds used or produced by the pulp and paper industry. (Baker-IVI)
W85-07019

ANAEROBIC TREATMENT OF SULPHITE EVAPORATOR CONDENSATE IN A PILOT PLANT OF NOVEL DESIGN,
PURAC A.B., Lund (Sweden).
L. Gunnarsson, and B. Rosen.
Water Science and Technology, Vol. 17, No. 1, p 271-279, 1985. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Wastewater treatment, *Pulp wastes, *Anaerobic digestion, *Pilot plants, *Evaporator condensate, Sulfites, Fixed bed reactor, Biological wastewater treatment, Chemical oxygen demand, Suspended solids, Sludge.

Sulfite evaporator condensate has been treated in an anaerobic pilot plant, consisting of two separate units. One unit was an ordinary mixed reactor. The second reactor was identical to the first, but is contained in addition a plastic medium as a fixed bed reactor. The agitator in the reactor provided circulation through the medium. Both reactors had internal sedimentation and no external settling device. The reactor with a fixed biofilm was more stable and had an overall better performance than the reactor without a medium. The latter was particularly severely disturbed by an instantaneous intrusion of high amounts suspended solids, which did not affect the former. Twelve weeks after the start of the tests, the fixed bed reactor was not yet in final equilibrium, but at a loading of 0.5 cu m/cu m and 6 kg COD/cu m x d, the COD-reduction was 66%, the BOD-reduction 84%, giving 68% methane in the biogas and 0.15 cu m CH4 was produced per kg COD added. The results show a positive effect of the conversion of a suspended growth system to a partially attached system. The results were not affected by the performance of the separation of sludge and water as filtered reactor content was analyzed in order to focus on the biological transformation process. The sludge in the reactor without attached growth was, at least partially, washed out when a shock load of suspended solids entered the reactor, thus demonstrating one disadvantage of the system. (Baker-IVI)
W85-07020

INFLUENCE OF SULFUR COMPOUNDS ON BIOGAS PRODUCTION FROM FOREST INDUSTRY WASTEWATER,
Tampere Univ. of Technology (Finland).
J. A. Puhakka, J. A. Rintala, and P. Vuoriranta.
Water Science and Technology, Vol. 17, No. 1, p 281-288, 1985. 3 Fig, 3 Tab, 28 Ref.

Descriptors: *Wastewater treatment, *Sulfur compounds, *Pulp and paper industry, Biogas, Anaerobic digestion, Methanogenesis, Sulfur, Evaporator condensate, Lignosulfonate.

Various inorganic sulfur compounds and lignosulfonate were studied with respect to their effect on biogas production from synthetic wastewater simulating sulfite evaporator condensate. In biogas production assay tests municipal digester sludge was used as seed material. The results show that the oxidation state of sulfur had an influence on inhibition of biogas production from the simulated evaporator condensate wastewater. Sulfate and sulfide in concentrations 100 mg S/l had no effect whereas sulfite, thiosulfate and dithionite caused a lag-period in biogas production. Inorganic sulfur compounds were partially reduced to sulfide in anaerobic conditions. (Baker-IVI)
W85-07021

ROLE OF FACULTATIVE ANAEROBIC MICRO-ORGANISMS IN ANAEROBIC BIODEGRADATION OF CHLOROPHENOLS,
Enso-Gutzeit Oy, Imatra (Finland). Research Centre.
R. Hakulinen, S. Woods, J. Ferguson, and M. Benjamin.
Water Science and Technology, Vol. 17, No. 1, p 289-301, 1985. 10 Fig, 3 Tab, 23 Ref.

Descriptors: *Microorganisms, *Anaerobic digestion, *Chlorophenols, Organic compounds, Wastewater treatment, Bacteria, Yeasts, Phenols.

A search was begun for microorganisms that might dechlorinate chlorophenols in continuous flow reactors and to isolate and identify these organisms in pure or mixed cultures. Pure cultures of facultative anaerobic bacteria and yeasts were isolated from anaerobic reactors fed synthetic wastewater which contained eight different chlorophenolic compounds. The most common species were Klebsiells spp. and K. pneumoniae. Some common colonies were identifed as Pseudomonas-like organisms and Aeromonas hydrofilia. The concentration of Pseudomonas-like organisms increased, as did the concentration of yeasts, when the total chlorophenol concentration in the feed was increased from zero to 2.4 or 5.3 mg/l. Under anaerobic conditions pure and mixed cultures were tested for use of 2,4,6-trichlorophenol (2,4,6-TCP) as a sole carbon and energy source. None of the isolates was able to degrade 2,4,6-TCP under anaerobic condition in pure cultures. Mixed cultures containing only P. aeruginosa and K. oxytoca were able to degrade 2,4,6-TCP. Microscopic observations suggest that yeasts, morphologically resembling Candida type, may play a major role in the formation of flocs in an anaerobic dechlorination reactor system. The yeasts may also play a role in chlorophenol degradation, as their number increased with an increasing chlorophenol concentration. (Baker-IVI)
W85-07022

ANAEROBIC TREATMENT OF FIBRE BOARD MILL WASTEWATER,
Technische Univ., Vienna (Austria). Inst. fuer Wasserguete und Landschaftswasserbau.
H. Kroiss, and K. Svardal.
Water Science and Technology, Vol. 17, No. 1, p 307-311, 1985. 2 Fig, 2 Tab.

Descriptors: *Anaerobic degradation, *Wastewater treatment, *Pulp and paper industry, Neutralization, Pilot plants, Water reuse.

Wastewater treatment of fiber board mill effluents has important economic considerations because of the high cost of treatment. Reuse of treated wastewater can considerably reduce wastewater discharge, provided that this does not effect product quality. The specific pollution load per ton of fiber board at an Austrian factory is in the range of 110 kg COD or 50 kg BOD5. Aerobic treatment would result in unacceptable costs. Reliable neutralization was shown to be necessary to obtain good results before the wastewater enters the reactor. Maximum removal efficiencies for the COD of 86% and for the BOD5 of 94% could be achieved in lab scale investigations at low volumetric loadings. The growth of the methanogens seems to be partially inhibitied. Semitechnical pilot investigations at the mill site have not so far resulted in stable removal efficiencies over long periods. The low BOD5 concentration of the raw wastewater resulted in a relatively high loss of biomass from the sludge solids separation step. In combination with the inhibited growth of the methanogens this results in low concentration of active biomass in the anaerobic reactor. (Baker-IVI)
W85-07023

SLUDGE REDUCTION BY IN-PLANT PROCESS MODIFICATION: NEW YORK CITY'S EXPERIENCES,
New York City Dept. of Environmental Protection, Wards Island. Div. of West Operations.
For primary bibliographic entry see Field 5E.
W85-07039

DYNAMIC OPTIMIZATION OF REGIONAL WASTEWATER TREATMENT SYSTEMS,
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
S. L. Klemetson, and W. J. Grenney.
Journal of the Water Pollution Control Federaton, Vol. 57, No. 2, p 128-134, February, 1985. 9 Fig, 2 Tab, 1 Ref.

Descriptors: *Wastewater treatment, *Optimization, *Jordan River, *Salt Lake, *Utah, Planning, Decision making, Model studies.

A wastewater treatment optimization model (WTOM) was developed to analyze regional wastewater treatment needs and evaluate the timing and capacity expansion decisions for wastewater treatment systems. The procedure consists of selecting the combination of treatment plants and treatment levels over the planning period that best meets the desired objectives at the lowest total discounted future cost. The model will not perform detailed cost analyses, but does allow the economic evaluation of a large number of treatment alternatives. The application of the WTOM in the Lower Jordan River Region along the Wasatch Mountains in Salt Lake and southern Davis Counties, Utah is described. There are eight treatment plants in Salt Lake County and one in Davis County that discharge effluent into the Jordan River in sufficient quantity to be considered for study. There was sufficient treatment capacity in the region to meet the current needs; however, three of the plants, Murray, Tri-Community, and Sandy, were overloaded. Planning of wastewater treatment systems was needed because of the population growth predicted for the region. The WTOM was able to analyze the costs of 10 alternative over a 20 year period in about 20 seconds. The time for the dynamic programming portion of the model for analyzing four alternatives over a 20 year period was about 30 seconds. The model can also perform a complete economic analysis of an individual alternative to provide information for preliminary reports. The proper timing of additions and expansions to wastewater treatment systems is critical from an economic standpoint. The problem can best be solved in the context of an optimal staging policy which allows the construction and operation of a treatment system that meets water quality standards at the lowest possible cost. (Baker-IVI)

W85-07041

BIOLOGICALLY ENHANCED OXYGEN TRANSFER IN A FIXED-FILM SYSTEM,
Washington Univ., Seattle. Dept. of Civil Engineering.
S. Reiber, and D. Stensel.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 135-142, February, 1985. 13 Fig, 1 Tab, 19 Ref.

Descriptors: *Biological wastewater treatment, *Oxygen transfer, *Fixed-film reactors, Biochemical oxygen demand, Dissolved oxygen, Wastewater treatment.

A measurement technique was sought to separate interfacial oxygen transfer and bulk liquid dissolution transfer rates, to investigate oxygen transfer characteristics in a sparged fixed-film system, and to determine fundamental parameters that affect interfacial oxygen transfer rates in a sparged, fixed-film system. An experimental apparatus incorporating a closed gas recycle loop and electrolytic oxygen generator provided a continuous and accurate in situ method to measure oxygen consumption in a biological reactor. Steady-state and unsteady-state oxygen consumption rates could be monitored. In a sparged, fixed-film biological reactor, interfacial transfer and bulk liquid dissolution occurred simultaneously. Oxygen dissolution to the bulk liquid was assumed to follow the conventional concept of two-film gas transfer. Interfacial oxygen transfer, on the other hand, represented an additional consumption pathway resulting from the close contact between sparge gas bubbles and an active biofilm surface. The bulk liquid dissolution rate was determined from clean water test procedures performed at each combination of sparge and hydraulic application rate. The interfacial oxygen transfer rate was determined by measuring the total system oxygen consumption rate using the CFER and then subtracting both the oxygen transfer rate caused by bulk liquid dissolution and the oxygen consumption rate from the influent liquid. (Baker-IVI)
W85-07042

OPTIMAL DESIGN OF FLUIDIZED BED BIOREACTORS,
State Univ. of New York at Buffalo. Dept. of Chemical Engineering.
G. Andrews, and R. Trapasso.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 143-150, February, 1985. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Fluidized bed process, *Optimization, *Bioreactors, Systems design, Biological wastewater treatment, Particle size, Support particles.

For any supported film bioreactor there exists, for a given support particle size and substrate concentration, a film thickness that maximizes the uptake rate per unit reactor volume. In choosing the support particles for best reactor performance several factors must be considered. One is solids mixing, which must in practice fall somewhere between three possible extremes: complete mixing, complete stratification based on support particle size, and with monosize support particles, stratification based on microbial film thickness. With the small particle sizes and bed porosities required for high loadings, one of these forms of stratification will usually be significant. Any design must have a Reynolds number greater than 1 to minimize the liquid-phase mass transfer resistance. Between this constraint and the extremes of solids mixing, numerous modes of operation are possible, of which two appear promising. The first involves light monosize support particles. Such particles tend to stratify with the thickest films near the base of the bed, which approximates the optimum distribution of film. The second involves heavy particles like sand. They can be smaller, which compensates for their tendency to stratify in reverse with the thinnest films near the base. (Baker-IVI)
W85-07043

INVESTIGATION OF THE REMOVAL OF ORGANICS AND NITROGEN IN AN OXIDATION DITCH,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang, and D. M. Drew.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 151-156, February, 1985. 3 Fig, 3 Tab, 26 Ref.

Descriptors: *Oxidation ditches, *Wastewater treatment, *Nitrogen, *Organic compounds, Nitrification, Denitrification, Oxidation.

Oxidation ditches, in addition to reducing short-circuiting by providing a plug-flow regime, can provide favorable conditions for simultaneous reduction of organic and nitrogenous materials. A significant process stability was illustrated by the relatively uniform final effluent quality, under substantially variable influent loading conditions. The organic substrate reaction rates of the aerobic zones were about two orders of magnitude higher than that of the post aeration zone, and about three orders of magnitude higher than those of the anoxic zones. The specific cell growth rates of the aerobic zones were similar to substrate reaction rates, about two orders of magnitude higher than that for the post aeration zone. Through the linearization of the Monod model, the maximum specific cell growth rates determined for aerobic and post aeration zones were 0.2/hr and 0.00156/hr, respectively. The bioactivity may vary considerably within an oxidation ditch, and be highest at the aerobic zones where the aerators are located. The rapid alternation between aerobic and anoxic conditions provides a natural environment for nitrification and denitrification in which total nitrogen removal results. The ammonia reaction rate and the specific cell growth rate of Nitrosomonas in the aerobic zones were two orders of magnitude higher than that in the post aeration zone. Overall treatment efficiency can be increased by adjusting the oxygenation capacity along the ditch channels. A progressive increase in dissolved oxygen is maintained from the upstream to downstream channels, providing buffering capacities for diurnal peak loadings and favorable conditions for sludge that settles well. (Baker-IVI)
W85-07044

WATER QUALITY IMPACTS OF CHLORINATING PAPERMILL EFFLUENTS,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Water Quality Management.
R. H. Shertzer.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 172-180, February, 1985. 4 Fig, 7 Tab, 18 Ref.

Descriptors: *Water quality control, *Chlorination, *Brandywine Creek, *Pennsylvania, *Pulp and paper industry, Bacteria, Klebsiella, Escherichia, Coliforms, Wastewater treatment, Effluents.

The water quality benefits and detriments of chlorinating two papermill effuents aproximately 6 km upstream from a drinking water intake in Chester County, Pennsylvania, were evaluated. Klebsiella was a major component of the fecal coliform bacteria discharged by both papermills and consistently outnumbered Escherichia coli in the effluents and at all downstream sampling stations. E. coli were dominate in the background stream collections and in the discharge from the municipal wastewater treatment plant. All samples (stream and effluent) demonstrated a trend toward lower bacteria counts during the chlorination phases of the study. Neither papermill satisfied current applicable permit requirements for coliform bacterial density with chlorination. Both Klebsiella and E. coli densities demonstrate progressive instream reductions with distance downstream from the papermills. This pattern, attributable to dilution, die-off, or settling, was not altered by chlorination, indicating limited carry over of chlorine or chlorine compounds into East Branch Brandywine Creek and little or no regrowth of bacteria instream. An evaluation of instream water quality showed that conditions were fairly constant during chlorination and nonchlorination phases of the study. Stream biology was not altered by chlorine addition. Macroinvertebrate collections made above and below the papermills showed virtually no change after chlorination and characterized the stream as a warm water habitat receiving organic or oxygen-demanding waste which caused slight to moderate degradation. No toxic response from either chlorine or heavy metals and no adverse impact on protected recreational water uses was detected. (Baker-IVI)
W85-07047

OVERLAND FLOW WASTEWATER TREATMENT AT EASLEY, SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
A. R. Abernathy, J. Zirschky, and M. B. Borup.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 291-299, April, 1985. 4 Fig, 11 Tab, 12 Ref.

Descriptors: *Overland flow, *Wastewater treatment, *Performance evaluation, *Easley, *South Carolina, Ammonia, Biochemical oxygen demand, Total organic corbon, Suspended solids, Nitrogen, Model studies, Kinetics.

Data was collected from the Easley, South Carolina overland flow treatment system to develop kinetic rate constants for describing pollutant removal during overland flow. These constants are compared with similar constants in the literature. The performance data show the process to be efficient and cost-effective. Pollutant removals from wastewater as it flows down the overland flow slopes followed first-order kinetics. The kinetic rate constants developed from the Easley data generally differed significantly from similar constants in the literature. Differences in the characteristics of the Easley system and the systems from which the other models were developed could account for the poor performance of these models. When the UCD model was modified to account for a different residual TOC concentration, however, it accurately predicted BOD and TOC removal at the Easley system (with the exception of BOD removal at the 0.21 cubic m/hr application rate). Agreement between the CRREL Method and the Easley data was also limited. Although both the UCD model and the CRREL Method successfully modeled pollutant removal on the systems in which these models were developed, these models should be verified further with data from other overland flow systems. The UCD models should, perhaps, be modified to account for residual pollutant concentrations which may differ from those used to develop the model. (Baker-IVI)
W85-07050

SIMULTANEOUS DENITRIFICATION WITH NITRIFICATION IN SINGLE-CHANNEL OXIDATION DITCHES,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, and W. E. Langeland.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 300-308, April, 1985. 4 Fig, 9 Tab, 39 Ref.

Descriptors: *Denitrification, *Oxidation ditches, *Nitrification, Chemical oxygen demand, Nitrogen, Wastewater treatment, Performance evaluation, Oxygen.

Successful one-reactor denitrification with nitrification was documented at two full-scale single-channel oxidation ditches. Nitrogen loss and reduction in required oxygen were demonstrated through mass balances. Sampling of dissolved oxygen and NO2(-) + NO3(-)-N, as well as theoretical considerations, indicated that denitrification occurred continuously in anoxic microzones inside the floc. Anoxic zones within the reactor were not necessary and were never detected at one of the facilities. Operation of one-reactor denitrification with nitrification in an oxidation ditch was relatively simple. The primary control parameter was the oxygen transfer rate, which was sufficient to transfer enough oxygen to satisfy nitrification and aerobic COD oxidation and maintain a suitable dissolved oxygen concentration. Average concentrations between 0.1 and 0.5 mg/L oxygen were successful at the two field sites. (Baker-IVI)

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W85-07051

RATIONAL DESIGN PARAMETERS FOR AMMONIA CONVERSION IN WATER HYACINTH TREATMENT SYSTEMS,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
A. S. Weber, and G. Tchobanoglous.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 316-323, April, 1985. 10 Fig, 5 Tab, 11 Ref.

Descriptors: *Water hyacinth, *Wastewater treatment, *Ammonia, Design criteria, Plug flow reactors, Aquatic plants, Hydraulic properties.

Parameters currently used to design (size) aquatic systems include hydraulic detention time, hydraulic loading rate, hydraulic applicaton rate, and nitrogen loading rate. A series of pilot scale plug flow water hyacinth reactors were operated under a variety of experimental conditions to determine rational design parameters for NH4(+)-N conversion. Ammonium nitrogen conversion in plug flow water hyacinth systems is a function of the hydraulic application rate and reactor length. Ammonium nitrogen conversion rate is independent of the NH4(+)-N loading rate. The use of hydraulic detention time as a design parameter is not recommended. (Baker-IVI)
W85-07052

KINETIC STUDIES OF CHEMICAL AND BIOLOGICAL TREATMENT FOR RENOVATION,
Technion - Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
M. Rebhun, N. Galil, and N. Narkis.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 324-331, April, 1985. 12 Fig, 6 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Wastewater renovation, *Kinetics, Biological wastewater treatment, Chemical treatment, Lime, Acidity, Nitrification, Denitrification, Sludge treatment.

A comparison was made of the substrate removal and growth rate constants, and die-off rate and yield coefficients of chemically treated and conventionally settled wastewater from the same source. Alum chemically flocculated wastewater (CFW) can be biologically treated in all modes of operation; the high-pH lime CFW can be treated in the nitrification and combined nitrification-denitrification modes, because of the acidity generated in nitrification that reduces the high pH. The CFW contains only soluble BOD (substrate) to be removed by biodegradation and biosynthesis; the settled wastewater (SW) contains the same soluble BOD and also particulate BOD to be removed by biodegradation and by agglomeration in the biofloc. Expressions were developed to distinguish and calculate the rate of removal by biodegradation as part of total removal rate and the biomass yield coefficient as a part of total sludge yield coefficient. The substrate removal rate constants, the growth rate constants, and the yield coefficients were considerably higher for CFW than for SW. The growth rate of nitrifiers of CFW was much higher than for SW; the critical sludge age for nitrification of CFW was 4 days, as compared to 10 days for SW. The soluble organic substrate (soluble BOD) in SW and in CFW was readily available as a carbon source for denitrification, whereas the particulate BOD was not available in the denitrification reactors at residence times of 1 to 2 hours. (Baker-IVI)
W85-07053

STUDY OF THE BIODEGRADABILITY OF RESIDUAL COD,
A. F. Gaudy, and T. R. Blachly.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 332-338, April, 1985. 9 Fig, 1 Tab, 15 Ref.

Descriptors: *Chemical oxygen demand, *Aerobic treatment, *Biodegradation, Continuous flow processes, Wastewater treatment, Oxygen demand.

Biological treatment for removal of soluble waste organic substrates has proven highly successful, but treatment efficiency is seldom 100%. Residual organic material remains even when simple monosaccharides or organic acids are fed to an acclimated microbial population under ideal aerobic growth conditions. The long term fate of the COD remaining after aerobic treatment of a synthetic waste was explored. The major conclusion is that while the residual COD measured in batch or continuous-flow treatability studies is nonbiodegradable, for practical purposes, in secondary treatment processes, it can be metabolized over the long term. More than 90% of this residual is subject to biological metabolism. Long cell retention times correspond to slow specific growth rates. This work indicates that slow specific growth rates make for lower specific decay rates, but it seems that an equilibrium value is approached. (Baker-IVI)
W85-07054

CANMET'S PROJECT ON THE CHEMISTRY, GENERATION AND TREATMENT OF THIOSALTS IN MILLING EFFLUENTS,
Noranda Research Centre, Pointe Claire (Quebec).
M. Wasserlauf, and J. E. Dutrizac.
Canadian Metallurgical Quarterly, Vol. 23, No. 3, p 259-269, July-September, 1984. 2 Fig, 3 Tab, 41 Ref.

Descriptors: *Thiosalts, *Sulfide ore milling, *Wastewater treatment, *Wastewater analysis, Effluents, Costs, Biological wastewater treatment, Sample preservation, Titration.

During the milling of sulfide ores, part of the sulfide content is oxidized by oxygen dissolved in processing streams. Although the thermodynamics of the oxidation process suggest that only sulfate should be produced, kinetic limitations in neutral or alkaline media result in the formation of partially oxidized sulfur oxyanions, collectively known as thiosalts. Thiosalt-containing effluents are unstable at ambient temperatures. Methods of storing and analyzing thiosalt effluents were developed. The Noranda mercuric chloride titration procedure is both simple and accurate. Both in-mill and laboratory studies were conducted to evaluate the factors governing the generation of thiosalts during milling. The principal factors affecting thiosalt generation in milling circuits were grinding pH, sulfide content of the ore, residence time and temperature. Mass balances were conducted at two operating mills to define the relative importance of the various unit operations. Fourteen methods of thiosalt destruction were evaluated on technical and economic grounds. Although most of these methods were evaluated in bench scale tests or in preliminary studies, pilot scale on-site tests were conducted to determine the feasibility of biological oxidation. Considering all aspects of the treatment, thiosalt destruction costs are very high. None of the methods has been demonstrated to be continuously effective for the large scale treatment of actual thiosalt effluents. (Moore-IVI)
W85-07091

RECOVERY OF ACID FROM WASTEWATER BY ELECTRODIALYSIS,
Yokohama National Univ. (Japan).
K. Urano, T. Ase, and Y. Naito.
Desalination, Vol. 51, No. 2, p 213-226, August, 1984. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Chemical recovery, *Electrodialysis, *Wastewater treatment, Membrane processes, Iron and steel industry, Acid recovery.

Acidic wastewater which is released from the iron and steel industry is one of the wastewaters that needs the application of techniques which not only can remove pollutants but also can recover valuable materials from wastewater. The optimum operating conditions for electrodialysis using a newly developed membrane were studied for recovery of acid from acidic wastewater released from the iron and steel industry. Equations are given to express the limiting current densities and the current efficiencies. The concentration of iron(III) ion should be controlled lower than one twentythird of the acid concentration of diluting solution since the electric resistance of the cation exchange membrane was increased considerably by fouling with iron(III) ion. Calculations for the plant design and the cost estimate were attempted from the experimental results obtained. (Baker-IVI)
W85-07095

REMOVAL OF HEAVY METALS FROM WASTEWATER BY APPLICATION OF HOT IRON DESULFURIZATION SLAG,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
G. S. Lee, and J. J. Ganczarczyk.
Asian Environment, Vol. 6, No. 4, p 17-20, 1984. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Heavy metals, *Desulfurizing slag, Iron, Phenols, Economic factors, Sulfides, Precipitates.

Desulfurizing slag proved advantageous for the removal of soluble heavy metals from wastewater both technically and economically. This process was superior to hydroxide precipitation as well as sulfide precipitation in the sense that it remained effective over a wider range of pH. A steady stream of good quality effluent could be produced with less attendance. This process eliminated chemical costs that are associated with sulfide precipitation and hydroxide precipitation. Low residual dissolved zinc of not more than 0.2 mg/l can be achieved over a pH range of 9.0 to 10.9. The main removal mechanism was believed to be a combination of sulfide precipitation and hydroxide precipitation. Other mechanisms like adsorption could also have contributed. Dissolved sulfide was introduced into the wastewater by the desulfurizing slag but only in very small amounts which was not likely to cause any pollution problems. Phenol removal was an added advantage of slag; phenols were totally eliminated from the blast furnace blowdown from an initial concentration of 29.44 micro-g/l by using 8 micro-g/l of desulfurizing slag. (Baker-IVI)
W85-07108

EFFECT OF THE RATIO OF REACTOR DIAMETER TO PARTICLE SIZE ON THE PERFORMANCE OF A MOVING MEDIA REACTOR,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. J. Bhatt, D. S. Bhargava, and P. S. Panesar.
Asian Environment, Vol. 6, No. 4, p 21-23, 1984. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Phenols, *Reactor size, *Particle size, Diffusion, Adsorption, Organic compounds, Moving media reactor.

The effect of reactor size on phenol removal was investigated. The ratio of equilibrium concentration attained in the effluent sample (C) to the initial influent concentration of phenol (Co), that is (C/Co), is observed to increase with an increase in ratio of sorbent to sorbate mass input rates (Ws/WL). At lower values of Ws/WL the rate of reduction in C/Co is faster compared to the higher values of Ws/WL. A Ws/WL ratio of .015 to .02 is observed to be optimum giving C/Co values in the range of 0.45 to 0.6 (that is, removal of 40 to 55%). The variation in values of C/Co is also observed to be dependent upon the ratio of reactor diameter to charcoal particle diameter (D/dm). A charcoal particle having diameter 280 micron giving a D/dm ratio of 402.8 is found to be optimum giving a C/Co value of 0.45 (that is, 55% removal) at an optimum value of Ws/WL = .02. The variation in phenol removal efficiency, in microgram per gram of charcoal (qe) decreases with an increase in ratio of sorbent to sorbate mass input rates (Ws/WL). At lower values of Ws/WL variation in qe is sensitive and significant while at higher values of Ws/WL the variation in qe values is not so significant. The variation in qe values is also dependent on the ratio of the diameter of reactor to diameter of the sorbent particle (D/dm). A charcoal particle size of 280 micron giving a D/dm ratio of 402.8 is optimum giving maximum qe values of 300 micrograms of phenol removed/gram charcoal at an optimum Ws/WL ratio of .02. The Reynolds

Number and the terminal settling velocity for the charcoal particle govern the overall removal for a given D/dm and Ws/WL ratios. (Baker-IVI)
W85-07109

BIOLOGICAL WASTEWATER TREATMENT IN A FLUIDIZED BED REACTOR,
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
T. Akiyama, I. Tanaka, M. Koga, H. Hori, and M. Yano.
Asian Environment, Vol. 6, No. 4, p 24-26, 1984. 5 Fig, 2 Tab, 5 Ref.

Descriptors: *Biological wastewater treatment, *Fluidized bed process, Total suspended solids, Dissolved oxygen, Suspended solids, Wastewater treatment, Organic carbon.

A biological fluidized bed process has several important advantages due to the high concentration of biomass that can be maintained in the bed. The major advantages are reduction of construction cost, energy and space requirements. Basic data obtained experimentally by using the laboratory scale reactor for the optimum design in a biological fluidized bed treatment to primary-treated domestic sewage are presented. Measurements of conventional parameters were started after the TOC removal efficiency was indicated to be above 80%. TOC removal efficiency slightly increased with decreasing sand diameters. TOC removal rate was proportional to TOC loading rate. The local VSS (volatile suspended solids) concentration was varied along the bed height in the fluidized bed, that is, a few in the lower region, maximum in the middle and decreasing numbers with height in the upper region. DO and TSS concentration decreasd with the bed height. The effuent BOD5 concentration exceeded 20 mg/l, when the BOD5 load rate was 7 kg/cubic m day. This value was similar to that in the previous reports. The average VSS was 11 g/l in the biological fluidized bed treatment and the value was several times larger than the conventional activated sludge treatment. (Baker-IVI)
W85-07110

MODEL SYSTEM OF BULKING AND FLOCCULATION IN MIXED CULTURE OF SPHAEROTILUS SP. AND PSEUDOMONAS SP. FOR DISSOLVED OXYGEN DEFICIENCY AND HIGH LOADING,
Osaka Univ. (Japan). Dept. of Biochemical Engineering.
H. Tanaka, N. Kurano, S. Ueda, S. Ueda, and M. Okazaki.
Water Research, Vol. 19, No. 5, p 563-571, 1985. 13 Fig, 3 Tab, 20 Ref.

Descriptors: *Activated sludge processes, *Bulking sludge, *Flocculation, *Dissolved oxygen, Organic loading, Sedimentation, Bacteria.

A mixed continuous culture system was made up as a model for bulking and flocculation phenomena of the activated sludge to study the effect of dissolved oxygen deficiency and the effect of high organic loading. The system consisted of a floc forming bacterium and a filamentous bacterium which were isolated from the activated sludge and were identified as Pseudomonas sp. and Sphaerotilus sp., respectively. Sphaerotilus sp. had the potential to cause a filamentous bulking phenomenon on the activated sludge. In the sample activated sludge, a slight reduction of dissolved oxygen (DO) level in the reactor induced filamentous bulking gradually, while a further reduction of DO level caused it more rapidly. In this bulking sludge, the respiration activity has increased, but the affinity for oxygen is constant. In the case of this filamentous bulking owing to DO deficiency, the maximum oxygen uptake rate may depend on the change of microflora. The filamentous bulking in the sample sludge is caused by addition of the filamentous bacterium. On the contrary, the mixed culture of the filamentous and the floc forming bacteria has good settling characteristics compared to the pure cultures of each strain. Therefore the change of DO level gives rise to the transformation of growth figures of both strains. (Baker-IVI)
W85-07115

INFLUENCE OF PROCESS VARIABLES ON THE MODELLING AND DESIGN OF A ROTATING BIOLOGICAL SURFACE,
Genoa Univ. (Italy). Ist. di Scienze e Tecnologie dell'Ingegneria Chemica.
M. Del Borghi, E. Palazzi, F. Parisi, and G. Ferraiolo.
Water Research, Vol. 19, No. 5, p 573-580, 1985. 8 Fig, 4 Tab, 29 Ref.

Descriptors: *Biochemical oxygen demand, *Rotating biological surface, Model studies, Design criteria, Temperature effects, Wastewater treatment, Biological wastewater treatment, Industrial wastewater.

The Rotating Biological Surface (RBS) process variables were investigated to determine the efficiency of BOD5 removal from wastewater. Operating parameters including influent substrate concentration, liquid retention time, stage temperature, flow rate, disk surface area, hydraulic loading, disk rotational speed, disk sizes, number of disks, fractional submergence, were evaluated. The process parameters were obtained from a pilot scale RBS plant constructed and applied to the treatment of municipal and industrial wastewater and from the literature. The data were employed to determine a kinetic equation of general application which tends to the well-known Michaelis-Menten equation for municipal wastewater and easily degradable substrates. The hydraulic loading, stage number and wastewater temperature are the most significant variables affecting the RBS system performance. The presently developed RBS model shows higher accuracy in predicting the effectiveness of percent BOD removal than Wu's model. The obtained model for urban wastewaters cannot be applied to high strength industrial wastewaters where poorly biodegradable substrates are present together with easily degradable substrates. The situation has been verified by treating strawpaper and tannery wastewaters. For those substrates a more complex equation has been obtained that becomes the Michaelis-Menten type equation at high values of a BOD fraction in the effluent. (Baker-IVI)
W85-07116

DENITRIFICATION BY PACKED BED REACTORS IN THE PRESENCE OF CHROMIUM(VI); RESISTANCE TO INHIBITION,
Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
Z. Lewandowski.
Water Research, Vol. 19, No. 5, p 589-596, 1985. 6 Fig, 3 Tab, 11 Ref.

Descriptors: *Chromium, *Denitrification, *Wastewater treatment, *Packed bed reactors, Filters, Inhibition, Bacteria.

Chromium salts are soluble and toxic for aquatic organisms, especially salts of Cr(6+). The effect of Cr(6+) on bacterial denitrification was investigated in packed bed reactors. Despite the long operation time of the packed bed reactors no adaptation of bacterial systems to the presence of chromium Cr(6+) was observed. The packed bed reactors supplied with various organic compounds as the electron donors for microorganisms and operated under identical conditions showed different reactor resistance to inhibition, RRI. The reactor resistance to inhibition defined as the initial concentration of inhibitor at which the obtained results in terms of the process efficiency are deteriorated may be explained. The reason for this is the difference between the time needed for the process performance and the detention time. The excess detention time over that required leads to existence of reserve in reaction rate which may be reduced by inhibitor action without deterioration of the obtained results. The biological reactors can be designed with the determined reactor resistance to inhibition RRI, according to the expected inhibitor concentration. Inhibition coefficient measurement seems to be a good tool for the inhibitor action assessment. The introduced parameters of specific inhibition sensitivity and specific resistance to inhibition seem to be convenient to characterize the bacterial system being inhibited. (Baker-IVI)
W85-07118

CHARACTERIZATION AND TREATMENT OF CONDENSATES FROM HIGH EFFICIENCY APPLIANCES,
Iowa State Univ., Ames. Dept. of Civil Engineering.
D. E. Harrold, and E. R. Baumann.
Water Research, Vol. 19, No. 5, p 627-638, 1985. 2 Fig, 6 Tab, 39 Ref.

Descriptors: *Heaters, *Condensates, *Wastewater treatment, Neutralization, Flue gases, Metals, Acidity, Sulfur compounds, Nitrogen, Nitrates, Sulfates, Limestone.

High efficiency heating equipment recovers additional heat from the combustion of fossil fuels by using heat exchangers to cool the flue gases formed in the combustion process. In order to characterize the condensate waste stream from experimental high efficiency heaters and a pulse combustion furnace, samples were analyzed for total solids, pH, acidity, alkalinity, nitrate, nitrite, sulfate and selected metals, and were screened for semivolatile organic priority pollutants including phenols and polynuclear aromatic hydrocarbons. Inorganic constituents likely to be found in the condensates were nitrite, nitrate and sulfate which form mineral acids in aqueous solution and account for the acidity and corrosiveness of condensates from gas-fired appliances. Components of condensates with the greatest potential for causing adverse effects and being environmentally unacceptable in soil or residential wastewater systems are pH and metals. Typically, pH values of 3-4 can be expected for condensates produced by high efficiency natural gas appliances. Organic priority pollutants were not detected in condensates from high efficiency natural gas-fired furnaces. Levels of copper in condensates from the experimental heaters indicate significant corrosion of the heat exchanges. Neutralization can be accomplished by passing condensate through a limestone-filled column connected to condensate drain lines, within or adjacent to the appliance, followed by disposal to a residential wastewater system, or by percolation of condensate through limestone used as the porous media in a soil absorption system. (Baker-IVI)
W85-07121

TWO-PHASE ANAEROBIC TREATMENT KINETICS OF PALM OIL WASTES,
National Univ. of Singapore. Dept. of Civil Engineering.
W. J. Ng, K. K. Wong, and K. K. Chin.
Water Research, Vol. 19, No. 5, p 667-669, 1985. 4 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Anaerobic digestion, *Palm oil wastes, Kinetics, Hydraulic retention times.

Palm oil mill effluent (POME) is a major agro-industrial waste in the Southeast Asian region. A laboratory scale two-phase anaerobic digestion system was used to treat a POME containing around 63,000 mg/l COD. Phase separation was accomplished through control of the hydraulic retention times of two reactors operated in series. Acid and methane phase biokinetic coefficients were evaluated. Steady state parameters indicate good process stability with high gas yields. The results indicate that phase separation could be achieved by manipulating the retention times of the reactors and that POME can be effectively treated with a two-phase anaerobic fermentation system. Treatment efficiency reached 85% with the (1 + 30) day system with no cell recycle. The significantly shorter minimum cell regeneration time of the two phase system should be of interest since reactor volumes can be thus reduced. (Baker-IVI)
W85-07124

INHIBITION COEFFICIENT (KI) DETERMINATION IN ACTIVATED SLUDGE,
Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
Z. Lewandowski, K. Janta, and J. Mazierski.
Water Research, Vol. 19, No. 5, p 671-674, 1985. 5 Fig, 5 Ref.

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Descriptors: *Activated sludge process, *Inhibitors, Biological wastewater treatment, Chromium, Cyanide, Pesticides, Organic compounds, Wastewater treatment, Enzymes.

In biological reactors for wastewater treatment there exist many various microorganisms producing many enzymes inhibited in different ways by the toxic compounds. The observed effect is the total influence of the toxic compounds on the biological system rather than the pure inhibition of a single enzyme. The possibility of determining the inhibition coefficient Ki in activated sludge systems by means of respiration rate measurements by the application of a dissolved oxygen matter have been proven. The measured values of Ki were equal to: 87 mg/l of chromium Cr(6+); 0.293 mg/l of cyanide CN(-); 2220 mg/l of DDVP; and 13,800 mg/l of des-methyl DDVP. The applied method of measurement of the inhibition coefficient is simple and time saving. (Baker-IVI)
W85-07125

BIOTRANSFORMATION OF TETRACHLOROETHYLENE TO TRICHLOROETHYLENE, DICHLOROETHYLENE, VINYL CHLORIDE, AND CARBON DIOXIDE UNDER METHANOGENIC CONDITIONS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-07127

GROWTH CHARACTERISTICS OF AQUATIC MACROPHYTES CULTURED IN NUTRIENT-ENRICHED WATER: II. AZOLLA, DUCKWEED, AND SALVINIA,
Central Florida Research and Education Center, Sanford, FL.
K. R. Reddy, and W. F. DeBusk.
Economic Botany, Vol. 39, No. 2, p 200-208, April-June, 1985. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Azolla, *Duckweed, *Salvinia, *Plant growth, *Biomass, Florida, Aquatic plants, Macrophytes, Nitrogen, Phosphorus, Seasonal variation, Floating plants.

The success of aquatic macrophyte-based wastewater treatment systems depends on rapid year-round plant growth and nutrient uptake. The seasonal growth characteristics and biomass yield potential of 4 small-leaf, floating, aquatic macrophytes cultured in nutrient nonlimiting conditions were studied under central Florida's climatic conditions. Biomass yields were 10.6, 11.3, 16.1, and 32.1 t (dry wt)/ha/yr, respectively, for azolla (Azolla caroliniana), giant duckweed (Spirodela polyrhiza), common duckweed (Lemna minor), and salvinia (Salvinia rotundifolia). Operational plant density was in the range of 10-80 g dry wt/sq m for azolla, 10-88 g dry wt/sq m for giant duckweed, 10-120 g dry wt/sq m for common duckweed, and 35-240 g dry wt/sq m for salvinia. Specific growth rate (% increase per day) was maximum at low plant densities and decreased as the plant density increased. Although small-leaf, floating plants may not be suitable in monoculture biomass production systems because of low biomass yields, they may be suitable for inclusion in polyculture systems with larger aquatic plants. The high N content (crude protein = 20-33%) of small-leaf, floating plants suggests the use of biomass as animal feed. Overall N and P removal by these plants is low compared to many large-leaf, floating plants, but the narrow N/P ratio suggests that these plants are efficient in removing P from wastewaters. (Moore-IVI)
W85-07144

5E. Ultimate Disposal Of Wastes

FEASIBILITY OF USING FOREST VEGETATION TO RENOVATE SEPTIC TANK EFFLUENT IN THE NEW JERSEY PINE BARRENS,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
For primary bibliographic entry see Field 5D.
W85-06310

REGULATING HAZARDOUS AND MIXED WASTE AT DEPARTMENT OF ENERGY NUCLEAR WEAPONS FACILITIES; REVERSING DECADES OF ENVIRONMENTAL NEGLECT,
Natural Resources Defense Council, Inc., Washington, DC.
For primary bibliographic entry see Field 6E.
W85-06528

MULTI-OBJECTIVE OPTIMIZATION MODEL FOR AQUIFER MANAGEMENT UNDER TRANSIENT AND STEADY-STATE CONDITIONS,
Nebraska Univ., Lincoln. Dept. of Mathematics.
For primary bibliographic entry see Field 4B.
W85-06562

USE OF THE CONVEYANCE METHOD IN DESIGN AND ANALYSIS OF PRESSURIZED EFFLUENT DISTRIBUTION SYSTEMS,
P. Vosse.
Journal of Environmental Health, Vol. 47, No. 4, p 180-183, January/February, 1985. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Effluent distribution systems, *Pressurized systems, *Conveyance method, Wastewater disposal, On-site wastewater disposal, Mathematical equations, Hydraulic design.

The trend in on-site sewage disposal systems to large distribution fields, mounds and filter beds has resulted in the increased use of pressurized effluent distribution systems to obtain equal application. The design of such systems has been complicated by the need to determine the sum of pressure losses between each discharge orifice and each manifold outlet, a process requiring several iterations of complicated equations. The Conveyance Method simplifies the design of pressurized distribution systems by providing an equation to calculate the total pressure loss in such a pipe in one step. A procedure is presented for designing a pressurized effluent distribution system using the Conveyance Method to determine pressure balance in the system. The procedure includes the determination of the spacing discharge orifices and the sizing of the effluent pump and pump chamber. The purpose of a pressurized system is to provide equal distribution of the sewage effluent throughout the drainfield piping. This will occur if there is equal flow in each lateral, equal flow from each orifice, and the orifices are equally spaced within the lateral. The flow within the system is controlled by the orifice diameter and the hydraulic pressure. Application of the conveyance method is demonstrated by an example. The steps in the procedure call for determining orifice flow, orifice spacing and total system flow, headloss calculations, percent difference in orifice pressure, and completion of the hydraulic design by determining the total required pump head. (Baker-IVI)
W85-06608

EFFECT OF SLUDGE APPLICATION OF PHYSICAL PROPERTIES OF A SILTY CLAY LOAM SOIL,
Wisconsin Univ.-Madison. Dept. of Soil Science.
Q. F. Wei, B. Lowery, and A. E. Peterson.
Journal of Environmental Quality, Vol. 14, No. 2, p 178-180, April/June, 1985. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Land treatment, *Soil types, *Soil properties, *Sludge disposal, Sludge utilization, Bulk, Infiltration, Permeability coefficient, Aggregate stability.

The long-term effect of dewatered sludge application was studied on a silty clay loam soil, which possesses poor permeability and other undesirable properties. A Zimpro-processed dewatered sludge was applied in early 1977 at treatment rates of 0, 11.2, 22.4, 44.8, and 112.0 Mg/ha (dry solids basis) to a Kewaunee silty clay loam soil (Typic Hapludalf). A sixth treatment was an annual application of 22.4 Mg/ha from 1977 to 1982, resulting in a total input of 134.4 Mg/ha. Bulk density, infiltration, hydraulic conductivity, and aggregate stability were measured 5 yr after application (note: fifth year of annual sludge application at 22.4 Mg/ha). The bulk density decreased by 0, 0.7, 3.5, 8.3, and 6.3% over the control for the 11.2, 22.4, 44.8, 112.0, and 134.4 Mg/ha of sludge treatment, respectively. The hydraulic conductivities of saturated soil cores were 0, 4.2, 45.4, 70.2, and 70.6% higher for the 11.2, 22.4, 44.8, 112.0, and 134.4 Mg/ha sludge treatment, respectively, over the control. The improved soil permeability was due to the enhancement of aggregate stability, which increased relative to the control by 3.3, 9.4, and 11.9% with the 44.8, 112.0, and 134.4 Mg/ha treatment, respectively. The in situ volumetric moisture content of the sludge-treated soils was always higher than control, especially after a prolonged period of evaporation. At 33.3 kPa or less, more water was released from soils or less, treated with high rates of sludges. This indicated an increase in the volume of larger pores, which resulted in the higher hydraulic conductivities. Lower rates of sludge treatments (11.2 and 22.4 Mg/ha) had no effects on the soil physical properties after 5 yr. Small yearly applications improved the soil physical properties equally as well as a single large application. (Author's abstract)
W85-06715

REACTION OF FERTILIZER AND LIQUID MANURE PHOSPHORUS WITH SOIL AGGREGATES AND SEDIMENT PHOSPHORUS ENRICHMENT,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
V. K. Bhatnagar, M. H. Miller, and J. W. Ketcheson.
Journal of Environmental Quality, Vol. 14, No. 2, p 246-251, April/June, 1985. 5 Fig, 5 Tab, 24 Ref.

Descriptors: *Fertilizers, *Liquid manure, *Phosphorus, *Soil aggregates, *Sediments, *Agricultural runoff, No-till management, Land management, Liquid wastes, Manure, Farm wastes, Adsorption, Soil properties, Potassium.

Phosphorus enrichment ratios (PER) were estimated for sediment from six runoff events from plots that had been under one of three management systems for at least 5 yr: no-till (NT), no-till manured (NTM), and fall plowed manured (FPM). Sodium bicarbonate-extractable P enrichment ratios (Ext-PER) sediments were 2.15, 1.30, and 1.10 for NT, NTM, and FPM treatments, respectively. The higher Ext-PER on the NT treatment could not be explained solely by a higher clay enrichment. A laboratory experiment was conducted to test three hypotheses developed to explain the difference in Ext-PER values. Phosphorus in the form of either inorganic salt (KH_2PO_4) or liquid poultry manure (Chicken, Gallus gallus domesticus) was added to soil at rates up to 400 mg P/kg. Soils were passed through 7-d wetting and drying cycles for 235 d and sampled periodically. Most of the added P from both the manure and inorganic P treatment was associated with the clay fraction. The proportion of P that was desorbable increased as the amount of P added increased. This may, in part, explain the lower Ext-PER on the manured plots, which had a greater amount of P added. Manure increased water stability of soil aggregates. In addition, the Ext-P concentration in water-stable aggregates from the manure treatment increased with increasing aggregate size, whereas the inorganic P source had no effect. Manure did not alter the size distribution of dry-sieved aggregates, but Ext-P was increased to a greater extent in the larger aggregates, indicating that there was a preferential sorption of manure P by larger-sized aggregates. This conclusion was supported by results from a small field trial. The preferential sorption of P from liquid manure by larger, more stable aggregates may result in a lower Ext-PER in sediment from manured fields. (Author's abstract)
W85-06722

LONG-TERM PHOSPHORUS SORPTION IN A BRUNISOL IN RESPONSE TO DOSED-EFFLUENT LOADING,
British Columbia Ministry of Environment, Victoria.
N. K. Nagpal.
Journal of Environmental Quality, Vol. 14, No. 2, p 280-285, April/June, 1985. 3 Fig, 6 Tab, 23 Ref.

Descriptors: *Phosphorus, *Sorption, *Brunisol, *Septic wastewater, *Nutrients, Soil types, Leachate, Soil properties, Groundwater contamination, Fate of pollutants, Percolation.

Phosphorus sorption characteristics of a major soil in the Shawnigan Lake area of Vancouver Island were studied in response to periodic secondary effluent loading. Five soil columns 0.60 m long and 0.139 m in diam were prepared from the B horizon of the Shawnigan gravelly silt loam (classified as a Dystric Brunisol and Typic Dystrochrept according to the Canadian and U.S. Systems of soil classification, respectively). Water table level was maintained at the base of the two partially saturated columns (PSC). The other three columns (USC) remained unsaturated at all times and were subjected to a tension of 6.0 kPa. A single, daily dose of 1 L (approximately 6.6 cm) of secondary effluent was applied to all columns except on weekends and holidays. The effluent P was retained effectively by the USC columns initially, but broke through with time as in case of the PSC columns. The leachate P concentration reached an equilibrium value (EPC) after about 70 pore volumes of effluent had passed through the columns. The EPC changed only slightly beyond 70 pore volumes, but was a function of effluent P concentration and percolation rate. About 60 to 90% of added P was retained by the columns, even after 2.7 yr of leaching. Surface layers were the most effective renovators of effluent P; however, the total amount of P retained by the soil was dependent more on effluent percolation rate and leaching period, and less on water table level. (Author's abstract)
W85-06726

EFFECT OF SEWAGE SLUDGE ON MOBILIZATION OF SURFACE-APPLIED CALCIUM IN A GREENVILLE SOIL,
Georgia Univ., Athens. Dept. of Agronomy.
K. H. Tan, J. H. Edwards, and O. L. Bennett.
Soil Science, Vol. 139, No. 3, p 262-269, March, 1985. 1 Fig, 5 Tab, 30 Ref.

Descriptors: *Land application, *Sludge disposal, *Calcium, *Soil properties, Leaching, Potassium, Calcium, Magnesium, Aluminum, Iron, Zinc, Cadmium, Hydrogen ion concentration.

The effect of sewage sludge on movement of surface-applied Ca was determined with controlled leaching studies in the laboratory. Soil columns were prepared by filling 5.5- by 30-cm PVC plastic tubes with samples of the Ap horizon of a Greenville soil (clayey, kaolinitic, thermic Rhodic Paleudult). These were affixed to the 5.5- by 30- cm tubes filled with Bt1 horizon samples, so that the total column was 60 cm long. The soil columns, receiving various lime and sewage sludge treatments were leached with distilled water at a flow rate of 40 ml/h until 2 L of leachates was collected. The leachates were analyzed for K, Ca, Mg, Al, Fe, Zn, and Cd concentrations. After leaching, the soil columns were sectioned into four 15-cm layers for determination of pH and the above elements. Although amounts equivalent to 4.5 metric tons (t) CaCO3 and 112 t sewage sludge per ha were applied, no differences were detected in Ca contents of the leachates from soils with or without sewage sludge. Very low levels of K and Mg and negligible amounts of Al, Fe, Zn and Cd were also found in the leachates, indicating minor leaching losses of these elements. The soil apparently served as a sink for the Ca and other metals ions investigated, which is in agreement with many of the earlier published results. The present result compared favorably with results of long-term experiments, indicating that significant Ca translocation can also be achieved in a shorter term even though most of the Ca was retained in the surface section of the soil columns. A sharp decrease in extractable Ca was noted from 13.9 mmol/kg at 15 to 30 cm deep to 2.04 mmol/kg at 30 to 40 cm deep in the soil columns without sewage sludge. The bottom sections of the sludge-amended columns contained more Ca than the top sections or the original, nontreated, Ap and Bt1 horizon samples. Calcium movement into the subsoil increased soil pH. Infrared analysis indicated that mobilization of Ca was facilitated by formation of Ca-chelates, formed by the interaction of lime and fulvic acid produced by sewage sludge. Being a cation, Ca(2+) would, otherwise, be subjected to cation exchange reaction and would not be free to move down with the percolating water. (Author's abstract)
W85-06748

DEGRADATION OF PESTICIDES IN CONTROLLED WATER-SOIL SYSTEMS,
Ames Lab., IA.
G. A. Junk, J. J. Richard, and P. A. Dahm.
ACS Symposium Series, Vol. 259, p 37-67, 1984. 17 Fig, 2 Tab, 42 Ref.

Descriptors: *Pesticides, *Degradation, *Waste disposal, *Soil-water systems, Atrazine, Alachlor, 2,4-D, Trifluralin, Carbaryl, Parathion, Insecticides, Herbicides, Organic compounds.

Atrazine, alachlor, 2,4-D ester, trifluralin, carbaryl, and parathion were added individually and as mixtures to 60 L of water and 15 kg of soil held in 1100 L plastic garbage containers that were buried partially in open ground to determine if controlled soil-water systems are satisfactory for the disposal of small amounts of formulated pesticides. Additional variables of aeration at 1 l/min and peptone nutrients at 0.1 weight percent were also studied. Aliquots from 56 buried containers were taken for chemical analyses during a 68 week period. Soil and water in an inexpensive container provide for satisfactory containment of common pesticides so that chemical and biological degradation can occur. The soil is a source of microorganisms, a food source and a great aid to containment because of its high adsorption capacity. The water is an aid in monitoring and for microbiological activity. Aeration and addition of buffers, nutrients and inoculants are of questionable value. Volatilization losses should be insignificant since even the very volatile trifluralin was not lost. Atrazine and alachlor are both very persistent. The use of half-life to estimate the persistance of a pesticide in the natural environment is a debatable practice. (Baker-IVI)
W85-06780

LEACHABILITY AND REVEGETATION OF SOLID WASTE FROM MINING,
Industrial Environmental Research Lab.-Cincinnati, OH.
For primary bibliographic entry see Field 5G.
W85-06990

LAND DISPOSAL OF SEWAGE SLUDGE, VOL VIII: APRIL 1, 1979 - MARCH 31, 1980,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
T. E. Bates, and Y. K. Soon.
Environmental Canada, Canada-Ontario Agreement on Great Lakes Water Quality, Research Report No. 108, 1981. 17 p, 5 Tab. Ontario Lottery No: 12.

Descriptors: *Metals, *Sludge disposal, *Sludge utilization, *Nutrients, *Crop yield, *Bioaccumulation, *Soil amendments, *Land disposal, Heavy metals, Phosphorus, Phosphorus removal, Crop production, Plant growth, Bye, Bromegrass.

Three sludges resulting from the treatment of sewage for P removal with calcium hydroxide, ferric chloride and aluminum sulfate were compared to ammonium nitrate fertilizer as sources of N, and their effects on crop yield and nutrient and metal content of crops and soil were measured. In a second study, crop growth and the uptake of nutrients and metal were measured for six sewage sludges with high metal contents. Yields of bromegrass and corn resulting from sludge application were at least as high as yields with ammonium nitrate. Sodium bicarbonate extractable soil P was increased by sludge application in the order Ca sludge > Fe sludge > Al sludge. Soil pH and extractable soil Ca were highest with Ca sludge, and soil pH was lowest with Fe sludge. Ca, Cu, Ni, and Zn concentrations in plant tissues increased with sludge application rates, and were particularly high with applications of sludges high in these metals. Root, shoot and soil analysis of greenhouse grown ryegrass crops showed, after the fourteenth harvesting, low mobility of Pb and Cr in the soil-plant system. Cd and Cu were readily absorbed by the root, but were not so readily transported to the shoot. With the exception of Zn, metal concentration were generally much higher in the root than in the shoot, as evidenced by root/shoot metal concentration ratios.
W85-06991

SLUDGE INCINERATION AND PRECIPITANT RECOVERY, VOL. IV: PILOT SCALE MULTIPLE-HEARTH FURNACE INVESTIGATIONS,
Department of the Environment, Ottawa (Ontario).
W. H. Schroeder, P. J. Crescuolo, H. W. Campbell, and D. B. Cohen.
Environment Canada, Canada-Ontario Agreement on Great Lakes Water Quality, Research Report No. 107, 1981. 51 p, 7 Fig, 8 Tab, 13 Ref, 2 Append. Project No. 72-3-4.

Descriptors: *Sludge disposal, *Solid waste disposal, *Pilot plants, *Trace metals, *Trace elements, *Incineration, *Municipal wastes, *Carbon, Calcium, Metals, Waste disposal, Silica, Heavy metals, Sludge drying.

Pilot scale multiple-hearth sludge incineration was carried out at the Hamilton Water Pollution Control Plant to determine the fate of a selected number of elements within a normal operating range for the handling of municipal sewage sludge. Optimal and/or boundary conditions of temperature, throughout capacity, and center shaft speed were determined with regard to the prevention of clinker formation and minimization of the residual organic content of the incinerator ash. Under the constraints of the experiment, P, Zn, Fe, Mg, Al, Ni, Cu, Ca, Cr, Pb and Si proved conservative and remained in the ash while varying proportions of Cd, Hg, and As were removed to the gas stream. Minimum levels of total C destruction were 98.7%. The most important factor in determining the auxiliary fuel consumption is the water content of the feed sludge. Clinker formation could be avoided at high temperatures (928 degrees) by ensuring a short residence time within the furnace by increasing throughput rate and center shaft speed.
W85-06992

BED DEFORMATION IN CURVED ALLUVIAL CHANNELS,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 2J.
W85-07033

SLUDGE REDUCTION BY IN-PLANT PROCESS MODIFICATION: NEW YORK CITY'S EXPERIENCES,
New York City Dept. of Environmental Protection, Wards Island. Div. of West Operations.
L. A. Carrio, A. R. Lopez, P. J. Krasnoff, and J. J. Donnellon.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 116-121, February, 1985. 6 Fig, 8 Tab.

Descriptors: *Sludge digestion, *New York City, *New York, *Sludge disposal, Wastewater treatment, Anaerobic digestion, Sludge thickening.

Sludge treatments common to all New York City plants involves gravity thickening and anaerobic digestion in the high rate mode. The raw sludge is digested for stabilization and odor elimination because the plants are located in densely populated areas. After digestion, the sludge produced is stored on site. The sludge is disposed of at sea by a fleet of four City owned self-propelled sludge vessels. Recirculation of digested sludge to earlier stages in the wastewater treatment process is a practice that has been used in the city facilities for many years. Recirculated sludge was returned through exits in piping to the thickener influent, the aerators and the head of the plant. The usefulness of decanting operations, elutriation, and thermophilic digestion incorporated into the sludge treatment procedures has been investigated. Sludge volume to sea and disposal costs were reduced by simple in plant process modifications. Sludge

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volume reduction was maximized by a combination of processes. The process modifications were simple to operate and did not require sophisticated testing procedures or knowledge of process control other than that normally required of plant operating personnel. Sludge volume reductions were accomplished without increased manpower requirements and without chemical addition. The additional power consumer in some of the operation was negligible when compared to the savings resulting from the reduction in sludge volume. The process control modifications for sludge volume reduction did not have any significant adverse effect on plant treatment efficiency. (Baker-IVI)
W85-07039

MATERIALS BALANCE IN THE COMPOSTING OF WASTEWATER SLUDGE AS AFFECTED BY PROCESS CONTROL STRATEGY,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
F. C. Miller, and M. S. Finstein.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 122-127, February, 1985. 1 Fig, 6 Tab, 22 Ref. EPA project R806829010.

Descriptors: *Sludge composting, *Wastewater treatment, Sludge digestion, Landfills, Decomposition, Composting.

A previously reported field comparison between two fundamentally different composting process control strategies has been extended to consider materials balance. Both strategies were implemented in static pile configuration: each pile consisted of 36.3 wet metric tons of a mixture of raw wastewater sludge and woodchips (bulking agent). The comparative process performance was as follows: composting time, 12.4 days (Rutgers strategy) compared to 20.8 days (Beltsville Process); total dry sludge solids decomposed, 41.8% (Rutgers strategy) compared to 11.3% (Beltsville Process); volatile dry sludge solids decomposed, 56.9% (Rutgers strategy) compared to 15.4% (Beltsville Process); and water removed, 78.2% (Rutgers strategy) compared to 19.4% (Beltsville Process). In calculating the extent of decomposition, the woodchips were assumed to remain unchanged. In a separate field trial that involved only the Rutgers strategy, woodchips were replaced with recycled compost as the bulking agent. Using a dry weight recycle ratio of three parts sludge to one part recycled compost (pile wet weight, 6 metric tons), the outcome was as follows (solids refers to the mixture of sludge and compost): composting time, 9.5 days; total dry solids decomposed, 24.7%; volatile dry solids decomposed, 36.4%, and water removed, 85.4%. (Baker-IVI)
W85-07040

CHARACTERISTICS OF ACTIVATED SLUDGE EFFLUENTS BEFORE AND AFTER OZONATION,
Purdue Univ., Lafayette, IN. Dept. of Environmental Engineering.
R. D. Watt, E. J. Kirsch, and C. P. L. Grady, Jr.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 157-166, February, 1985. 6 Fig, 7 Tab, 48 Ref.

Descriptors: *Ozonation, *Sludge treatment, Wastewater treatment, Organic compounds, Biodegradability, Dissolved oxygen, Hydrogen ion concentration.

Research was conducted to determine how ozonation influenced the characteristics of dissolved organic matter in effluents from activated sludge reactors, and to determine whether manipulation of environmental variables, such as the pH and dissolved oxygen (DO) concentration, in the bioreactor affected the nature of the ozonated effluents. Ozonation of effluents from lab scale activated sludge reactors to a dissolved ozone residual of 0.30 to 0.35 mg/L after 5 minutes of contact did not significantly reduce DO concentration. Ozonation changed the shapes of the isotherms from linear or concave upward to concave downward, and increased the concentration of organic materials which totally resisted removal by carbon adsorption. Ozonation reduced the fraction of organic matter with high molecular weight (greater than 100,000 AMU) and increased the fraction with low molecular weight (less than 1000 AMU). Both pH and DO concentration had significant effects on some characterization parameters. Operation of the bioreactors at 7 mg/L DO produced less nonadsorbable material than did operation at 1 mg/L DO. All three bioreactor variables influenced the amount of nonbiodegradable material in the ozonated effluents, but feed type had the greatest effect. Operation of the bioreactor at pH 6 generated more low molecular weight material and less high molecular weight material in ozonated effluents than did operation at pH 8. (Baker-IVI)
W85-07045

WATER QUALITY IMPACTS OF CHLORINATING PAPERMILL EFFLUENTS,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Water Quality Management. For primary bibliographic entry see Field 5D.
W85-07047

ALTERNATIVE SLUDGE HANDLING AND DISPOSAL AT KENT COUNTY, DELAWARE,
O'Brien and Gere Engineers, Inc., Blue Bell, PA.
D. R. Pizarro.
Journal of the Water Pollution Control Federation, Vol.57, No. 4, p 278-284, April, 1985. 3 Fig, 6 Tab, 6 Ref.

Descriptors: *Sludge disposal, *Land disposal, *Kent County, *Delaware, Municipal wastes, Sludge drying, Cost analysis.

The development, implementation, and costs of land application of municipal sludges to agricultural land in Kent County, Delaware, are described. Analysis of sludge management costs at Kent County indicate that land application of sludge in liquid form at 5% solids within a 24.1 km haul distance is currently the recommended mode of operation. Land application of cake sludge could be competitive with liquid operations if the current situation changes with regard to land availability or weather constraints. The use of drum thickeners is an effective approach to thicken waste activated sludges, particularly those with poor dewatering characteristics such as extended aeration sludges. Field testing of the oxygenation and mixing capabilities of the submerged turbine aeration system indicate that the application of this equipment for aerobic digestion of sludge at 5% solids is appropriate and will provide significant flexibility from both an operational and an energy-consumption standpoint. A conservative approach should be used to determine land requirements based on sludge analyses and the resulting allowable application rates. Implementation of an effective pretreatment program is necessary to eliminate or minimize the effect of contaminants on land application rates. (Baker-IVI)
W85-07049

WASTE DISPOSAL TECHNOLOGIES FOR POLYCHLORINATED BIPHENYLS,
Oregon State Univ., Corvallis. Dept. of Statistics.
W. T. Piver, and F. T. Lindstrom.
Environmental Health Perspectives, Vol. 59, p 163-177, February, 1985. 9 Fig, 3 Tab, 62 Ref.

Descriptors: *Waste disposal, *Polychlorinated biphenyls, *Dioxins, *Incineration, *Hazardous waste disposal, Source of pollutants, Path of pollutants, Unsaturated zone, Groundwater contamination.

Improper practices in the disposal of polychlorinated biphenyl (PCB) wastes by land burial, chemical means and incineration distribute these chemicals and related compounds such as polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzodioxins (PCDDs) throughout the environment. The complete range of methods for disposal that have been proposed and are in use were analyzed, with emphasis given to the two most commonly used methods: land burial and incineration. The understanding of aquifer contamination caused by migration of PCBs from subsurface burial sites requires a description of the physical, chemical and biological processes governing transport in unsaturated and saturated soils. For this purpose, a model was developed and solved for different soil conditions and external driving functions. The model couples together the fundamental transport phenomena for heat, mass, and moisture flow within the soil. To rehabilitate a contaminated aquifer, contaminated groundwaters are withdrawn through drainage wells, PCBs are extracted with solvents or activated carbon and treated by chemical, photochemical or thermal methods. The chemical and photochemical methods were reviewed with primary emphasis devoted to the use of incineration as the preferred method of disposal. Performance characteristics of different thermal destructors were analyzed with consideration given to the formation of PCDFs and PCDDs during combustion from chloroaromatic, chloroaliphatic, as well as organic and inorganic chloride precursors. To understand how this information can be used, basic design equations were developed from governing heat and mass balances that can be applied to the construction of incinerators capable of more than 99.99% destruction with minimal to nondetectable levels of PCDFs and PCDDs. (Author's abstract)
W85-07074

SHOULD SEWAGE BE DISCHARGED AT THE WATER SURFACE OR NEAR THE BED,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol. 152, p 443-454, March, 1985. 6 Fig, 14 Ref.

Descriptors: *Wastewater discharge, *Bacteria, *Flow, Dilution, Light intensity, Fluid mechanics, Radioactive wastes, Marine environment.

The mortality of bacteria in sewage discharges into shallow seas is strongly influenced by light and varies with distance from the free surface. A criterion is derived for deciding between the opposing strategies of getting rapid bacterial decay by directing the sewage up to the surface at the sacrifice of initial dilution, or of achieving high initial dilution with a distributed source along the bed perpendicular to the flow direction. For steady discharges in flowing water, the contaminant plume is greatly elongated in the flow direction. Not only does this mean that longitudinal concentration gradients are much smaller than transverse gradients, but also in the longitudinal direction the effects of diffusion are overwhelmed by advection. At large distances downstream the transverse concentration profile becomes Gaussian. Whenever possible sewage works, and the associated sewage outfalls, are not situated in high-amenity areas. In examining the benefits of surface vs bottom discharges, it is found that at large distances a bottom discharge would need to be sufficiently wide in order to achieve the same concentration as from a narrow surface discharge. Conversely, a radioactive discharge with specified parameters is best discharged at the bed. In one case the dominant physical effect is the enhanced decay rate near the surface, while in the other it is the small extra amount of time taken for the radioactive contaminant to diffuse into the faster moving part of the flow. (Baker-IVI)
W85-07086

CHEMICAL CLEANING WASTE DISPOSAL BY LANDFARMING,
Arkansas Power and Light Co., Little Rock.
E. L. Green, and D. W. Moore.
Power Engineering, Vol. 89, No. 5, p 44-45, May, 1985. 1 Fig, 2 Tab.

Descriptors: *Ammoniated citric acid, *Wastewater disposal, *Wastewater treatment, Economic factors, Ammonia, Land disposal.

Recycling spent nonhazardous chemical cleaning waste by landfarming offers economic and environmental benefits. The advantages of the process were demonstrated after the application of ammoniated citric acid wastewater. In the course of reviewing proposals from various contractors for a new approach for wastewater disposal at Arkansas

Nuclear One, landfarming was considered. The method appeared to offer major advantages. First, the cost was less than half of conventional precipitation or demineralization methods. Second, landfarming converted a waste product to an environmentally beneficial end use. Land application of the waste material was expected to pose no toxic problems and the nitrogen in the waste would demonstrate beneficial results. The site is undulating, with a 0-10% slope. The soils offer percolation rates of 1/2 in/hr and a cation exchange capacity sufficient to treat the ammoniated citric acid. The soil type and its current nitrogen content indicated that the soil could accomodate 500 lb/acre of nitrogen. Tests indicated that the wastewater could safely be applied at a single application rate up to 4000 gal/acre. After the test application no ammonia odor was detected in the buffer zone areas, either before or after rainfall. No odor complaints were received from nearby homeowners. The ammoniated citric acid was applied to about 70 acres at the Lynch power plant in the summer of 1983. Broadleaf weeds were killed in all treated areas and did not return in the three month period. Narrow-leaf grass plants were not harmed. Landfarming thus has merit for nonhazardous wastewater disposal. (Baker-IVI)
W85-07097

REMOVAL OF NITROGEN FROM WASTEWATER BY SOIL PERCOLATION WITH ALTERNATE FLOODING AND DRYING,
Murdoch Univ. (Western Australia). School of Environmental and Life Science.
K. Mathew, G. E. Ho, and P. W. G. Newman.
Asian Environment, Vol. 6, No. 4, p 9-16, 1984. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Nitrogen removal, *Denitrification, *Percolation, *Soil properties, *Land disposal, Wastewater disposal, Flooding, Drying, Nitrification, Alluvial soil, Model studies.

The removal of nitrogen from sewage effluent during soil percolation by alternate flooding and drying is an effect of many processes. Data are provided on an experimental determination of dispersion and adsorption properties of an alluvial soil and the rate of nitrification and denitrification in this soil. The effects of infiltration rate and periods of flooding and drying on removal efficiency were also determined by a simple model. Only a soil with cation exchange capacity of at least 5 meq/100 g can provide for adequate removal of nitrogen. At the same time the soil should have a hydraulic conductivity which allows the required recharge velocity. If the amount of ammonium applied during a flooding period is more than the ammonium nitrified in the drying period ammonium will be leached into groundwater. The concentration and the quantity can be calculated by using the model developed. The nitrate in the soil will be leached out to be groundwater along with the wetting front of the incoming flow. The amount of nitrate leached out can be reduced by increasing the denitrification rate by adding organic carbon and increasing the period of denitrification by reducing infiltration rate. Using the model the percentage removal of nitrogen can be estimated for a given scheme. On using Pyrton Sandy Loam at the recharge site with 1 day flooding and 12 days drying at an infiltration rate of 23 cm/day it is predicted that up to 90% nitrogen could be removed. (Baker-IVI)
W85-07107

5F. Water Treatment and Quality Alteration

OXIDATION OF ORGANIC COMPOUNDS THROUGH THE COMBINATION OZONE-HYDROGEN PEROXIDE,
Compagnie Generale des Eaux, Paris (France).
R. Brunet, M. M. Bourbigot, and M. Dore.
Ozone: Science and Engineering, Vol. 6, No. 3, p 163-183, 1984. 21 Fig, 17 Ref.

Descriptors: *Water treatment, *Ozone, *Hydrogen peroxide, *Organic compounds, Drinking water, Ozonation, Oxidation, Irradiation, Chemical reactions.

Short chain organic compounds are formed during the treatment of drinking water with ozone. These compounds are not very adsorbable and are partly responsible for the residual organic carbon content in distributed water. The generation of very reactive oxidant entities in the medium without modifying its characteristics would help rid the water of these chemicals. The initiation of radicals is one such method and can be done through irradiation or through the combined action of oxidants such as hydrogen peroxide associated with ozone. The action of the couple ozone-hydrogen peroxide on various organic compounds was studied in solution with water. The results were compared with oxidation uniquely using ozone or hydrogen peroxide. Among the organic compounds studied there are compounds that are more or less readily oxidizable by ozone, and stable oxidation products. The merits of the combined treatment were demonstrated, particularly with respect to the oxidation of certain carbonyl compounds during water ozonation which are stable towards ozone. (Baker-IVI)
W85-06212

OZONATION SCHEMES OF ORGANO PHOSPHORUS PESTICIDES APPLICATION IN DRINKING WATER TREATMENT,
Ecole Nationale Superieure de Chimie de Rennes (France). Lab. de Chimie des Nuisances et Genie de l'Environnement.
A. Laplanche, G. Martin, and F. Tonnard.
Ozone: Science and Engineering, Vol. 6, No. 3, p 207-219, 1984. 10 Tab, 15 Ref.

Descriptors: *Ozonation, *Drinking water, *Water treatment, *Organophosphorus pesticides, Ozone, Oxidation, Chemical reactions, Pesticides.

The behavior of organophosphorus pesticides towards ozone is studied. Experiments were performed in organic and aqueous solution on representative molecules of various organophosphorus families. After identification of the main products of oxidation reactions, the evolution of starting and resulting compounds was followed. For phosphorothioates, a cycloaddition of ozone occurs on the double bond P=S before the molecule breaks down. For phosphorodithioates, a competitive reaction occurs between the precedent cycloaddition and the electrophilic attack of oxidant on the second sulfur. For phosphoroamidates, the same electrophilic attack was noted on the nitrogen. After formation of the intial adduct the free point of the ozone molecule can go either on the phosphorus or the carbon atom adjacent to heteroatom, and this constitutes a cyclic intermediate leading to different isolated products. (Baker-IVI)
W85-06214

BOILING OF DRINKING-WATER: CAN A FUEL-SCARCE COMMUNITY AFFORD IT,
Baltimore City Hospitals, MD.
R. H. Gilman, and P. Skillicorn.
Bulletin of the World Health Organization, Vol. 63, No. 1, p 157-163, 1985. 2 Tab, 8 Ref.

Descriptors: *Public health, *Drinking water, *Boiling, *Costs, *Bangladesh, Water treatment, Developing countries, Sanitation, Economic factors.

The financial feasibility of boiling drinking water in efforts to control and prevent diarrhea for a village in Bangladesh was investigated. Family income was categorized and the pattern of household fuel consumption determined. Families in the lowest income quartile would have to spend about 22% of their yearly income on fuel, and those in the highest income bracket about 10%. Boiling of drinking water would result in an 11% increase in the household budget for a typical family in the lowest income quartile, compared with a 3% increase for a typical family in the highest income quartile. Recommendations concerning boiling of drinking water in developing countries should not be urged until some provision for the economic feasibility of this approach is undertaken. (Baker-IVI)
W85-06217

FORMS OF OCCURRENCE OF FLUORINE IN DRINKING WATER,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
P. Pitter.
Water Research, Vol. 19, No. 3, p 281-284, 1985. 8 Fig, 2 Tab, 10 Ref.

Descriptors: *Drinking water, *Fluorides, *Oxidation, *Fluoroaluminates, Chemical reactions, Alum, Fluoridation, Water treatment, Hydrolysis, Protonation.

Alum coagulation and fluoridation are common processes in many water treatment plants. Under these conditions, fluorine may be present in treated water as less physiologically active fluoroaluminates. The results of a mathematical analysis of the corresponding chemical equilibria are presented. At least two possible side reactions must be considered, protonation and hydrolysis. In neutral and alkaline solutions, fluoroaluminates will be, under given conditions, converted to hydroxoaluminates so that the total fluoride concentration can be considered approximately equal to the free fluoride ions. Among the many methods suggested for the determination of fluoride ion in water, the electrode method is the most satisfactory at the present time. In acid solutions the presence of fluoroaluminates might be significant. (Baker-IVI)
W85-06218

REMOVAL OF ORGANIC PRECURSORS BY PERMANGANATE OXIDATION AND ALUM COAGULATION,
Hercules, Inc., Wilmington, DE.
B. Moyers, and J. S. Wu.
Water Research, Vol. 19, No. 3, p 309-314, 1985. 1 Fig, 5 Tab, 14 Ref.

Descriptors: *Trihalomethanes, *Organic compounds, *Permanganate, *Alum, Oxidation, Coagulation, Water treatment, Phenols, Anilines, Aliphatic diketones, Chloroform, Humic acid.

Much is known about the removal and reaction mechanisms of the naturally occurring precursors of trihalomethanes such a humic and fulvic acids. However, another class of precursors including phenols, anilines and aliphatic diketones has not been thoroughly investigated. This study shows that these truly soluble, monomeric precursors are poorly removed by alum coagulation. The use of permanganate preceding alum coagulation provides a good reduction of chloroform in water samples containing high proportions of monomeric precursors. The process was found to be less effective for water samples containing a high proportion of humic acid. This is possibly due to the degradation products from the permanganate oxidation of humic acid. These degradation products are not readily removed by alum coagulation and become available for subsequent chloroform formation. (Author's abstract)
W85-06222

FIELD OBSERVATIONS ON THE OCCURRENCE OF NEW INDICATORS OF DISINFECTION EFFICIENCY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5A.
W85-06224

REMOVAL OF ORGANICS FROM WATER IN AN AERATION BASIN; A MATHEMATICAL MODEL,
Washington Univ., Seattle. Dept. of Chemical Engineering.
G. W. Albin, and G. C. Holdren.
Water Research, Vol. 19, No. 3, p 363-371, 1985. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Aeration, *Organic compounds, *Mathematical models, Air stripping, Water treatment, Drinking water, Volatile compounds, Temperature, Bubbles, Residence time.

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Air stripping is one of the treatment methods that has been widely considered for the removal of volatile organics from drinking water. Aeration is generally most effective in removing low molecular weight organics, including trihalomethanes and many industrial solvents. A mathematical model was developed to describe the removal of volatile organic compounds from drinking water in aeration basins. The model was used to simulate removal under a range of expected treatment conditions using the Continuous Systems Modeling Program. Temperature and air-to-water ratio are the major factors influencing the removal of chloroform from water in an aeration basin. Bubble diameter was a lesser factor while liquid residence time had the smallest effect of the variables examined. The model can be used to evaluate the applicability of aeration basins for organics removal. Because basin size is relatively unimportant, it may be possible to convert existing treatment basins, such as softening basins, for this purpose. (Moore-IVI)
W85-06229

COST EFFECTIVE OPERATION OF URBAN WATER SUPPLY SYSTEM USING DYNAMIC PROGRAMMING,
California State Dept. of Water Resources, Woodland.
M. H. Sabet, and O. J. Helweg.
Water Resources Bulletin, Vol. 21, No. 1, p 75-81, February, 1985. 7 Fig, 3 Tab, 14 Ref.

Descriptors: *Water conveyance, *Urban areas, *Dynamic programming, *Cost analysis, Municipal water, Utilities, Costs, Groundwater, Optimization, Pipelines, Network analysis, Energy costs.

Efficient operation of a city water supply system is an important goal of all municipalities. Efficient operation should result in minimum operation cost through reduction in total energy use and/or reduction in on-peak energy consumption. An optimization model was designed for operating the water supply systems of cities using groundwater. The Newton-Raphson pipe network was used for network analysis and a dynamic programming optimization algorithm was used for determining a schedule for pump operation in the pipe network system. The model is most suitable for use in small cities with up to 45,000 in population, but with large-scale disintegration techniques may also be used for larger cities. The savings in operation costs are a function of energy cost and energy use pattern and water use pattern in the area. (Author's abstract)
W85-06241

PROBLEMS IN WATER CONTAMINATION AND ITS ANALYTICAL UNDERSTANDING (PROBLEME DER WASSERKONTAMINATION UND IHRER ANALYTISCHEN ERFASSUNG),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
For primary bibliographic entry see Field 5A.
W85-06267

COMPARATIVE STUDIES FOR INDICATION OF CHLORINE IN DRINKING AND BATHING WATER ON THE BASIS OF O-TOLIDINE AND DIETHYL-P-PHENYLENEDIAMINE (DPD) (VERGLEICHENDE UNTERSUCHUNGEN ZUM NACHWEIS VON CHLOR IM TRINK- UND BADEWASSER AUF DER BASIS VON O-TOLIDIN UND DIATHYL-P-PHENYLENDIAMIN (DPD)),
Bezirks-Hygieneinspektion und -Inst., Erfurt (German D.R.).
P. M. Theus, and U. Ponsold.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No 5, p 583-594, 1983. 5 Fig, 21 Ref.

Descriptors: *Chlorine, *Tolidine, *Diethyl-p-phenylenediamine, *Drinking water, *Photometry, Water treatment, Measuring instruments, Photometer, Water analysis.

The detection of free chlorine with the aid of o-tolidine is connected with systematic errors within the range of concentrations below 0.1 mg/l and above 0.7 mg/l, reproducibility being otherwise good. In the case of the simultaneous presence of free and bound active chlorine, especially in bathing water, this method determines 50-70% of varying shares of the bound chlorine depending on the reaction time. As detailed statistical investigations have shown, the determination of chlorine with the aid of diethyl-p-phenylenediamine (DPD) by the Palin method is free of systematic errors and correctly determines free and bound active chlorine with detection limits of 0.03 mg/l. Also low concentrations of free chlorine together with high concentrations of monochloro amine can be safely detected. Therefore, the DPD method is recommended as a standard method, and for the waterworks practice a battery-operated chlorine photometer is developed for rapid determinations. (Author's abstract)
W85-06276

ACID RAIN AND DRINKING WATER DEGRADATION,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 5B.
W85-06286

EFFECT OF RESERVOIR INDUCED CIRCULATION ON THE WATER QUALITY OF RECREATIONAL FRESHWATER EMBAYMENTS,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W85-06317

FY 83 PROGRAM SUMMARY REPORT OF UTAH CENTER FOR WATER RESOURCES RESEARCH,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 9D.
W85-06322

STATISTICAL COMPARISON OF A DIRECT FILTRATION AND A CONVENTIONAL WATER TREATMENT FACILITY IN THE INTERMOUNTAIN REGION,
Utah Water Research Lab., Logan.
S. Burns, and V. D. Adams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157816/AS, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, Sept. 1984. 66 p, 14 Fig, 6 Tab, 41 Ref, 2 Append, USGS G872-05.

Descriptors: Drinking water, *Water treatment, *Filtration, Particulate matter, Turbidity.

More stringent EPA standards are causing many communities to search out a cost effective treatment method for reducing drinking water turbidity. Conventional processes employ flocculation, costly settling basins, and polishing filters. Recently developed mixed media filters can be kept from clogging and permit direct filtration without first passing the water through settling basins. Because of the reduced capital costs, space requirements, sludge quantities, and coagulant dosages, direct filtration is being increasingly employed at new plants around the world. The specific objectives of this research were to review the literature to determine the factors affecting the performance of direct filtration systems and to use this background in gathering time series of data on relevant parameters for comparing the performance of a direct filtration with a conventional treatment system. A comparison of the turbidities of the water treated at the Utah Valley Water Purification Plant at Orem, Utah, with the water treated at the Little Cottonwood Metropolitan Treatment Plant at Salt Lake City over a three-year period showed no significant difference. Furthermore, the water produced by both plants was far below the standard of 1 TU required by EPA. Direct was thus found to perform satisfactorily in turbidity removal.
W85-06324

CONSUMER ATTITUDES TOWARD PUBLIC WATER SUPPLY QUALITY: DISSATISFACTION AND ALTERNATIVE WATER SOURCES,
Southern Illinois Univ. at Carbondale.
For primary bibliographic entry see Field 6D.
W85-06347

BROMIDE-OXIDATION INTERACTIONS AND THM FORMATION: A LITERATURE REVIEW,
Capitol District Library Council for Reference and Research Resources, Troy, NY.
For primary bibliographic entry see Field 5B.
W85-06490

SURROGATE PARAMETERS FOR MONITORING ORGANIC MATTER AND THM PRECURSORS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
J. K. Edzwald, W. C. Becker, and K. L. Wattier.
Journal of the American Water Works Association, Vol. 77, No. 4, p 122-132, April, 1985. 14 Fig, 12 Tab, 38 Ref.

Descriptors: *Monitoring, *Organic compounds, *Water quality control, *Trihalomethanes, *Grasse River, *Glenmore Reservoir, *New York, Rivers, Reservoirs, Pollutant identification, Ultraviolet, Water treatment, Pilot plants, Chlorination.

UV (254 nm) absorbance is a good surrogate parameter for nonpurgeable total organic carbon (NPTOC) and total trihalomethane formation potential (TTHMFP). UV absorbance can be used to estimate the NPTOC and TTHMFP (THM precursors) concentrations of raw waters, to monitor pilot-plant performance, and to monitor full-scale water treatment plant performance. Based on the NPTOC-UV regression equations, TTHMFP-NPTOC regression equations, seasonal THM yields, and UV to TOC ratios for the two waters (Grasse River and Glenmore Reservoir in New York) the nature of the organic matter in a highly colored, humic stream such as Grasse River is different from that in the protected, upland reservoir. Even so the THM precursors in the two supplies are similar in terms of relating their concentrations as TTHMFPs to UV absorbance. The raw water surrogate equations developed from the Grasse River data were tested successfully on other waters. Direct filtration pilot-plant data demonstrated that UV can be used to monitor pilot-plant performance for removals of NPTOC and THM precursors. For two plants studied, UV was an excellent predictor of plant performance for removals of NPTOC and THM precursors. Instantaneous TTHMs of the finished waters can be predicted from raw water UV, finished water pH, chlorine consumption, and temperature data. Particular attention should be given to the selection of sampling locations and to the sample-handling conditions. (Baker-IVI)
W85-06491

REMOVING HUMIC SUBSTANCES BY CHEMICAL TREATMENT AND ADSORPTION,
Michigan Univ., Ann Arbor.
W. J. Weber, Jr., and A. M. Jodellah.
Journal of the American Water Works Association, Vol. 77, No. 4, p 132-137, April, 1985. 9 Fig, 4 Tab, 6 Ref. EPA Grant 80735901.

Descriptors: *Alum, *Lime, *Water treatment, *Total organic carbon, Organic matter, Adsorption, Chemical reactions, Humic acids, Coagulants.

Humic substances comprise the major class of organic matter in natural waters. Alum coagulation and lime softening exhibit variable effectiveness for removing the total organic carbon (TOC) associated with humic substances in water supplies. This variability related primarily to differences in sources and types of humic matter. Both alum and lime treatment result in humic residuals that manifest different adsorption characteristics than those present in the same waters prior to chemical pretreatment. This appears to relate more to modification of humic acid speciation than to changes in the inorganic composition of the water from which adsorption occurs, although the latter effect has been observed to have an influence under certain conditions. The extent of alterations in adsorption behavior again depends on the origin and type of

the humic materials involved. Alum coagulation appears to generally improve overall adsorbability, at least for the TOC associates with the humic solutions tested in this work. (Baker-IVI)
W85-06492

ENERGY REQUIREMENTS FOR AIR STRIPPING TRIHALOMETHANES,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, and J. A. Levy.
Journal of the American Water Works Association, Vol. 77, No. 4, p 138-146, April, 1985. 16 Fig, 3 Tab, 35 Ref.

Descriptors: *Air stripping, *Trihalomethanes, *Water treatment, Energy, Economic aspects, Energy, Design criteria, Drinking water, Water management, Aeration, Costs.

Design methods for surface aeration and for countercurrent packed columns are reviewed. Methods for estimating energy requirements to achieve chosen treatment objectives are presented and the efficacy of multiple staging of surface aeration basins are demonstrated. Energy requirements for multiple-stage surface aeration versus countercurrent air stripping are compared. The risks of improperly neglecting the gas-phase transfer resistance when dealing with trihalomethane (THM) stripping are demonstrated. The energy comparison shows a standoff between the countercurrent packed column and mechanical surface aeration processes for air stripping of THMs. Mechanical surface aeration requires greater land area than the packed-column alternative. In climates where subfreezing temperatures are common, freezing of open aeration basins might present problems. The capital investment is likely to be less for mechanical surface aeration than for packed-tower contacting, if land is available at a reasonable cost. The operating and maintenance labor costs will be smaller for mechanical surface aeration, especially if there is a risk of chemical precipitation or biological growth that would tend to clog a packed column, necessitating frequent shutdowns for cleaning. Mechanical surface aeration offers many advantages for air stripping of THMs in water treatment. The process is simple to build and operate, there is a great deal of pertinent experience with oxygen transfer applications, and the energy requirements are not substantially greater than for packed column contacting. (Baker-IVI)
W85-06493

ORGANIC HALOGEN MEASUREMENTS: CURRENT USES AND FUTURE PROSPECTS,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W85-06494

DECHLORINATION AND TRIHALOMETHANE YIELDS,
Maryland Univ., College Park. Dept. of Chemistry.
G. R. Helz, A. D. Uhler, and R. Sugam.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 4, p 497-503, April, 1985. 1 Fig, 3 Tab, 8 Ref. Electric Power Research Inst., Palo Alto, Ca. contract RP 733-1.

Descriptors: *Trihalomethanes, *Dechlorination, *Chlorination, Water treatment, Powerplants, Cooling water, Effluents,.

Chlorinated effuents are sources of both trihalomethanes and macromolecular halocarbons. At power plants, chlorine is used to control fouling in cooling water, so contact times of only a few minutes are sufficient. Tests were run to determine whether dechlorination after chlorine contact times of only a few minutes can reduce or eliminate trihalomethane emissions. When the chlorine dose was sufficient to give a residual of 15 microM (1 mg/L) or less at the condenser outlet, trihalomethanes were undetectable. At higher chlorination rates, the trihalomethane yield increased with dose. Dechlorination appears to be more effective at reducing CHCl3 yields than at reducing CHBrCl2 yields. The findings indicate that the benefits of dechlorination can include reduction in trihalomethanes, as well as oxidant emissions. (Baker-IVI)
W85-06527

HEAVY METALS IN THE DRINKING WATER FROM CISTERNS SUPPLYING SINGLE-FAMILY DWELLINGS,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
A. F. Gumbs, and F. E. Dierberg.
Water International, Vol. 10, No. 1, p 22-28, March, 1985. 1 Fig, 2 Tab, 26 Ref.

Descriptors: *Heavy metals, *Drinking water, *Cisterns, *St. Maarten, *Netherlands Antilles, Cadmium, Chromium, Lead, Zinc, Water quality control.

Heavy metal concentrations (cadmium, chromium, lead, zinc) in 46 cistern water supply systems from single-family dwellings on St. Maarten, Netherlands Antilles were considerably below US drinking water limits in most cases. St. Maarten is a Caribbean island which has an annual mean temperature of 27 C and 114 cm of rainfall per year. The topography of the island is mountainous and plays an important part in promoting rainfall from easterly tradewinds. The cistern system typically consists of the house roof which serves as an impervious catchment for precipitation. The catchment surface is commonly constructed of corrugated galvanized iron sheets. In the rain water cistern system zinc was the most abundant metal in bulk precipitation followed by lead, chromium, and then cadmium. Mean concentrations were higher than the average cistern surface concentrations, suggesting that particulate matter containing heavy metals settled out of suspension under quiescent conditions in the cistern. Because metal precipitates and particulates are concentrated in the sediment layer of cisterns, care should be exercised in withdrawing water for human consumption. Since running tap water had insignificantly higher levels of zinc, lead and cadmium than the cistern surface water, these metals are released in the distribution system as a result of in-line corrosion processes. (Baker-IVI)
W85-06545

NORTH MIMMS TREATMENT WORKS' REFURBISHMENT AND AUTOMATION,
R. N. Rhodes, and J. M. Stoker.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 1, p 9-26, February, 1985. 5 Fig, 3 Tab.

Descriptors: *Water treatment facilities, *North Mimms Treatment Works, *England, *Automation, Water quality control, Chalk aquifer, Rehabilitation, Design criteria, Construction.

North Mimms Treatment Plant was constructed in 1924 to abstract and treat up to 9 Ml/d of water from a chalk well and adit system. The unusual geological conditions in this area of South Hertfordshire result in a raw water which can fluctuate rapidly in quality between that normally associated with a chalk well, and one which contains a high-loading of colloidal sized clay particles, with turbidities in excess of 80 NTUs. Before refurbishment the station was operated by eight men working on a rotating shift. The treatment process involved flocculation, settlement and rapid gravity filtration, together with superchlorination. Quality of treated water and the efficiency of the works were becoming unacceptable. The experimental, design and construction stages of a new project are described. The experience gained at North Mimms indicates that it is feasible to fully automate a relatively small treatment works and thus make it cost effective. The extensive alarm and fault finding system installed has been effective in both preventing the works from passing unsuitable water into supply and overflowing. In addition, it has allowed for the speedy detection of plant failure. Although careful planning is necessary in this sort of refurbishment, perhaps even more so than on a large works, the flexibility and cooperation of all those concerned is essential if it is to be successfully completed. (Baker-IVI)
W85-06573

APPLICATION OF SCIENCE TO WATER SUPPLY PROJECTS IN DEVELOPING COUNTRIES,
Southern California Metropolitan Water District, Los Angeles.
F. W. Crowley, C. R. Jackson, and T. R. Heard.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 1, p 46-57, February, 1985. 3 Fig, 4 Ref.

Descriptors: *Water supply development, *Developing countries, *Water treatment, Water quality control, Rivers, Groundwater management, Suspended solids, Seawater, Color.

The application of science to the non-engineering parts of a water supply project, particularly those areas related to the quality and treatability of water, is considered. A number of case studies are described to illustrate the wide variety of raw waters which are encountered in countries overseas and some approaches used to determine suitable methods of treatment. The raw waters include two with high suspended solids, one with high color and a unique case of fresh groundwater overlying seawater. Specifics discussed include preparations for fieldwork, sampling water quality and analysis operations, treatability studies, and establishment of water quality criteria and standards. Case studies noted include the River Tigris in Iraq, water supply in greater Algiers, treatment of a highly colored water, and groundwater treatment. (Baker-IVI)
W85-06575

VIRUSES AND DRINKING WATER,
Thames Water Authority (England). Northern Div.
J. S. Slade.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 1, p 71-80, February, 1985. 1 Tab, 16 Ref.

Descriptors: *Drinking water, *Public health, *Viruses, Water quality control, Legislation, United Kingdom, Water treatment, Reviews.

Developments in water virology are examined with particular reference to their implications for potable water supplies. The relevant legislation in the United Kingdom is reviewed and the circumstances under which virological tests can be most usefully employed are defined. An extremely large number of different virus types may be found in natural waters. Specific attention is devoted to four: poliovirus, hepatitis virus A, norwalk virus, and rotavirus. A major consideration in the spread of viruses is the number required to establish an infection - that is, the minimum infective dose. Methods for removing viruses in water are noted and indicators of water quality in relation to virus content are given. (Baker-IVI)
W85-06577

TASTES AND ODORS: THE FLAVOR PROFILE METHOD,
Southern California Metropolitan Water District, La Verne.
S. W. Krasner, M. J. McGuire, and V. B. Ferguson.
Journal of the American Water Works Association, Vol. 77, No. 3, p 34-39, March, 1985. 2 Fig, 4 Tab, 29 Ref.

Descriptors: *Water quality control, *Drinking water, *Taste, *Odor, Organoleptic properties, Testing, Chlorine, Chloramines, Pollutant identification, Microorganisms.

At Metropolitan Water District of Southern California, flavor profile analyses have been used to assist in detecting, controlling and understanding off-flavors in drinking water. Threshold odor number determinations (TON) have often failed in the past to provide sensory data that were of reliable use, except in cases of gross contamination. The flavor-profile panel has been carefully selected and extensively trained in use of the flavor profile

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method. The panel has analyzed numerous raw and treated waters and has provided information on the presence and intensity of numerous character notes in these samples. Specific applications have included a determination of the effects on the taste and odor of water when changing from free chlorine to chloramine disinfection. As long as the formation of dichloramine and trichloramine was minimized, the finished water had a lower chlorine like aroma and flavor than the water produced using free chlorine. The flavor profile technique was also used to help elucidate the presence of an industrial contaminant in a domestic water system, and it could also be useful for water utilities that must content with industrial wastes and spills in their source waters. In the case of off-flavors caused by naturally occurring materials, such as MIB produced by microorganisms in the source water, the flavor-profile panel could identify and quantify such odorants even in the presence of other smells and tastes in the sample matrices. (Baker-IVI)
W85-06582

EVALUATION OF PUBLIC NOTIFICATION REQUIREMENTS IN CALIFORNIA,
California Univ., Berkeley. School of Public Health.
For primary bibliographic entry see Field 6E.
W85-06583

USING POLYMERS WITH DIRECT FILTRATION,
East Bay Municipal Utility District, Oakland, CA.
K. E. Carns, and J. D. Parker.
Journal of the American Water Works Association, Vol. 77, No. 3, p 44-49, March, 1985. 5 Fig, 5 Tab, 4 Ref.

Descriptors: *Drinking water, *Filtration, *Polymers, *Water treatment, Turbidity, Alum, Coagulation, Clay, Chlorination, Trihalomethanes.

Clay-polymer coagulation can be used in conjunction with direct, in-line filtration to treat low turbidity waters. Clay-polymer coagulation increases plant capacity by 40-50% because of higher filtration rates and longer filter runs. The effectiveness of clay-polymer coagulation in removing turbidity equals that of alum for raw water turbidity values greater than 3.5 ntu. Clay is essential as a polymer coagulant aid for treatment of water with raw water turbidity less than 3.5 ntu. An increase in clay dosage improves turbidity removal at a constant polymer dosage; a limit to this improvement is reached and more polymer is required for further improvement. An increase in polymer dosage improves turbidity removal at a constant clay dosage to a point, after which no further improvement occurs. A surface wash system is essential to the proper operation of a treatment facility using clay-polymer. Clay polymer coagulation can produce a filtered effluent of less than 0.1 ntu. There are no significant differences in the costs of coagulant for alum-lime, polymer, or clay-polymer coagulation. Clay-polymer coagulation requires at least 50% less water for backwashing than is necessary for alum treatment. Polymer coagulation produces less than 50% of the sludge that is produced during alum treatment. Cationic polymers may exert a chlorine demand of up to 0.6 mg chlorine/1 mg polymer. Cationic polymers have the potential of producing up to 13 microg trihalomethanes/liter. The combination of alum and polymer has the potential for producing excellent quality filtered water at rapid filtration rates of 7 gpm/sq ft and enhancing operational flexibility. (Baker-IVI)
W85-06584

REMOVING COLOR CAUSED BY HUMIC ACIDS,
G. A. Edwards, and A. Amirtharajah.
Journal of the American Water Works Association, Vol. 7, No. 3, p 50-57, March, 1985. 17 Fig, 13 Ref.

Descriptors: *Water treatment, *Color removal, *Humic acids, Coagulation, Acidity, Water quality, Turbidity, Hydrogen ion concentration.

Organics, in the form of humic substances, are undesirable in a potential water supply. Coagulation with aluminum sulfate, a standard procedure for removing suspended colloids, is also an effective method for removing organic color. Optimum domains for the removal of color during the coagulation process were studied in a series of jar tests and diagrammed as an aid to the design and operation of water treatment plants. Optimum color removal areas tend toward lower pH ranges and higher alum dosages as the concentration of humic acid increases. The presence of turbidity in the range of 27-30 tu has little effect on the removal of color. Mechanisms for removal of color appear to be related to those for turbidity removal. At pH ranges above 5.75, the removal mechanism appears to be associated with the formation of aluminum hydroxide precipitate. At pH ranges below 5.75 the removal mechanism is charge neutralization-precipitation of humics. (Baker-IVI)
W85-06585

REMOVING AQUATIC HUMUS FROM NORWEGIAN LAKES,
Norsk Inst. for Vannforskning, Oslo.
E. A. Vik, D. A. Carlson, A. S. Eikum, and E. T. Gjessing.
Journal of American Water Works Association, Vol. 77, No. 3, p 58-66, March, 1985. 16 Fig, 5 Tab, 47 Ref.

Descriptors: *Humus, *Water treatment, *Lakes, *Norway, Lake Tjernsmotjern, Lake Hellerudmyra, Lake Smaputten, Coagulation, Aluminum, Hydrogen ion concentration, Turbidity, Organic carbon.

Research was conducted to clarify the mechanism of removal of aquatic humus by coagulation with aluminum and to determine the optimum coagulant dosage and pH for maximum removal of humus. The maximum possible removal of organic carbon was evaluated for several lake waters. Total organic carbon (TOC) content is probably the best way of describing the humic content of a sample. There was a good correlation betwen TOC and UV absorption and between color and UV absorption. Three different raw waters, from lakes Tjernsmotjern, Hellerudmyra, and Smaputten (Norway) were studied. Conventional coagulation was studied in several series of experiments, in which pH and aluminum dosage were varied. When the sequence of chemical addition was studied, no major differences were found between the case in which alum was added first, immediately followed by NaOH, and the case in which NaOH was added first, immediately followed by alum, as long as the pH was < 7. The optimum pH range broadened with increasing alum dosage, and in all cases of pH of 5.5 was the optimum for efficient coagulation. (Baker-IVI)
W85-06586

POLYELECTROLYTE SELECTION FOR WATER TREATMENT,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
M. M. Ghosh, C. D. Cox, and T. M. Prakash.
Journal of the American Water Works Association, Vol. 77, No. 3, p 67-73, March, 1985. 10 Fig, 3 Tab, 25 Ref.

Descriptors: *Water treatment, *Polyelectrolytes, Filtration, Flocculation, Polymers, Colloidal suspensions.

The interrelationships between polymer molecular weight, charge density, polymer dosage, mixing conditions, and the flocculated particle-size distribution are complex and, in many cases, poorly understood. Flocculation probably takes place according to the mechanism of charge neutralization. However, there are many observations that cannot be explained by this model. Because charge neutralization does not completely explain the data, it appears that polymer bridging plays at least a minor role in flocculation of particles by oppositely charged polyelectrolytes. Although a scientific method of polymer selection is out of reach presently, a basic understanding of the effects of polymer properties on flocculation is beginning to form. For these experiments polymer dosage was independent of molecular weight in most cases. In addition, there appears to be a strong correlation between the number of charges a molecule carries and its optimum flocculation dosage. The size and strength of a floc may be controlled to some extent by proper selection of polymer molecular weight. Accurate and readily available information concerning molecular weight, structure of the polymer, charge density, and concentration of active polymer would greatly simplify further studies in this field and provide a limited basis on which polymer selection could be made. (Baker-IVI)
W85-06587

POLYALUMINUM CHLORIDE AND ALUM COAGULATION OF CLAY-FULVIC ACID SUSPENSIONS,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
B. A. Dempsey, H. Sheu, T. N. T. Ahmed, and J Mentink.
Journal of the American Water Works Association, Vol. 77, No. 3, p 74-80, March, 1985. 12 Fig, 4 Tab, 21 Ref.

Descriptors: *Water treatment, *Polyaluminum chloride, *Coagulation, *Alum, Fulvic acids, Clay, Turbidity, Hydrogen ion concentration, Coagulants.

Polyaluminum chloride (PACl) is an unconventional coagulant that will soon be introduced to the US market. It is produced by partial hydrolysis of aluminum chloride and is thought to consist of stable cationic polymers of aluminum. The benefits of polyaluminum choride relative to alum have been investigated as a function of pH, raw water composition, and mixing conditions. Conditions are outlined that might indicate the effective use of polyaluminum chloride instead of alum. At low to moderate concentration of contaminants, PACl is likely to be a better coagulant than alum. This may be due to the greater charge-neutralizing capability of PACl for the stated conditions. As the concentration of contaminant is increased, then the relative benefits of PACl over alum are decreased. In normal situations, the concentration of fulvic acid or natural organic material will determine the required coagulant dose. Turbidity only slightly influences color removal by increasing the coagulant demand and perhaps by broadening the zone of removal. Floc formed by PACl appears to be very sensitive to shear. Sludge volume is a function of the concentration of the coagulant. At low coagulation concentrations the sludge volume per mass of contaminant removed was low; at high coagulant concentration the sludge volume was high. No differences were observed between PACl and alum for cases in which identical coagulant doses were applied. The coagulant that can be successfully used at the lowest concentration will result in the smallest sludge volume per mass of contaminant removed. (Baker-IVI)
W85-06588

CONTROLLING PHOSPHATE BASED WATER TREATMENT PROGRAMS,
Hercules, Inc., Wilmington, DE.
L. Freedman.
Hydrocarbon Processing, Vol. 64, No. 1, p 81-85, January, 1985. 10 Fig, 6 Ref.

Descriptors: *Phosphates, *Corrosion control, *Water treatment, *Cooling water, Monitoring, Temperature effects, Hydrogen ion concentration, Suspended solids, Hardness, Water properties.

Successful phosphate based cooling water corrosion programs depend upon good feed, control and monitoring. Phosphates can exist in several specific, identifiable forms, each with different properties and inhibitive characteristics. Those discussed include orthophosphates, polyphosphates, and organic phosphates. For a mechanism of corrosion control with phosphates to be effective it must deal with the apparent discrepancies between observations made in operating systems and those from sophisticated instrumental techniques used in research laboratories. Guidelines are offered for high phsophate treatments based on laboratory evaluations and extensive field experience. Probably no system parameter is as important as the control of pH. Methods of control are suggested for hardness,

biological factors, suspended solids, and iron. One limitation to the use of phosphates is that they form their protective films slowly. To compensate for this, a pretreatment stage is typically recommended. The inhibitor is fed at some multiple of the normal recommended level (2.5 to 3.0 times) and is held there for three days to one week. Specifics of system metallurgy, system velocity, temperature and washout time are also addressed. (Baker-IV)
W85-06598

LEAKAGES IN URBAN WATER SYSTEMS: VILLAGE CREEK, CANBERRA, AUSTRALIA,
New South Wales Univ., Kensington (Australia). Faculty of Military Studies.
J. S. Burgess, E. Woolmington, and A. Henderson.
Journal of Environmental Management, Vol. 19, No. 2, p 133-146, September, 1984. 6 Fig, 37 Ref.

Descriptors: *Leakage, *Water conveyance, *Sewerage, *Australia, *Canberra, Village Creek, Diurnal variation, Water loss, Water management, Urban areas, Storm runoff, Streams.

An examination of water discharge and quality indicators in a small stream in Canberra, Australia, reveals that leakages from various engineered water systems into Village Creek produce considerable changes to the natural systems. In Canberra, as in other cities in the developed world with sophisticated systems of water organization, all planning strategies, whatever their specified objectives, are founded upon a dual system of water organization. The dual system comprises the following. The preexisting natural drainage systems, modified by such engineering works as piping, or lining or original stream channels, and accommodating precipitation by hooking up stormwater drainage systems to such channels, thereby preserving the autonomy of rainfall and stream discharge relationships within the original drainage system. Construction of a substantially independent urban water supply sewerage and disposal system to serve the urban area is the second part. Village Creek is one of the numerous tributary systems of the Murrumbidgee River which flow through what is now the Canberra urban area. In its pre-urbanized state it was an ephemeral stream flowing through an area of Quaternay alluvium and Silurian aged volcanic formations. Most of the data from the various water parameters investigated in the study would appear to point in a single direction, namely towards leakages from urban supply/elimination systems into the natural waterway, although some indications are either inexplicable or possibly insignificant. (Baker-IVI)
W85-06603

PHARMACOPEIA REQUIREMENTS AND WATER STANDARDS IN THE UNITED STATES OF AMERICA,
Vaponics, Inc., Plymouth, MA.
For primary bibliographic entry see Field 6D.
W85-06627

CHLORINATION OF HUMIC ACIDS AND CHLOROFORM PRODUCTION,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
V. Janda, and A. Moucha.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 3-9, 1983. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Trihalomethanes, *Humic acid, *Chloroform, *Chorination, Public health, Drinking water, Water treatment, Organic compounds, Chemical reactions.

This study was designed to reduce the concentration of halogen derivatives in drinking water to as low a value as possible since low molecular chlorinated compounds in drinking water have been shown to present a risk for consumers. Analysis were made of the chlorine, humic matter, pH, and chloroform present in water samples. Humic water samples were prepared by dilution of the humic stock solution in the pure water free of volatile organics. At low concentrations of humic matters and a high dose of chlorine, the concentration of humic matters was a limiting factor from the point of view of chloroform concentration. On the other hand, at high concentrations of humic matters and a low dose of chlorine, the concentration of chlorine is a limiting factor. In the first case organic precursors of chloroform underwent a complete reaction and the higher dose of chlorine did not provide an increasing concentration of chloroform. A similar explanation may be given for the second case. In the water treatment practice these solutions give only a rough semiquantitiative estimate of chloroform concentration in water, because its concentration in water is influenced by the nature of the humic matter, the time of contact of chlorine with water, the temperature of the water and other factors. (Baker-IVI)
W85-06648

HYDROCHEMICAL RESULTS OF THE TREATMENT OF HEAVILY LOADED SURFACE WATER AND BANK FILTRATION WITH HYDRATED LIME. PART 1 (HYDROCHEMISCHE ERGEBNISSE ZUR AUFBEREITUNG STARK BELASTETER OBERFLACHENWASSER UND UFERFILTRATE MIT KALKHYDRAT, TEIL 1),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
L. Bohm.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 2, p 215-222, 1983. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Water treatment, *Hydrated lime, *Filtration, Chemical treatment, Organic matter, Precipitants, Magnesium, Aluminum, Iron, Polymers, Adsorption, Water temperature, Magnetic treatment.

Several laboratory-scale-tested variants of the treatment of organically loaded surface water samples with hydrated lime are described. Possibilities of the additional application of magnesium, aluminum and iron salts and of the anionic polymer 'activated silicic acid' are discussed. The aim has been a considerably reduced application of metallic salts and precipitants at a maximum adsorption of organic pollutants. Another factor influencing crystallization and double hydroxide formation consists of low water temperatures, < 8 C. With the aid of a magnetic treatment, disturbing effects were avoided and even increases of the rates of growth and sedimentation were achieved. (Author's abstract)
W85-06663

HYDROCHEMICAL RESULTS OF THE TREATMENT OF HEAVILY LOADED SURFACE WATER AND BANK FILTRATION WITH HYDRATED LIME. PART 2 (HYDROCHEMISCHE ERGEBNISSE ZUR AUFBEREITUNG STARK BELASTETER OBERFLACHENWASSER UND UFERFILTRATE MIT KALKHYDRAT. TEIL 2),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
L. Bohm.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 2, p 223-233, 1983. 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Water treatment, *Filtration, *Hydrated lime, Surface waters, Humic acid, Lignosulfonic acid, Chemical treatment, Precipitants, Metallic salts, Flocculation, Aluminum, Magnesium.

Continuing the first part on this subject, the results of precipitation experiments are described by the example of the removal of humic acid and lignosulfonic acid. Moreover, to increase the number of process variants and in accordance with process methods after Haberer, a two-stage chemical treatment, inter alia, is proposed. According to the latest findings, a metallic salt dosing should be done at the first stage so that the purification effect can be improved. This new technique, termed 'combination stage flocculation', is based on new findings concerning the solubility behavior of aluminum compounds at higher pH-values in the presence of magnesium salts, when slightly soluble aluminum-magnesium double hydroxides originate. (Author's abstract)
W85-06664

TRIHALOMETHANES IN GROUNDWATER SYSTEMS,
Howard Univ., Washington, DC. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-06696

USE OF HISTORICAL DATA FOR ESTIMATING THE NUMBER OF SAMPLES REQUIRED FOR MONITORING DRINKING WATER,
National Water Research Inst., Burlington (Ontario).
A. H. El-Shaarawi, J. C. Block, and A. Maul.
Science of the Total Environment, Vol. 42, No. 3, p 289-303, April, 1985. 4 Fig, 4 Tab, 7 Ref.

Descriptors: *Drinking water, *Water quality management, *Bacteria, *Monitoring programs, Dispersion, Model studies, Data interpretation, Water sampling.

Statistical techniques were reviewed for estimating the number of samples required to monitor the quality of drinking water when the dispersion of bacteria in the water can be modeled by the Poisson or the negative binomial distributions. The concept of the operating characteristic (OC) curve of the water distribution system was used to evaluate the risk of declaring that the bacteriological water quality regulation is met when only a small portion of the water is analyzed. Assuming that the regulation requires that the monthly mean bacterial counts for samples of standard volume are to be less than one per ml, the OC curves are compared for different sample sizes and for different values of the parameters of the negative binomial. The results indicate that the correct specification of the model is very important in evaluating the risk of sampling (i.e. making the wrong decision). Total bacterial counts based on 1-ml samples, from the cities of Nancy and Metz in France, support the use of the negative binomial as a model for the dispersion of bacteria in drinking water. In the few cases where the negative binomial did not fit the data, the lack of fit can be attributed to the greater occurrence of the frequency of finding only one bacterium in the sample than that expected for the negative binomial. The OC curve indicated that the present monitoring strategy for the city of Nancy is adequate for monitoring the water quality if (i) the regulation requires that the monthly mean of total bacterial counts should not exceed one bacterium per ml, and (ii) the probability of accepting that the water quality is meeting the regulation, when the true mean number of bacteria per ml is two, should not be larger than 0.05. On the other hand, the city of Metz data indicated that it is necessary to increase the intensity of sampling both in time and space in order to achieve the same level of adequacy as that of the city of Nancy. (Author's abstract)
W85-06703

CORROSION IN THE SWISS DRINKING WATER DISTRIBUTIONS SYSTEMS,
Sulzer Bros. Ltd., Winterthur (Switzerland). Water and Wastewater Engineering Div.
J. C. Ginocchio.
European Water and Sewage, Vol. 88, No. 1063, p 389-393, September, 1984. 11 Fig.

Descriptors: *Corrosion, *Water conveyance, *Drinking water, *Switzerland, Corrosion control, Pipes, Water treatment, Chemical treatment, Aeration.

Corrosion in the water distribution systems of several Swiss towns and villages not only damages the iron pipes, but impairs the quality of the drinking water. The corrosion is due primarily to: soft ground water with a relatively high concentration of free carbon dioxide; water with a negative Langelier index; a low concentration of dissolved oxygen as well as the sporadic presence of hydrogen sulfide; water stagnation; acidification of the water due to purification. The proper techniques for treating water to prevent corrosion are discussed, including: deacidification; aeration; monitoring to control the addition of chemicals; and passing the water through a filter containing treated calcium carbonate. (Cutty-IVI)

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W85-06810

EXPERIMENTS IN COLOUR REMOVAL FROM SURFACE WATER BY MEANS OF THE OFSY SYSTEM,
L. Coccagna.
European Water and Sewage, Vol. 89, No. 1067, p 38-39, January, 1985. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Surface water, *Water treatment, *Color removal, *OFSY system, Drinking water, Acidity, Disinfection, Turbidity, Trihalomethanes, Filtration.

The application of a number of theoretical findings has made it possible to confirm that color is removed from surface water by a high velocity direct filtration system. In relation to the duration of the filtration cycle, the quantity of the color to be removed is more critical than the turbidity which may be present. This fact can be ascribed to a higher dose of alum required, which causes the formation of a floc of poor physical resistance. The Omnifiltration System (OFSY) is described in which two in-series filters with three layers of filtering mineral and two layers of mineral serve as underdrain. This arrangement affords a higher performance than that provided by a mere combination of filters. The in-series layout of the filters allows a longer duration of the cycle as compared to that achieved with conventional single filtration. The duration of the cycle is 4 to 5 times as long, thus providing more time for color removal to occur. The pH value is the conclusive factor in the quality of the results. The optimum pH range does not always match exactly the goals set. The injection of a filter aid before the second filter of the series is essential as it contributes to holding the leakage from the first filter by forming flocs which resist detachment forces. Direct filtration makes it possible to achieve a considerable saving in chemicals. In general direct filtration can make a great contribution to preventing the formation of halogenated compounds. It can also be an alternative to more complex, bulky and expensive equipment for water treatment. (Baker-IVI)
W85-06813

TRENDS IN DRINKING WATER TREATMENT: THE SHAPE OF THINGS TO COME; PART II - NEW DEVELOPMENTS IN WATER TREATMENT,
Metcalf and Eddy of New York, NY.
G. P. Fulton.
Public Works, Vol. 116, No. 5, p 56-60, May, 1985. 1 Tab, 3 Fig.

Descriptors: *Water treatment, *Drinking water, Chlorination, Ozonation, Flocculation, Filtration, Adsorption, Disinfection, Chemical treatment, Sedimentation.

This paper reviews past and present techniques and chemicals used for drinking water treatment. The principal drinking water tratment unit processes are air stripping oxidation, coagulation/flocculation, settling, flotation and entrapment. The chemicals used are chlorine, chloramines, chlorine dioxide, ozone, alum and polymers. Alum usage in coagulation/flocculation units has decreased drastically with the co-use of either polymers and/or ozone. Higher energy in mixing produces a flow with superior separation characteristics and requires much less installation space. Plastic tube settlers or lamella plate settlers both operate by the phenomena of layered settling and both operate at better than three times the overflow rate of conventional settlers. Flotation by air bubbling is an efficient method to remove suspended matter of algal or plant origin. Entrapment may either be by granular filtration, DE filtration or granular activated carbon adsorption, and the technique of choice is determined by discrete particle removal, operation flexibility, space requirement, and capital and operating costs. Chlorine, the traditional drinking water disinfectant, is now being phased out due to the production of trihalomethanes, a loss of potential carcinogens. Ozone is a very active disinfectant that has a very short life cycle with reactions best accomplished under pressure or in a short detention device. (Cutty-IVI)

W85-06835

TECHNICAL SUPPORT PACKAGE ON SOLAR-POWERED WATER DISTILLATION,
Jet Propulsion Lab., Pasadena, CA.
F. J. Menninger, and R. J. Elder.
JPL Invention Report NPO-15894/5353, Spring 1984. 4 p, 3 Fig.

Descriptors: *Water treatment, *Distillation, *Solar distillation.

A solar still was designed to deliver pure water for cooling the klystron tube at the Venus station of the Deep Space Network Tracking Complex, Goldstone, California. It is composed of eight 1.85 sq m fiberglass solar still panels, which provide 6000 gal of water per year. The once-per-day flush and fill functions are automatic. The gravity feed system, using well water with high mineral content, is expected to save $5000 per year on operating costs and pay back its $24,000 costs within 3.5 years.
W85-06916

SMALL COMMUNITY WATER SUPPLIES: TECHNOLOGY OF SMALL WATER SUPPLY SYSTEMS IN DEVELOPING COUNTRIES.
International Reference Centre for Community Water Supply and Sanitation, The Hague (Netherlands).
John Wiley and Sons, New York, 1981. 442 p. Edited by E. H. Hofkes.

Descriptors: *Water supply, *Water treatment, *Water distribution, *Developing countries, Rural areas, Public health, Planning, Water management, Water resources development, Water quality, Water harvesting, Springs, Surface water, Groundwater, Water use, Water requirements, Water demand, Catchment basins, Water storage, Cisterns, Water tanks, Groundwater mining, Ditches, Dug wells, Tube wells, Shallow wells, Recharge, Artifical recharge, Groundwater recharge, Bank infiltration, Infiltration, Pumps, Chlorination, Reservoirs, Aeration, Coagulation, Flocculation, Sedimentation, Filtration, Disinfection, Conduits.

This handbook is an introduction to the technology of small community water supplies, especially in developing countries. It is directed to readers with some technical background in engineering, public health, or irrigation, but with no formal training or experience in water supply. Planning and management include supervision, training, community involvement, maintenance, and emergency operation. Guidelines for water requirements and quality are given. Types of water sources and their selection are described. These include rainwater harvesting in roof and ground catchments, tapping of gravity and artesian springs, groundwater withdrawal by different techniques (infiltration galleries, dug wells, tubewells), and surface water intake from rivers and lakes. Aquifer recharge can be accomplished by bank infiltration, spreading water on permeable surfaces, or sand fill dams. Pumping includes power sources, types of pumps (reciprocating, rotary, axial-flow, centrifugal, and air lift). Water treatment processes appropriate for small systems are aeration (waterfall and bubble), coagulation and flocculation, sedimentation in settling tanks and tilted plate or tube settlers, slow sand filtration, rapid filtration, and disinfection (physical or chemical). Canals, aqueducts, tunnels, pipelines, and pumping can be used to transmit water. Water distribution systems should be simple, either branched or looped. Service connections may be in the house, in the yard, or at a public standpipe. Design considerations for storage reservoirs, pumping stations, and the system as a whole are given. Appendixes cover sanitary survey, well drilling, water treatment plant design, and chemicals.
W85-06930

OPTIMIZATION OF BIOLOGICAL RECYCLING OF PLANT NUTRIENTS IN LIVESTOCK WASTE BY UTILIZING WASTE HEAT FROM COOLING WATER,
Tennessee Valley Authority, Muscle Shoals, AL. Div. of Agricultural Development.
For primary bibliographic entry see Field 5D.
W85-06983

CONSIDERATIONS INVOLVED IN THE REACTIVATION OF AN EXISTING WATER SUPPLY,
Massachusetts Metropolitan District Commission, Southborough. Water Div.
W. A. Brutsch, and S. L. Bishop.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 1-25, March, 1985. 10 Fig, 1 Tab.

Descriptors: *Water treatment, *Sudbury Reservoir, *Boston, *Massachusetts, Filtration, Oxidation, Ozonation, Clarification, Pilot plants, Water supply development, Hydraulic pulsed upflow, Activated carbon.

The Metropolitan District Commission (MDC) water system serves about 2.5 million people in 45 communities from Chicopee to Boston, Massachusetts. The Sudbury watershed, consisting of 75.2 sq mi, is not included in the MDC calculation of system safe yield since it can not function as an ongoing source without additional water treatment. A pilot plant testing program was undertaken to investigate alternative treatment processes for water from the Sudbury Reservoir. The hydraulic pulsed upflow clarification-filtration system produced water of an acceptable quality at a filtration rate twice that of the ozonation-filtration system. In general the hydraulic pulsed upflow clarification-filtration system was affected less by changes in color, turbidity, and algae than the ozonation-filtration system. The hydraulic pulsed upflow clarification-filtration system exhibited life cycle costs 76% of the ozonation-filtration system. The construction cost of the hydraulic pulsed upflow clarification-filtration system was estimated to be 87% of the ozonation-filtration system. As a result of these comparisons, the hydraulic pulsed upflow clarification-filtration system with granular activated carbon filters was recommended for treating water from the Sudbury Reservoir. (Baker-IVI)
W85-07056

PURIFYING OUR NEW ENGLAND DRINKING WATERS,
Camp, Dresser and McKee, Inc., Boston, MA.
P. W. Prendiville.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 26-38, March, 1985. 3 Fig.

Descriptors: *Drinking water, *New England, *Purification, Water treatment, Disinfection, Coagulation, Filtration, Carcinogens, Organic compounds.

Direct filtration and conventional treatment facilities are the core of today's water purification plants. In some cases, however, natural and synthetic organic matter can be present in the waters. Traditional treatment methods can be adjusted to remove some of this matter, but usually not enough of it to be safe. In addition to traditional processes like screening, coagulation, sedimentation and filtration, processes such as storage, aeration, oxidation, micro-flocculation with ozone and adsorption of organics on activated carbon can be applied economically. Five steps have been devised to arrive at the best conceptual design for treating a water supply: examine water quality records, run pilot and plant scale tests, research the literature, talk to experts and visit plants, and run alternative designs through conceptual design/cost alternates and conduct discussion and review meetings. Operational/maintenance problems which should be designed against are briefly discussed. Those designing the system must work closely with the operator, share experiences and in that way design a plant that will not only be pleasant to work in but that will produce a quality drinking water. (Baker-IVI)
W85-07057

REBUILDING WATER SUPPLY INFRASTRUCTURE,
Massachusetts Dept. of Environmental Quality Engineering, Boston.
M. I. Bhatti.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 39-45, March, 1985. 4 Ref.

Descriptors: *Water supply development, *Infrastructure, *Planning, *Massachusetts, Decision making, Financial aspects, Maintenance.

The term infrastructure is frequently used when discussing problems resulting from a lack of planned maintenance of the nation's physical stock. It appears that we are now urgently being called upon to pay the bills for the deferred maintenance of structures which were built with professional ingenuity and pride decades ago. A history is offered of various programs in Massachusetts including the grants program, the leak detection, and the rehabilitation program. In spite of the national emphasis on the need to rebuild the nation's infrastructure, water infrastructure does not appear to be accorded the priority it deserves. Innovative ways of financing will have to be explored at local, state and federal levels to commit financial resources on a long term basis to solve the problems. In the end, the most important goal should be the establishment of the true cost of water. State funds or federal funds can only provide financial assistance on a short term or temporary basis. Water utilities must take steps to establish self-sustaining systems. In the absence of that the infrastructure problem could only get worse. (Baker-IVI)
W85-07058

WATER SYSTEM OPERATION AND MAINTENANCE UTILIZING PUBLIC SECTOR EMPLOYEES AND PRIVATE SERVICE CONTRACTORS,
Cambridge Water Dept., MA.
J. J. Cussack.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 48-52, March, 1985.

Descriptors: *Cambridge Water Department, *Massachusetts, *Water conveyance, *Water distribution, Drinking water, Water treatment, Utilities, Maintenance.

The Cambridge Water Department (CWD) is a municipally owned and operated water utility serving about 100,000 permanent customers and an estimated additional 25,000 student population during the academic year. The principal assets of the CWD include three surface water reservoirs, a 24 mil gal/day water treatment plant, a 43 million gallon elevated distribution/storage reservoir, and about 175 miles of distribution and transmission mains, ranging in size from 4 in cast iron to 40 in steel. The Department is organized into three major operating divisions defined as Water Resources, Distribution and Transmission, and Treatment and Pumping. Each of these operating divisions has its own set of assets and liabilities which require customized programs for operation and maintenance. The CWD is presently utilizing a combination of public sector employees and private sector service contractors to perform operation and maintenance work on the Cambridge Water System. (Baker-IVI)
W85-07059

TRADITIONAL APPROACH TO WATER SYSTEM O AND M,
Manchester Water Works, NH.
D. Kittredge.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 53-61, March, 1985. 3 Fig, 1 Tab.

Descriptors: *Operation, *Maintenance, *Water conveyance, *Manchester, *New Hampshire, Planning, Drinking water, Water supply development, Water treatment, Watershed management.

Operation and maintenance techniques are described for the 40 mgd capacity water filtration plant located at Lake Massabesic, New Hampshire. This plant uses both conventional and non-conventional treatment processes including coagulation, settling, sand filtration and carbon filtration. A staff of ten fulltime operators operate and maintain all aspects of the facility including a 6 ton per day capacity carbon regeneration system plus one local and three remote pumping stations. All operators, including the plant manager-chemist are licensed to operate the treatment facility. A planned approach to routine operation and maintenance is followed by the plant supervisory staff with close follow-up to ensure completion of assigned tasks. Another major area of planned maintenance is that which occurs on the MWW's watershed land of over 8,000 acres plus its three covered distribution reservoirs. All this work is accomplished by a fulltime labor force of five men plus three part time summer laborers under the direct supervision of the Watershed Forester. Operation and maintenance of the water distribution system at Manchester is presently accomplished by 36 fulltime employees including a registered professional engineer who serves as general manager of the distribution division along with three principal supervisory staff employees. (Baker-IVI)
W85-07060

CONTRACT OPERATIONS - ONE ALTERNATIVE FOR WATER TREATMENT FACILITIES,
Metcalf and Eddy, Inc., Boston, MA.
W. Peterson.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 62-71, March, 1985.

Descriptors: *Water management, *Operation, *Maintenance, Decision making, Planning, Water treatment facilities, Contract operations.

Contract operation of water treatment facilities refers to the operation of a publicly owned facility by a private firm under contract to the municipal owners. Contract operation of wastewater treatment plants is expected to go from a $50 million per year business and industry to a $200 million annually business in 1990. Contract operation is characterized by a business-like entrepreneurial private sector approach to operating, maintaining, and managing water treatment facilities. The benefits of such an arrangement, the uniqueness of private sector operation and maintenance, and some examples of communities where this type of arrangement is working are considered. (Baker-IVI)
W85-07061

EMERGENCY: INTRUSION OF PROPANE INTO WATER MAINS,
Bridgeport Hydraulic Co., CT.
R. C. Smedberg.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 82-89, March, 1985.

Descriptors: *Trumbull, *Connecticut, *Water conveyance, *Accidents, *Propane, Water pollution sources, Hazardous materials, Emergency procedures, Hazards, Safety, Regulations.

Emergency plans of the Bridgeport Hydraulic Company (BHC) were put into effect in response to an incident of propane gas intrusion into a section of its distribution system, in Trumbull, Connecticut. At a propane plant in the area, one tank was being purged using water taken from a private hydrant through a 1.5 inch hose connected to the inlet of the tank, in violation of state and company rules. The initial phase of BHC's involvement was to identify the affected area and isolate the water mains in that area to contain the problem. Distribution crews began monitoring hydrants and air vents at strategic locations outside the area to ascertain that the problem was contained. One hydrant outside the initial containment area was found to be contaminated. Additional valves were shut. Homes and businesses were evacuated and electric power was shut off to the area. The water mains were filled and vented to drive out the propane. Teams went house-to-house in a systematic order, to restore individual water and gas service, check and vent each water using device and/or system, and relight gas pilots. The last phase involved a continuous flushing and sampling program within the area to monitor water quality to ensure the concentrations of propane in the water were reduced below the no health effects threshold level. Estimates indicated that propane was introduced in gaseous form over an approximate 20 minute period, and that as much as 750 C.F. was introduced into the water mains. (Baker-IVI)
W85-07063

EVALUATION OF CORROSION CONTROL INDICES FOR NEW ENGLAND WATERS,
J. J. Collins.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 90-95, March, 1985.

Descriptors: *Water quality, *Water treatment, *Corrosion control, Acidity, Langelier Index, Ryznar Index, Drinking water, Hydrogen ion concentration, Hardness, Buffering.

Highlights of the NEWWA Committee No. 55 report on Corrosion and Its Effects on Water Quality are presented. In particular an attempt is made to explain pHs (pH of saturation with respect to calcium carbonate), Langelier Index (LI), Ryznar Index (RI), and Aggressive Index (AI). Means of calculating each of these indexes are provided and a study of corrosion in Seattle, Washington is reviewed. The Seattle supply comes from two mountain rivers, resulting from rainfall and snowmelt runoff and thus is very soft and tends to be highly corrosive. Treatment given to these water sources is to add lime and sodium carbonate to the Tolt supply to attain the pH of the Cedar River supply and provide a fixed pH of 8.3. Because of the poor buffering capacity in the pH 8.0 to 8.5 range, it is advisable that open distribution reservoirs be covered to prevent carbon dioxide gain or loss which would affect maintenance of proper pH. (Baker-IVI)
W85-07064

INTERFACE BETWEEN FILTRATION AND BACKWASHING,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah.
Water Research, Vol. 19, No. 5, p 581-588, 1985. 11 Fig, 13 Ref. NSF grant ISP-80411449.

Descriptors: *Water treatment, *Filtration, *Backwashing, Water quality control, Degradation, Model studies, Filters, Mathematical models.

The initial quality of effluent from a granular media filter that has been used for several runs is usually poor. A conceptual model of the initial degradation phase of filtration is presented as an interface effect between backwashing and filtration. The initial degradation of effluent quality is due to the backwash water remnants within the media and the backwash water above the media. The two peak characteristics of initial degradation due to the backwash water remnants within the media and above the media is established by an extensive experimental investigation. A mathematical model for the quality of backwash water as a function of backwash water volume is developed. The concentration of particles in the backwash water remnant above the media varies as an exponential function with backwash water volume. The highest concentration of detached particles would therefore be at the top of the backwash remnant above the media. Filtration efficiency would be an inverse function of filtration rate at the initial stages of filtration, when all other parameters remain unchanged. This would imply that the magnitude of the second peak in initial degradation would be a direct function of filtration rate. (Baker-IVI)
W85-07117

EFFECT OF TEMPERATURE, PH, AND OXYGEN LEVEL ON THE MULTIPLICATION OF NATURALLY OCCURRING LEGIONELLA PNEUMOPHILA IN POTABLE WATER,
Pittsburgh Univ., PA. Graduate School of Public Health.
For primary bibliographic entry see Field 5B.

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W85-07128

USE OF BITUMINOUS COAL AS AN ALTERNATIVE TECHNIQUE FOR FIELD CONCENTRATION OF WATERBORNE VIRUSES,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Virology Section.
For primary bibliographic entry see Field 5A.
W85-07129

5G. Water Quality Control

MOISTURE SENSOR-CONTROLLED IRRIGATION FOR REDUCING N LEACHING IN BERMUDAGRASS TURF,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
G. H. Snyder, B. J. Augustin, and J. M. Davidson.
Agronomy Journal, Vol. 76, p 964-969, November-December, 1984. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Irrigation, *Nitrogen, *Grasses, *Bermudagrass, Plant growth, Leaching, Nutrients, Water pollution control, Sensor irrigation.

Turfgrass N fertilization may contribute to concentrations of NO3-N in groundwater. The feasibility of using a tensiometer-controlled irrigation system to reduce N leaching in turf grass while maintaining acceptable growth was determined. Bermudagrass was grown on a sand soil during a series of 2 month cycles. Irrigation was applied either daily or when permitted by tensiometer soil moisture sensors. Nitrogen at the rate of 5 g/sq m/month was applied bimonthly as NH4NO3 or sulfur coated urea or NH4NO3 through the irrigation system with each irrigation. Nitrogen leaching ranged from 56% to less than 1% of that applied, depending on treatment and cycle. Greatest N losses occurred with NH4NO3 combined with daily irrigation. Smallest losses were noted when NH4NO3 was applied through the irrigation system with each irrigation and these irrigations occurring only when the sensor indicated it was appropriate. Sensor irrigation reduced N leaching from all N sources. Acceptable turfgrass growth and quality were maintained under these conditions. (Baker-IVI)
W85-06187

EVALUATING THE OPTIONS FOR WATER QUALITY MANAGEMENT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. Cairns, Jr.
Water Resources Bulletin, Vol. 21, No. 1, p 1-6, February, 1985. 22 Ref.

Descriptors: *Water quality management, *Waste disposal, *Environmental effects, *Legislation, Water quality standards, Water quality control, Toxicity, Monitoring.

The agricultural revolution occurred because the unmanaged environment was not providing food in either the quantity or quality that society desired. The 'environmental revolution' is developing because the unmanaged environment is clearly not capable of assimilating societal wastes without being seriously degraded. Effective environmental management will require regional and site-specific modification of general principles and practices that can be used at a national or international level. An environmental management system can be operated in the same manner as any industrial quality control system with three basic components: (a) sensors at appropriate locations, (b) rapid generation and feedback of information, and (c) a quality control group capable of taking immediate effective action when system performance is outside predetermined boundary conditions. This discussion focuses primarily on three areas: (a) management options available to regulate intrusion of societal wastes into natural systems, (b) types of methods available for predicting and validating effects on natural systems, and (c) modifications of present legislation that would permit the most flexibility in selecting from the various management options. Also considered are multispecies toxicity tests using species with cosmopolitan distribution in test systems with a high degree of environmental realism. Among the many values of such tests is the ability to exchange information from all parts of the world effectively because the test organisms are not restricted to a particular geographic region. (Author's abstract)
W85-06232

COMPARATIVE BASES OF INDUSTRY POLLUTION ABATEMENT AND COMMERCIAL INNOVATION: IMPLICATIONS FOR WATER RESOURCES MANAGEMENT,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
R. E. Rickson, and C. E. Ramsey.
Water Resources Bulletin, Vol. 21, No. 1, p 89-97, February, 1985. 2 Tab, 33 Ref.

Descriptors: *Water pollution control, *Industrial wastes, *Water resources management, Regulations, Attitudes, Innovation, Water pollution prevention.

Adoption, maintenance, and operation of pollution control technology by manufacturing firms is essential to effective water resource management. In this study of 102 industries, it is found that company adoption of pollution control technology and practices is primarily associated with two factors: (1) the overall company capacity for innovation in its production technology; and (2) company relationships with state and federal pollution control agencies, local government officials and professionals. Managerial attitudes about pollution and government regulation are not associated with either pollution control or commercial innovation, but are seen as basic to industry-government relationships. The data suggest an important regulatory dilemma, the problem of regulating a large number of small companies with a low capacity for innovation, but which when taken together account for large volumes of toxic effluent. (Author's abstract)
W85-06243

BIOINDICATION FOR THE DECREASE IN NITROGEN LOSS AND NITROGEN POLLUTION OF THE WATERS (BIOINDIKATION ZUR VERMINDERUNG VON STICKSTOFF-DUNGERVERLUSTEN UND DER STICKSTOFFBELASTUNG VON GEWASSERN),
Akademie der Landwirtschaftswissenschaften der DDR, Halle/Saale. Inst. fuer Landschaftsforschung und Naturschutz.
U. Wegener.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 279-293, 1983. 5 Fig, 27 Ref.

Descriptors: *Water pollution control, *Nitrates, *Fertilizers, *Bioindicators, Leaching, Optimization, Water pollution sources, Agricultural chemicals, Climate, Temperature.

Prerequisite to the control of nitrogen leaching from agricultural soils in spring is the ecologically optimum control of the first nitrogen fertilizer application. On the basis of investigations carried out for some years, a method for determining the optimum time of fertilization with the aid of phenological data is presented. The blossoming data of Anemone nemorosa proved to be a suitable sensitive indicator; the onset of blossoming is the optimum time for the first nitrogen application. Depending on the altitude and variation of weather, in the temperate mountains this time is 90 to 116 d after the beginning of the year and corresponds to a temperature total > or = 5 C of 80-120 C or > 0 C: 160-230 C. Possibly, the leaf development of Alchemilla vulgaris or the first development of Poa pratensis are suitable as other bioindicators. The boundary conditions and disturbance variables of the bioindication are discussed. By the phenological date-determination of the beginning of fertilization the nitrogen losses can be reduced by 10 to 20% and the nitrate leaching can be considerably reduced especially in drinking-water protection areas. (Author's abstract)
W85-06260

METHOD FOR NITRATE ELIMINATION IN WATERS (VERFAHREN ZUR NITRATELIMINIERUNG IM GEWASSER),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
N. Fichtner.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 339-345, 1983. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Nitrates, *Nitrogen removal, *Hypolimnion, *Fatty acids, Anaerobic conditions, Water quality control, Storage reservoirs, Iron, Phosphorus, Manganese.

In a storage reservoir with a hypolimnic volume of 3.5 cu hm the water contains 40 mg/l nitrate. A straw bale of 60 by 20 by 1.5 m was introduced as a reactor. Hypolimnic water polluted with a waste product of fatty acid syntheses (30-20% formic, acetic, propionic, butyric and valeric acids) was pumped through it. By the use of a total of 43.8 t fatty acid mixture from June to August an additional oxygen depletion of 14 t O2 is achieved and 49 t NO3(-) are removed at the same time. The ammonium concentration did not increase; the NO2(-) concentration, however, rose to 12-13 mg/l NO2 at times. The fatty acids were used up except 0.1 mg/l. The increase in the NO2(-) concentration, in the number of microorganisms and in the iron, manganese and phosphorus resolution due to the controlled anaerobic conditions is the drawback of the process. (Author's abstract)
W85-06264

MATHEMATICAL REPRESENTATION OF SHORT TERM PHOSPHORUS VARIATIONS IN A NON-STRATIFIED SOUTHERN LAKE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W85-06285

NONPOINT SOURCE POLLUTION ABATEMENT IN THE GREAT LAKES BASIN/AN OVERVIEW OF POST-PLUARG DEVELOPMENTS.
International Joint Commission-United States and Canada, Windsor (Ontario).
Report to the Great Lakes Water Quality Board, August 1983, 96 p, 4 Fig, 6 Tab, 4 Append.

Descriptors: *Lakes, *Land use, *Nonpoint polluton sources, *Soil conservation, *Interagency cooperation, *Jurisdiction, *Pollution load, Chemical wastes, Agricultural runoff, Agricultural chemicals, Soil erosion, Economic aspects, Planning.

In 1972, the Pollution From Land Use Reference Group (PLUARG), a subgroup of the International Joint Commission (IJC), was established to determine the causes and levels of pollution from land use activities and to recommend appropriate remedial actions. PLUARG made its initial report in 1978. This report summarizes the effects of nonpoint pollution control in subsequent years. The need for nonpoint source control programs has increased during the period due to the intensifying use of farmland which increases soil erosion. Cash grain and monoculture crops have been replacing the more comprehensive operations that were the norm in the 1940s. This has been accompanied by an increasing reliance by farmers on complex technology, including elaborate equipment and greatly increased use of chemicals. In Canada, no action has been taken to develop a comprehensive program to address nonpoint sources of water pollution in the Great Lakes basin, although the level of expenditure on basin studies has averaged about $1.5 to $2 million per year since 1980. To date the Thames River Implementation Committee program has been one of the most successful in Ontario. As a result of the program, which encourages better land use practices, more farmers have begun using soil conservation practices. In the U.S., there is no comprehensive program for the control of nonpoint sources of pollution. There are large-scale soil conservation programs, however, they are not primarily focused on water quality. (Hawkins-Omniplan)
W85-06341

AERATION-DESTRATIFICATION OF LAKE EUREKA: SECOND YEAR OPERATION,
Illinois State Water Survey Div., Champaign.
R. K. Raman, and R. L. Evans.
ISWS Circular 159, 1984, 25 p, 13 Fig, 6 Tab, 3 Ref, 2 Append.

Descriptors: *Destratification, *Aeration, *Aerated lagoons, *Aerators, *Chemical treatment, *Lake restoration, *Lake rehabilitation, *Political aspects, *Water management, *Taste, *Odor control, Algae, Algae control, Water treatment, Lake Eureka, Illinois.

In response to taste and odor problems at Lake Eureka in Eureka, IL, an in-lake water quality management program was instituted in 1981 that included aeration-destratification in combination with in-lake chemical control of algae. The results are presented of the second-year operation of the destratification device. Factors in the lake that had been identified as causing taste and odor problems in the finished waters (such as high levels of iron, manganese, ammonia, and chlorine demand values; anoxic conditions in the deep waters; and blue-green algae dominance) were reduced or altered improving the lake water quality characteristics. The city of Eureka reverted to the lake from groundwater as its source of water supply in April 1982. With the aerator in place and with two chemical applications to control the blue-green algae during the summer months of 1982, the water treatment system functioned extremely satisfactorily without any source-related consumer complaints about taste or odor. Percentage reduction of 91, 94, 98 and 55 in the mean values of ammonia-nitrogen, iron, manganese and chlorine demand were achieved during 1982. Blue-green algae were never dominant in the lake. The lake water quality management scheme thus resulted in a savings of $40,000, or 43.6% of the operating cost in FY 1981-82. (Hawkins-Omniplan)
W85-06344

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, EXECUTIVE SUMMARY,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-A, June 1983. 13 p, 2 Tab, 1 Fig.

Descriptors: Surface water, River basins, *Monitoring, Trophic level, *Nonpoint pollution sources, *Toxicity, Eutrophication, Estuaries, Watersheds, Water pollution effects, Surface water records, Bays, Phosphorus, Water pollution, Coliforms, *New Jersey, *Water quality.

This report, a complete revision of a State Water Quality Inventory Report of 1977, reviews surface water in New Jersey from 1977 to 1981, using ambient monitoring data collected at 78 fixed stations. The ability of the state's waters to meet the swimmable and fishable goals of the Clean Water Act are discussed. It was found that surface water qualtiy throughout the state has been relatively stable over the last four to five years, while coastal bays and estuaries improved significantly. Water quality degradation occurred in the Passaic, Raritan and Hackensack River basins during a 1980-1981 drought. It was found that nutrient enrichment is a major problem in the state's waterways, with 45 percent of all total phosphorus values exceeding criteria. A large number of lakes in the state are considered eutrophic. For other water quality indices, four percent of the DO values fell below standards, while three percent of un-ionized ammonia two percent of total dissolved solids values exceeded their standards. The majority of fecal coliform samples were greater than the 200 MPN/100 ml criterion. New Jersey has approximately 1,600 permitted point source wastewater discharges, and many possible nonpoint sources of pollution. Toxic substances seemed to be fairly widespread at very low concentrations. Major recommendations for water quality improvement include coordinated watershed management activities, greater identification of nonpoint sources, and protection of groundwater levels and quality. (Hawkins-Omniplan)
W85-06348

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-B, June 1983. 195 p, 26 Tab, 16 Fig, 38 Ref, 3 Append.

Descriptors: Surface water, Groundwater basins, Rivers, *Water pollution sources, Phosphorus, Coliforms, *On-site data collections, *Toxicity, Streams, Water use, Water pollution effects, *New Jersey, *Water quality.

Water quality changes in New Jersey as the result of water pollution control efforts during the past decade are reviewed, and what improvements may be needed are suggested. There is a rating system of surface waters based on water quality conditions and water used, including potable water diversions, bathing beaches, fisheries, resources and agricultural water use. Each of these two indices is comprised of a number of parameters used to measure water quality and water uses in the 29 river basin segments studied. Toxic substances were examined in the water column, bottom sediments and fish tissues, and point scores were given for each medium examined, for a total of 100.0 if toxics were found in all three. The segments found to have the greatest water quality impairment were the Mid-Passaic, Lower Raritan Mid-Passaic tributaries and the South Branch Raritan, with water quality indexes of 146, 103, 98 and 85, respectively. The majority of New Jersey's inland surface waters do not meet minimum standards for swimming and are not expected to meet the national swimmable goal in the foreseeable future. Recommendations for improvement include increased monitoring, greater identification of surface water uses and resources, coordinated watershed management activities, identification and control of nonpoint pollution sources, and achieving effluent quality from point sources. Common ambient quality problems requiring treatment are high iron, high dissolved solids content, high manganese content, acidity, alkalinity, and hardness. (Hawkins-Omniplan)
W85-06349

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, APPENDIX--DELAWARE RIVER BASIN,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-C: 1.A, June 1983. 233 p, 3 Tab, 160 Fig, 11 Ref.

Descriptors: *River basins, Coliforms, *Water pollution sources, *Forest watersheds, Phosphorus, Dissolved oxygen, Natural streams, Watersheds, Groundwater basins, Large watersheds, Drainage area, On-site data collections, Rivers, *New Jersey, Water quality, *Delaware River basin.

Twelve river basins of the Delaware River are reviewed interms of water quality, problem assessment, and goal assessments and recommendations. Each basin is described, according to identified water uses, monitored swimming locations, fishing opportunities and resources, shellfish harvesting, and other specific uses unique to the region. Monitoring programs indicate that surface water quality within the Walkill River basin is marginal. Contravention of the fecal coliform 200 MPN/100 ml standard are frequent throughout the basin. Flat Brook is categorized as one of New Jersey's highest quality streams, with only one recorded DO concentration value recorded below 7.0 mg/l. Paulins Kill's watershed, which contains a variety of land uses, has normally high quality water with occasional concentrations approaching or exceeding applicable criteria. The Pequest River watershed is 58% forested, and the Musconetcong River watershed has areas of significant development, yet the surface waters of both are of overall good quality but exhibit excessive levels of fecal coliform and total phosphorus to varying degrees. At Pohatcong and Lopatcong Creeks, water quality was found to be generally good, although total phosphorus and fecal coliform concentrations were often found to be excessive. Seasonal low flow periods appeared to cause occasional adverse imapcts on 12 other tributaries to the Delaware River, and elevated fecal coliform concentrations indicated possible problems. Also discussed are Assunpink, Crosswicks, Assiscunk, Rancocas, Pennsauken, Woodbury, Mantua, Raccoon, Alloway, Big Timber and Oldmans Creeks, and four rivers. (Hawkins-Omniplan)
W85-06350

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, APPENDIX--ATLANTIC COASTAL BASIN,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-C: 1.B, June 1983. 103 p, 1 Tab, 60 Fig.

Descriptors: Parametric hydrology, Urban watersheds, Storm runoff, Groundwater basins, *Large watersheds, *Water pollution sources, Dissolved oxygen, Anaerobic conditions, Drainage area, Catchment areas, Watersheds, Buffering, *New Jersey, Water quality, *Atlantic Coastal basin.

Six watersheds of the Atlantic Coastal Basin area of New Jersey are described, using a segment analysis and graphs showing all raw data points collected for ten parameters. In the southern section, which includes a multimillion dollar casino/resort industry, water quality was generally good, with dissolved oxygen and biochemical oxygen demand concentrations at acceptable levels annually. Some contamination sources need to be studied further, and long-term and year-round monitoring stations prevent specific conclusions from being made. At Great Egg Harbor River, the upper watershed is in greatest need of improvement using advanced treatment and removal rates or alternative wastewater disposal practices at the Berlin Borough Treatment Plant. The Mullica River watershed is predominantly undeveloped state park and forests, where water quality is generally good although some occasional extreme values were exhibited during summer low flow conditions. In the Mid-Atlantic region, where there are more than 50 lakes, high trihalomethane levels were found, and stream water quality varied from generally good to marginal. Advanced treatment methods are recommended because of the low buffering capacity of the inland streams. The Manasquan River water quality was marginal at best, and one recommendation is the correction of malfunctioning septic systems. In the northern region, water quality was generally good, but stormwater runoff controls are probably needed. (Hawkings-Omniplan)
W85-06351

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, APPENDIX--NORTHEAST NEW JERSEY WATERS,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-C: 1.C, June 1983. 151 p, 65 Fig, 17 Tab.

Descriptors: *Rivers, *Watersheds, *Groundwater basins, River mechanics, *Water pollution sources, Ammonia, Coliforms, *Urban watersheds, On-site data collections, Regional analysis, On-site data collections, Regional analysis, Wastewater treatment, Catchment areas, *New Jersey, *Northeast New Jersey water, Water quality.

A water quality inventory of Northeast New Jersey waters included the Elizabeth, Rahway, Passaic and Hackensack river basins and Interstate Sanitation Commisssion waters. The Elizabeth and Rahway River basins have several land use types an have water quality problems which seem to be mostly the result of nonpoint sources originating from intensively developed urban and suburban watersheds. Both rivers show signs of excessive nutrients, and high concentration of ammonia are being found without any apparent source. Samples frequently exceeded a fecal coliform concentration

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of 200 MPN/100 ml. The upper Passaic River basin receives over 19.1 mgd of effluent from approximately 40 point source dischargers. Total dissolved solids concentrations also increased in the downstream direction and periodically exceeded 500 mg/l. The Mid-Passaic river area is approximately 67 percent underdeveloped consisting mostly of marsh lands. Samples exceeded the fecal coliform standard although the segment meets the fishable goal. The five mid-Passaic tributaries had generally good water quality in terms of dissolved oxygen, but fecal coliform concentrations were frequently above 200 MPN/100 ml. Point source dischargers need to be upgraded to level 4. In the lower Passaic River basin, water quality was generally poor; the Hackensack River water quality was generally good. It was found that municipal treatment plants for Interstate Sanitation District waters do not provide adequate pollutant removal. (Hawkins-Omniplan)
W85-06353

PRELIMINARY STUDY OF THE WATER QUALITY IMPACT DUE TO THE WANAQUE SOUTH PROJECT.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
May 1982. 77 p. 25 Tab, 19 Ref. Prepared for New Jersey District Water Supply Commission and Hackensack Water Company.

Descriptors: *Trophic level, *Mesotrophy, *Dynamic programming, *Reservoirs, *Water quality, *On-site data collection, Flow measurement, Phosphorus, Diversion, Algae, Rivers, Seasonal variation, Flow duration.

A two-phase study of the Wanaque Reservoir consisted of an analysis of the current trophic state of the reservoir and the proposed design of a reservoir water quality model. The analysis revealed that the reservoir was currently in a mesotrophic state, in generally good condition. However, its trophic state is such that any major new input, such as the Wanaque South diversions, of phosphorus to the reservoir will cause it to enter the eutrophic state. Current patterns indicate there is a slight to moderate increase in algae problems; in the winter, water problems remain and possibly might worsen. Peak monthly phosphorus loading is at least twice the annual average loading and roughly equal to the drought loading. During a normal year, the peak diversion pumping and, therefore, the peak phosphorus loading will occur in November. The proposed water quality model should minimize the total phosphorus loading inputs in order to meet the water supply and minimize the water quality impact in the reservoir and its diversion river system. The model should also (1) ensure the required water supply levels, (2) maintain an adequate water quality level in the diversion rivers, (3) maintain the established minimum flow levels in the diversion rivers, and (4) minimize overall management costs. Data requirements should include sampling for loading determination, in-reservoir sampling, and river water quality sampling. A steady state model which was previously used must be replaced by a dynamic or time dependent model. (Hawkins-Omniplan)
W85-06363

MARINE POLLUTION UNDER THE LAW OF THE SEA CONVENTION,
Queen Mary Coll., London (England).
For primary bibliographic entry see Field 6E.
W85-06366

HEALTH AND ENVIRONMENTAL ASPECTS OF SETTING CLEANUP CRITERIA,
Jordan (Edward C.) Co., Inc., Portland, ME.
R. M. Block, J. Dragun, and T. W. Kalinowski.
Chemical Engineering, Vol. 91, No. 24, p 70-73, November 26, 1984. 2 Fig, 10 Ref.

Descriptors: *Groundwater pollution, *Regulations, *Cleanup, Decision making, Planning, Management, Water quality control, Water pollution control.

The development of cleanup criteria is considered. Cleanup criteria, otherwise called action levels, represent the maximum contaminant concentration that may remain in groundwater without causing adverse human health and environmental effects. In many cases an action level will be based on standards or regulations, such as the US EPA drinking water standards. However, if no applicable standards exist, the remedial-action team must negotiate with the appropriate regulatory agency to establish a site-specific action level. Specifics considered include whether or not the substance in question is a carcinogen. For noncarcinogens the acceptable daily intake (ADI) is calculated from total exposure data, including contributions from diet and ambient air. Once an ADI has been calculated, the action level can be determined. In developing the action level one thus considers risk assessments as well as evaluation of available treatment technology, analytical methods, monitoring costs, and economic impacts. (Baker-IVI)
W85-06452

GROUNDWATER CONTAMINATION - PART 3: REMEDIAL ACTION,
R. W. Schneiter, J. Dragun, and T. G. Erler.
Chemical Engineering, Vol. 91, No. 24, p 73-78, November 26, 1984. 1 Fig, 3 Tab, 27 Ref.

Descriptors: *Groundwater pollution, *Water quality control, Water treatment, Decision making, Management, Planning, Water pollution control.

Remedial action seeks to control and/or reduce the effects of contamination on water bearing soil. Several remedial action alternatives are reviewed and the use of risk-benefit analysis in evaluating such options is considered. A remedial action plan consists of one or more treatment and/or management options. Possibilities include no direct cleanup action; in situ treatment; plume containment; or extraction and surface treatment. No action may be an attractive option under conditions of relatively low level contamination dispersed over a larger area where the potential for human exposure is low. In situ treatment, the treatment of contaminated material as it exists in place with minimal soil excavation or extraction can be achieved through physical/chemical treatment or biological treatment. Plume containment can be achieved through extraction well usage, construction of impermeable barriers, or interceptor trenches that interrupt groundwater flow in shallow aquifers. The most extensively applied remedial action is the extraction of the contaminated groundwater, followed by treatment at the surface, using traditional chemical engineering unit processes. (Baker-IVI)
W85-06453

RELATION OF WATER TRANSPARENCY TO SUSPENDED SUBSTANCE CONTENT IN LARGE RIVERS AND WATER BODIES OF THE UKRAINE (O SVYAZI PROZRACHNOSTI VODY S SODERZHANIEM VZVESHENNYKH VESHCHESTV V KRUPNYKH REKAKH I VODOEMAKH UKRAINY),
V. M. Timchenko, and P. V. Sipchenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 66-69, 1984. 1 Fig, 8 Ref.

Descriptors: *Transparency, *Turbidity, *Suspended solids, *Rivers, *Lakes, *Ukraine, Organic matter, Water quality control.

An empirical relationship was established between transparency and turbidity and the amount of organic matter suspended in large rivers and other water bodies in the Ukraine. Observations made to gather the data used in establishing these relationships are described. (Author's abstract)
W85-06462

EFFECT OF MECHANICAL AERATION OF INTRA-WATER-BODY PROCESSES IN A STRATIFIED LAKE (VLIYANIE ISKUSSTVENNOI AERATSII NA VNUTRIVODOEMNYE PROTSESSY V STRATIFITSIROVANNOM OZERE),
V. F. Brekhovskikh, and I. A. Korneev.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 69-76, 1984. 4 Fig, 28 Ref.

Descriptors: *Aeration, *Eutrophic lakes, *Stratification, Lake restoration, Phytoplankton, Biomass.

Aeration of a small eutrophic lake is shown to promote removal of biogenic substances to the photic layer. However, due to a high trophic status of the water body such an addition does not cause an increase in the phytoplankton biomass growth rate as compared with that in the control water body. (Author's abstract)
W85-06471

DECHLORINATION AND TRIHALOMETHANE YIELDS,
Maryland Univ., College Park. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W85-06527

IRON AND STEEL INDUSTRY CONSENT DECREE; IMPLEMENTING THE BUBBLE POLICY UNDER THE CLEAN WATER ACT,
T. J. Krueger.
Virginia Journal of Natural Resources Law, Vol. 4, No. 1, p 155-183, Fall, 1984. 234 Ref.

Descriptors: *Bubble concept, *Industrial wastes, *Steel industry, *Iron industry, *Regulations, Legal aspects, Standards, Legislation, Water pollution control, Outfalls.

The bubble concept is a regulatory alternative to limiting pollutant discharge at each discrete outfall. This alternative places a theoretical bubble over an entire plant and regulates the total discharge from that bubble. The individual outfalls within the bubble need not meet specific regulatory limits, but the total emissions from the bubble may not exceed the aggregate of the limits on the individual outfalls. Thus a plant manager may substitute relatively inexpensive discharge reductions at one pipe for more expensive reductions which would otherwise be required at another pipe. This is referred to as a bubble trade. These regulations for the iron and steel industry are an important step toward cooperation among the parties primarily concerned with environmental regulations - industry, environmentalists, and the EPA. Although such private regulatory agreements raise fears about accountability and about the parties' ability to accurately project the results of their agreements, systemic safeguards may protect the economic and environmental concerns of the parties and the public. This regulation by consensus is potentially valuable as it provides certainty, allows quick implementation, and avoids divisive litigation. If the bubble agreement works well in the iron and steel industry, the bubble concept may be applied to other industries and regulatory programs as well. (Baker-IVI)
W85-06530

POLLUTION CONTROL BY EFFLUENT CHARGES: IT WORKS IN THE FEDERAL REPUBLIC OF GERMANY, WHY NOT IN THE U.S.,
Washington Univ., Seattle. Dept. of Economics.
G. M. Brown, Jr, and R. W. Johnson.
Natural Resources Journal, Vol. 24, No. 4, p 929-966, October, 1984. 129 Ref.

Descriptors: *Germany (Federal Republic), *Water pollution control, *Effluent charges, Legal aspects, Economic aspects, Legislation, Political aspects.

The recent Federal Republic of Germany effluent charge law and the political and legal background that permitted this law to be enacted are described. The impact of that law is assessed, although the assessment is necessarily tentative in view of the short experience with the law to date. The economic and legal implications of enacting an effluent charge law in the United States also are analyzed. Included in this discussion are the advantages and disadvantages of state vs. federal enactment, the constitutional objections that might be raised to such a law, and how it might be coordinated with existing water pollution control laws in the United States. (Baker-IVI)
W85-06534

ACID RAIN CONTROL AND UNITED STATES ENERGY POLICY,
Argonne National Lab., IL. Energy and Environmental Systems Div.
D. G. Streets.
Energy, Vol. 9, No. 11-12, p 1049-1063, November/December, 1984. 7 Fig, 4 Tab, 20 Ref.

Descriptors: *Acid rain, *Water pollution control, *Energy, *Public policy, Legislation, Costs, Economic aspects, Sulfur dioxide, Coal, Transportation, Utilities.

The US Congress is currently considering whether to legislate a control program to reduce the perceived effects of acid rain. The effects of such a program would be costly, wide ranging and would have important implications for the development of US energy policy over the next several decades. The proposals call for reductions of between 30 and 50% in emissions of sulfur dioxide in the eastern US. Costs of achieving these reductions are estimated to be in the range of $4-12 billion annually over the next 20 yr so. In addition to the obvious economic impacts, there will be major energy implications, arising from shifts in the patterns of US coal production and consumption; coal resource, transportation and employment effects; electricity price increases; changes in electric utility system mix; effects on manufacturing industries; and penetration of innovative energy technology. The anticipated effects of acid rain control programs in these areas are discussed, together with creative new ways to address the acid rain issue, including targeted control strategies, emissions bubbling and early retirement. Any control program that seeks to reduce emissions enough to relieve the acid rain problems significantly is bound to be costly. The coal and utility industry will have to reevaluate its thinking on system planning and technology choice. (Baker-IVI)
W85-06555

REGIONAL PRIORITIES FOR ABANDONED MINE RECLAMATION IN THE BLACKLICK CREEK WATERSHED, PENNSYLVANIA,
Georgia Univ., Athens. School of Environmental Design.
B. K. Ferguson.
Journal of Environmental Management, Vol. 19, No. 3, p 249-259, October, 1984. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Land reclamation, *Water pollution control, *Strip mines, *Blacklick Creek Watershed, *Pennsylvania, Mine reclamation, Acid mine drainage, Mine wastes, Priorities, Planning, Environmental effects.

The Blacklick Creek Watershed in the Appalachian Plateau of Pennsylvania has been one of the most devastated of old mining regions. There are 300 surface coal mines; 200 sq mi of acid-bearing deep mines are continuously flushed out by groundwater, and 180 acid refuse banks lie exposed to rainfall. A novel framework was developed for setting the priorities for abandoned mine reclamation in the Blacklick Creek Watershed. Planning for abandoned mine reclamation is fundamentally different from other types of regional planning, in that it directs reclamation to places where degradation is worst and conflicts greatest, rather than laying out land uses in harmony with favorable land suitability. The framework that was developed sought to establish reclamation priorities by comparing the 'supply' of sites to be reclaimed (the degrees of old mines' land and water degradation) with the 'demand' for reclamation to be done (the human values represented by the region's demography, land use and other non-mining characteristics). At Blacklick, the degree of disturbance to land depended on how much regrading and revegetation were lacking. The degree of disturbance to water depended on how much pollution an old mine was discharging into the stream system. In regions with other types of mining impacts, disturbance may also depend on such factors as mine fires, subsidence, landslides and water supply damage. The locations, priorities, and phasing of land and water reclamation objectives shown on the resulting maps could guide any reclamation effort, no matter what reclamation technology is applied to achieve the objectives. A reclamation effort carried out in concert with the regional framework would be constantly directed toward types of reclamation projects, with strong leverage for creating the greatest and most rapid benefit for the application of limited reclamation funds. (Moore-IVI)
W85-06607

ETHYLENE DICHLORIDE/ETHYLENE GLYCOL SPILL IN A MAJOR WATER RESOURCE IN BRITISH COLUMBIA,
Public Health Dept. Kamloops (British Columbia).
K. L. Christian, and W. P. Moorehead.
Journal of Environmental Health, Vol. 47, No. 4, p 192-196, January/February, 1985. 4 Tab, 15 Ref.

Descriptors: *Chemical spills, *Water pollution, *Ethylene glycol, *Ethylene dichloride, *British Columbia, Toxicity, Water management, Decision making, Water pollution control, Spills, Public health, Organic compounds.

In March, 1982, a Canadian National Railway train containing hazardous chemicals derailed near Blue River in the interior of British Columbia, Canada. Significant quantities of ethylene dichloride and ethylene glycol were released into the North Thompson River. The local Public Health authority's role in response to this spill is discussed as it relates to the potential threat to domestic water supplies. Of immediate concern in the management of the situation were the extent of the spill, characteristics of the chemicals, interaction of the chemical spill with the environment, identification and notification of water users, characteristics and condition of the river in relation to dissemination of chemical, time factors in relation to the decision-making process and availability of accurate information, and the development of liaison and a climate of trust with the organizations involved. Concern regarding the ethylene glycol was short lived as it is completely soluble in water, the North Thompson River provided a high dilution factor relative to the volume spilled, initial calculations indicated that concentrations would be so low as to tax analytical capabilities of available testing equipment, and the toxicity of ethylene glycol was not significant compared to the ethylene dichloride which was spilled as well. Volatilization is the major transport process for removal of ethylene dichloride from aquatic systems. The US EPA has proposed human health criteria for chlorinated ethanes. The criterion for ethylene dichloride is 7 micro-g/liter. The interaction of the chemical spill and the environment in samples showed the North Thompson River reached the 7 micro-g/liter criterion within 8 weeks. A thorough review of the accident, the chemicals, and available laboratory results led to the decision to remove other water systems at risk from the river for 48 hours. This decision was followed by releases of information to individuals regarding the condition of their drinking water and suggested steps to prevent toxicity. (Baker-IVI)
W85-06610

ARTIFICIAL AERATION OF RIVERS IN LITHUANIA,
Kaunasskii Politekhnicheskii Inst. (USSR).
A. L. Skirkevicius.
Effluent and Water Treatment Journal, Vol. 25, No. 1, p 22-23 and 25, January, 1985. 1 Fig.

Descriptors: *Aeration, *River Nevezis, *Lithuania, Water quality control, Anaerobic conditions, Aerobic conditions, Rehabilitation.

Data collected from the artificial aeration of rivers in Lithuania are presented. Studies were carried out in the River Nevezis which is polluted by inadequately purified wastewater from the town of Panevezys. An experimental station, Nevezis I, was equipped with mechanical aerators with a capacity of 2.2 kw. The width of the river is 16-20 m and the length of the structure is 12 m. While artificial aeration under aerobic conditions did not lead to a significant increase in the powers of self-purification, it did prevent a reduction in self-purification, as it does stop the formation of anaerobic areas. Therefore, one must be careful not to overestimate the advantages of artificial aeration. It can be an inexpensive means of effective help to some degree to rivers. (Baker-IVI)
W85-06629

ESTIMATING THE EFFECTIVENESS OF VEGETATED FLOODPLAINS/WETLANDS AS NITRATE-NITRITE AND ORTHOPHOSPHORUS FILTERS,
Agricultural Research Service, Fort Pierce, FL. Southeast Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W85-06634

ROLE OF HIGHER AQUATIC VEGETATION IN IMPROVING WATER QUALITY AND INCREASING BIOLOGICAL PRODUCTIVITY OF RESERVOIRS,
A. B. Avakyan, and L. O. Einor.
Hydrotechnical Construction, Vol. 18, No.9, p 454-459, September, 1984. 12 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 57-61, September, 1984.

Descriptors: *Aquatic plants, *Reservoirs, *Water quality control, *Productivity, Macrophytes, Plants, Water quality, Drinking water, Design criteria.

Self-purification of natural water on the basis of the vital activity of the biota occurs as a result of the activity of all groups of aquatic organisms, since for them water is not simply a habitat but also a product of vital activity. Macrophytes in the case of their controlled development are an effective means of improving water quality. The participation of hydrobiologists and geobotanists both in the design and construction of reservoirs will help to establish the effectiveness of self-purification being accomplished by components of the biota and especially by macrophytes. When designing reservoirs and their engineering it is necessary to take into account natural conservation measures aimed at improving water quality, including a bank water-protection zone, beaches, bioplateaus with macrophytes, means for harvesting the plant biomass, and condition of its transporting, processing, and utilization in the economy. (Baker-IVI)
W85-06713

WATER QUALITY FROM EROSION CONTROL STRUCTURES IN NEBRASKA,
Nebraska Univ.-Lincoln.
For primary bibliographic entry see Field 2J.
W85-06716

PESTICIDE AVAILABILITY INFLUENCE OF SEDIMENT IN A SIMULATED AQUATIC ENVIROMENT,
Agricultural Research Service, Beltsville, MD. Pesticide Degradation Lab.
For primary bibliographic entry see Field 5B.
W85-06783

CONTAMINATION OF AQUIFERS BY OVERPRESSURING THE ANNULUS OF OIL AND GAS WELLS,
Allegheny Coll., Meadville, PA.
For primary bibliographic entry see Field 5B.
W85-06820

CONTROL OF GROUND WATER CONTAMINATION AT AN ACTIVE URANIUM MILL,
Earth-Fax Engineering, Inc., Murray, UT.
R. B. White, and R. B. Gainer.
Ground Water Monitoring Review, Vol. 5, No. 2, p 75-82, 1985. 12 Fig, 1 Tab, 26 Ref.

Descriptors: *Groundwater contamination, *Uranium mills, *Seepage, *Utah, *Water pollution control, *Mine wastes, *Dakota-Burro Canyon Formation, Path of pollutants, Geohydrology, Aquifers, Groundwater movement, Geologic fractures.

Seepage from tailings ponds associated with an active uranium mill in Utah has resulted in con-

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tamination of groundwater contained in the Dakota-Burro Canyon Formation. This aquifer is used in the area as a supply for domestic and industrial wells. Results of very low-frequency electromagnetic surveys and groundwater quality investigations at the site indicated that the flow of groundwater and contaminants is primarily fracture-controlled. Pumping tests were conducted to determine the hydraulic characteristics of the fractured system. The extent of contaminant migration was then determined using an analytical model of transport in fractured aquifers. Based on these investigations, a plan was designed to control future, and cleanup past, groundwater contamination. This plan consists of pumping from a single well intersecting the main fracture that transports contaminants off the site. The effectiveness of the plan was analytically modeled, taking account of the anisotrophy of the groundwater system. Subsequent monitoring of water levels in the area indicates that the plan has been effective since its inception in November 1983. (Author's abstract)
W85-06833

LYSIMETERS ALLOW QUICKER MONITORING OF HEAP LEACHING AND TAILING SITES,
Environmental Services International, Denver, CO.
W. R. Bond, and J. V. Rouse.
Mining Engineering, Vol. 37, No. 4, p 314-319, April, 1985. 2 Fig, 4 Ref.

Descriptors: *Lysimeters, *Mine wastes, *Leaching, *Monitoring, Leachates, Spoil banks, Water pollution control, Construction.

Pressure/vacuum (p/v) lysimeter use at mine sites has proven to be a valuable early warning system for detecting leakage of leachate fluids. Such a device can detect solution leaks in several days or weeks, whereas a conventional perimeter monitor well may take months or years. The basic design of a p/v lysimeter chamber consists of a porous material through which the soil water is drawn into a collection chamber. Access tubes run from the unit to the sample station at the ground surface. Most units currently available range from 25 to 76 mm diameter (1-3 inches). The intake, of porous material, on the lysimeter is the most complex and vulnerable portion of the unit. Installation techniques for permanent placement of p/v lysimeters are varied. High pressure units can be installed at depths up to 91 m below grade or serviced by sample tubes up to 152 m (500 ft) in linear distance. Factors to be considered in choosing an installation procedure include the geology of the area, chemical nature of the leachate fluid, site access, and the head differential from the lysimeter unit to the sample station and the friction involved with forcing the water sample through a small tube over a long distance. Where atmospheric oxygen may alter the water sample parameters being analyzed, a nitrogen gas tank should be used as a pressure source. In this way, the atmospheric oxygen contact with the sample is limited and the lysimeter unit is purged with the nitrogen gas. Timing of lysimeter installations into the contractor's overall schedule is very important. The most critical aspect in the case in point was the completion of all rough grade work for the pond base. The drill rig was then mobilized and installation began without concern for disturbing the finished grade. (Baker-IVI)
W85-06838

MODELING FLUID FLOW IN SELECTIVE PLACEMENT OF TOXIC MINE SPOIL,
Pennsylvania State Univ., University Park. Dept. of Mining Engineering.
For primary bibliographic entry see Field 5B.
W85-06839

ORGANOTIN COMPOUNDS AND INTERNATIONAL TREATIES ON THE POLLUTION OF WATER BY DANGEROUS SUBSTANCES: BLACK OR GREY LIST SUBSTANCES,
H. Vrijhof.
Science of the Total Environment, Vol. 43, No. 3, p 221-231, 1985. 4 Tab, 7 Ref.

Descriptors: *Organotin compounds, *Tin, *International agreements, *Black lists, *Grey lists, *Water pollution control, Environmental protection, Treaties, International law, Metals, Trace metals.

Shortly after the Oslo, London, and Stockholm pollution treaties, international treaties on the pollution of water by dangerous substances, based on the black and grey list classification, were being prepared in Paris, Helsinki, Barcelona and Strasbourg, under the auspices of the International Rhine Commission and the European Economic Community. In each of these treaties, organotin compounds, which had not been mentioned in the Oslo and London Conventions, appear on the black or the grey list. According to the text of the 1974 Paris Convention, organic compounds of tin are included on the grey list because, although exhibiting similar characteristics to the substances in the black list and requiring strict control, they seem less noxious or are more readily rendered harmless by natural processes. It may be assumed that lack of familiarity with the characteristics of organotin compounds also played a role. Contracting parties to the 1974 Helsinki Convention agreeed to take all appropriate measures to monitor and strictly limit land-based pollution of inland seas by noxious substances and materials contained in a grey list which includes tin and its organic and inorganic compounds but which does not give tin highest priority. Organotin compounds are omitted from both the black and grey list of the 1976 Barcelona Convention which regulates dumping from ships and aircraft but are included in the black list of the 1980 Athens protocol to the Barcelona Convention which regulates the problem of land-based pollution. The Rhine Chemical Convention and the Dangerous Substances Directive 76/464/EEC and the Groundwater Directive 80/68/EEC placed organotin compounds on black lists as well. No scientific arguments have apparently been put forward to date either in support of these priorities or to explain the need to move this group of substances to the black list. The lack of a general understanding of the chemistry, the origin and the biological effect of organotin compounds in the aquatic environment makes it appear that the selection has been based mainly on production figures. (Author's abstract)
W85-06845

NUTRIENT LOAD, TROPHIC CONDITION AND RESTORATION PROSPECTS OF LAKE MAGGIORE,
Istituto Italiano di Idrobiologia, Novara.
For primary bibliographic entry see Field 2H.
W85-06883

DRINKING WATER SUPPLIES, PROTECTION THROUGH WATERSHED MANAGEMENT,
North Carolina Univ. at Chapel Hill. Center for Urban and Regional Studies.
R. J. Burdy, E. J. Kaiser, J. L. Miller, and D. H. Moreau.
Ann Arbor Science, Ann Arbor, MI. 1983. 272 p.

Descriptors: *Water quality control, *Water pollution prevention, *Watershed management, *Water supply, *Drinking water, Water pollution sources, Water pollution effects, Public health, Legal aspects, Water law, Urbanization, Water management, Land use, Agricultural watersheds, Planning, Water treatment, Wastewater treatment, Nonpoint pollution sources, Erosion control, Storm water, Septic tanks, Taxes, Monitoring, Protection, Industrial waste, Model studies, Zoning, Permits, Waste disposal, Property rights.

This guidebook is designed as a resource document for formulating watershed management programs to protect water supply sources. Background material includes the major problems addressed by watershed management, the historical evolution of source protection, types of pollution in surface waters, sources of pollution, impacts of pollution on receiving waters, health effects of pollution, and the state of watershed management practices in the U.S. A 12-step procedure for identifying problems using existing management policies is proposed. In addition, methods for evaluating the relative importance of these problems is given. Various aspects of formulating a watershed management program include the direction-setting dimensions (goals, target pollutants, sources, locations, land use, etc.), intervention measures (regulatory measures, property rights acquisition, capital impovements, and preferential taxation), and formulation of the final management program. Monitoring and evaluation methods are described so that the necessary mid-course corrections are possible.
W85-06934

POLLUTION CONTROL FACILITIES PROJECT SOUTHEASTERN OAKLAND COUNTY SEWAGE DISPOSAL SYSTEM, OAKLAND COUNTY, MICHIGAN: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Technical Report HL-82-4, February 1982. Final Report. 32 p, 18 Fig, 2 Tab.

Descriptors: *Water pollution control, *Weirs, *Models studies, *Hydraulic models, *Wastewater treatment, *Sewer systems, *Head loss, *Mathematical studies, Water pollution prevention, Water pollution treatment, Settling basins, Models, Mathematical models.

Head losses through the Red Run Drain Pollution Control Structure were determined for a range of discharges and tailwaters. Two 1:20-scale models were used to determine head losses through two vee-shaped weir and baffle structures, and calculations, using Manning's equation, were used to determine losses in the retention basin. Results showed that the roughness of the retention basin is highly significant in determining head losses. Curves were generated to calculate head losses for a given discharge and tailwater. Modifications to the pollution control structure were tested. These included streamlining an abrupt ceiling transition and eliminating roughness caused by ceiling beams. These modifications had little effect on the total head loss through the structure. Opening the downstream access gate also had a negligible effect on total head losses. The model provided sufficient data to study the effect of the pollution control structure on flooding in the upstream drainage basin.
W85-06937

GUIDE TO GROUND-WATER STANDARDS OF THE UNITED STATES.
Ecological Analysts, Inc., Sparks, MD.
For primary bibliographic entry see Field 6E.
W85-06940

OPTIMIZING SALINITY CONTROL STRATEGIES FOR THE UPPER COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5C.
W85-06960

OIL SPILL BARRIERS AND THEIR USE,
Environmental Protection Service, Ottawa (Ontario).
L. A. Robertson.
EPS 3-EC-81-5, December 1981. 95 p, 31 Fig, 4 Tab, 7 Ref, 1 Append.

Descriptors: *Oil spills, *Barriers, *Water quality control, *Shore protection, *Environmental protection, Cleanup operations, Canada, Beaches, Water pollution prevention, Flotation, Bubbles, Jets, Absorption, Dams, Ice, Water currents, Marinas, Harbors, Waves, Buoys, Wind, Temperature, Tides, Water depth, Tidewater, Air curtain.

Barriers (mechanical, air curtain, and water jet) to control the spread of oil and other floating contaminants are described. The basic components of mechanical barriers are flotation, skirt, ballast, and tension members. Some have additional features such as vertical stiffeners, anchor points, hand-

holds, and connectors. Barriers commercially available in Canada include skirt (curtain) type, fence type, miscellaneous (inflated tubes and sorbent barriers), pneumatic barriers (air or bubble curtain), and water jets. These commercial barriers are described in detail in the Appendix. Some barriers which have been improvised for use in emergencies or remote areas are chicken wire sausage and chicken wire jelly roll filled with straw, snowfence with sorbent, chicken wire and floating drums with sorbent, plywood and barrels, plywood inserted vertically through ice, styrofoam logs in burlap, small dams of earth or sand bags, log booms, and boards. Environmental factors to consider before deploying barriers include current, wind, waves, temperature, tides, and water depth. Deployment methods and equipment, including techniques for current and non-current situations, are detailed. Controlled drift and towing in catenary techniques are effective for tidal and deep offshore areas.
W85-06972

WATER QUALITY OPTIMIZATION THROUGH SELECTIVE WITHDRAWAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
A. B. Poore, and B. Loftis.
Technical Report E-83-9, March 1983. Final Report. 41 p, 1 Fig, 15 Ref, 1 Append.

Descriptors: *Water quality control, *Optimization, *Reservoir operation, *Lakes, Algorithms, Mathematical studies, Stratification, Reservoir releases, Outlets, Multipurpose reservoirs, Multiobjective planning.

This report discussed the problem of operating a multipurpose reservoir through regulation of a multilevel outlet works for a number of water quality objectives. Operation of a reservoir to meet downstream goals for multiple water quality parameters often results in conflict. A problem formulation and solution are presented as an attempt to resolve these conflicts. The multi-parameter reservoir regulation problem is fomulated in terms of a scalar objective function, which indicates the relative value of any specified operation strategy, and a linear constraint set. These constraints include the hydraulic characteristics of the outlet works and any specified bounds on the release concentrations of the water quality parameters. Two different problem formulations are addressed. The target-concentration problem is formulated to achieve specific downstream target. Concentrations without actual constraints on the release concentrations. The constrained-concentation problem is formulated to allow the specification of upper and lower bounds for all or some of the water quality constituents. Both formulations can accurately deal with the hydraulic complexity of a multilevel outlet works. The algorithms presented herein can be used to regulate a reservoir in a real-time mode in which the state of the system is known by actual measurements. The algorithms can also be used with an ecosystem simulation model in which the state of the system is predicted. (Author)
W85-06974

OVERVIEW OF CURRENT SPILL CLEANUP TECHNOLOGY,
Municipal Environmental Research Lab., Cincinnati, OH.
R. A. Griffiths.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116939. EPA-600/D-82-341, 1982. 14 p, 2 Tab, 30 Ref.

Descriptors: *Cleanup operations, *Chemical spills, *Dispersants, *Surfactants, *Biodegradation, Skimming, Booms, Turbulent flow.

A review of the equipment and techniques for responding to spills of dangerous cargoes is presented. Categorizing spilled products as floaters, sinkers, mixers, or vapors provides a convenient viewpoint for discussing response technology, which depends strongly on which behavior the product exhibits. Spills of radioactive and bateriological agents are not covered in this paper, though the potential use of bacteria for mitigating oil or chemical spills is noted. The technologies for responding to spills of floaters and sinkers are shown to be the most well developed of the four types. Equipment and techniques in common use by the United States and Canadian governments are discussed to illustrate this. Current technology includes both removal of the pollutant using now-conventional equipment such as booms, skimmers, dredges, or sorbents and in-place treatment such as chemically-enhanced dispersion, enhanced microbiological degradation, or in-place burning. Significant weaknesses are noted, however, in three areas: spill cleanup in rough seas, in fast currents, and in the arctic (or cold climates). Little technology is available for response to spills of mixers or vapors, and a major concern at these spills continues to be the safety of the response equipment operators and divers. Experimental, infrequently-used techniques for in-place treatment and for actual cleanup and removal are discussed.
W85-06975

LEACHABILITY AND REVEGETATION OF SOLID WASTE FROM MINING,
Industrial Environmental Research Lab.-Cincinnati, OH.
M. L. Apel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-136010. EPA-600/2-82-093, November 1982. 160 p, 97 Fig, 9 Tab, 35 Ref, 5 Append.

Descriptors: *Mine wastes, *Leachates, *Fate of pollutants, *Waste disposal, *Land reclamation, *Sludge disposal, *Water quality control, *Drainage, Acid mine drainage , Neutralization, Pyrite, Geochemistry, Contrary Creek, Virginia, Disposal, Metals, Vegetation, Lime, Fertilizers, Mine drainage, Solid wastes, Spoil disposal, Wastes.

Several strategies for disposing of pyrite mine solid wastes were evaluated by pilot plant leaching columns at Contrary Creek, Virginia. The best option was covering the waste with 1.2 m of cover soil. The next best technique involved mixing sewage sludge, fertilizer, and lime into the upper layer of waste. Placing a mixture of sludge and fertilizer on top of lime-treated mine waste was less effective than incorporation of the neutralizing materials. However, a lime layer spread between mine waste and cover soil produced column leachates of poorer quality than the control column. Vegetation was quickly reestablished on the soil cover but was much slower and 75% less dense than in soil amended experiments. No vegetation grew on the untreated mine waste. A thin layer of lime between the cover soil and mine waste greatly improved root penetration into the mine waste layer.
W85-06990

PROCEEDINGS OF STORMWATER AND WATER QUALITY MODEL USERS GROUP MEETING: JANUARY 27-28, 1983.
Environmental Protection Agency, Athens, GA. EPA-600/9-83-015, September 1983. University of Florida, Gainesville. Edited by Thomas O. Barnwell. 282 p.

Descriptors: *Computer models, *Model studies, *Mathematical models, *Hydrological models, *Water quality, *Water supply, *Water pollution sources, Simulation analysis, Symposiums, Water managment, Nonpoint pollution sources, Pesticides, Forest management, Storm sewers, Snowmelt, Detention reservoirs, Storm runoff, Areal precipitation.

This report includes 17 papers on topics related to the development and application of computer based mathematical models for water quantity and quality management presented at the semi-annual meeting of the Joint U.S.-Canadian Stormwater and Water Quality Model Users Group held on January 27-28, 1983 in Gainesville, Florida. Topics covered included an application of the QUAL-II model in the Northeastern U.S. and Columbia, South America; applications of STORM in Singapore and the Republic of China; and implementation of SWMM in Tunisia. Modeling pesticides in small ponds and mixing zones in rivers was also discussed, as well as sizing detention ponds to meet water quality objectives. A program to assess the impact of forest management practices on water quality was also presented as was a mechanistic model for nonpoint source simulation. Papers related to precipitation discussed data management, estimation of missing values, and areal intensity-duration-frequency curves. The questions of hydrological regionalization, snowbelt, and porous pavements were addressed. Other papers discussed regional stormwater management facilities and storm sewer design optimization. (Author's abstract)
W85-06999

PROJECT SUCCESS: SENSITIVITY TO PROJECT ASSUMPTIONS, 'THE MEDELLIN CASE',
Dames and Moore, Bethesda, MD.
For primary bibliographic entry see Field 6A.
W85-07000

LOSSES FROM EFFLUENT TAXES AND QUOTAS UNDER UNCERTAINTY,
Geological Survey, Reston, VA.
W. D. Watson, and R. G. Ridker.
Journal of Environmental Economics and Management, Vol. 11, No. 4, p 310-326, December, 1984. 4 Fig, 5 Tab, 8 Ref.

Descriptors: *Cost analysis, *Water pollution control, *Uncertainty, *Taxes, Effluent taxes, Damages, Benefits, Cost-benefit analysis.

Empirical estimates are provided of expected control and damages costs for the so-called criteria air and water pollutants, using functions that reflect current knowledge. This analysis uses nonlinear control cost and damage functions and multiplicative nonsymmetric errors for both the control and damage cost functions. For a set of alternative plausible scenarios, the empirical analysis demonstrates that selective application of effluent charges could reduce expected social losses to the nation by as much as several hundred billion dollars over the period from 1975 to 2025. Reduction in social losses could require time-dependent application of both kinds of policy instruments; for example, quotas in early years followed by effluent charges in later years. A conceptual framework is provided and the methods used to empirically estimate expected control and damage costs under effluent charges and quotas are described. Estimates of expected control and damage costs are provided and the efficient policy instrument, an EPA relaxed policy, and an optimal policy are identified. Sensitivity tests for the cost comparisons are offered by repeating the calculations using different values for key parameters. (Baker-IVI)
W85-07089

POSSIBLE EFFECTS OF FORESTRY ON INLAND WATERS OF TASMANIA; A REVIEW,
Forest Ecology Research Fund, Launceston (Australia).
For primary bibliographic entry see Field 4C.
W85-07145

EFFECTIVENESS OF HYDROTREATMENT IN REDUCING THE TOXICITY OF A COAL LIQUEFACTION PRODUCT TO JUVENILE CHANNEL CATFISH,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. F. Cada, and M. Kenna.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 746-753, May, 1985. 1 Fig, 1 Tab, 11 Ref. DOE contract DE-AC05-840R21400.

Descriptors: *Hydrotreatment, *Coal liquefaction, *Toxicity, *Wastewater treatment, Fish, Synthetic fuels, Fuels, Catfish.

Because coal-derived oils contain many organic compounds that are readily soluble in water and also toxic to aquatic biota, coal oil spills are expected to be more damaging to the environment than petroleum oil spills. The effectiveness of hydro-

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treatment in reducing the acute toxicity of a representative coal liquefaction product was evaluated. Acute bioassays with juvenile channel catfish were used to compare the toxicities of raw H-Coal oil, four samples of the same H-Coal oil subjected to different degrees of upgrading by hydrotreatment, and a petroleum crude oil. Upgrading by means of hydrotreatment can be an effective mitigative measure for reducing at least the short-term environmental hazards of coal liquids. Although a relatively high severity of hydrotreatment was necessary, the acute toxicity of H-Coal oil was reduced to a level comparable to or below that of petroleum crude oil. Because the cost of hydrotreating coal liquids may be offset by the subsequent process engineering advantages it confers, as well as the reduced need for special storage, handling, and transportation facilities, hydrotreatment should prove to be a valuable tool in the environmentally sound development of coal liquefaction technologies. (Baker-IVI)
W85-07152

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

PLANNING FOR DROUGHT: THE ROLE OF STATE GOVERNMENT,
Nebraska Univ.-Lincoln. Inst. of Agriculture and Natural Resources.
D. A. Wilhite, and D. A. Wood.
Water Resources Bulletin, Vol. 21, No. 1, p 31-38, February, 1985. 4 Fig, 10 Ref. NSF grant ATM-8108447.

Descriptors: *Drought, *Planning, *State government, Emergency planning, Water shortage, Drought response plans, Water supply, Water management, Colorado, South Dakota, New York.

Although droughts are a frequent occurrence over much of the United States, response by state and federal government has been ineffective and poorly coordinated. Recently, several states have recognized the value of drought emergency planning and have developed plans to assist them in responding more effectively to prolonged periods of water shortage. These states have created an organizational structure to coordinate the assessment and response activities of state and federal agencies. Each state's drought response plan is unique since each state's water supply and management problems, and their consequent impacts, are unique. The drought response plans developed by Colorado, South Dakota and New York are reviewed here in detail. It is recommend that other states affected by frequent and severe water shortages also develop drought emergency plans. These plans will enhance state government's ability to implement effective measures in a timely manner and, ultimately, may provide added incentive for the federal government to develop the national drought response plan called for by the General Accounting Office in 1979. (Author's abstract)
W85-06236

MATRIX AND ACCOMPANYING CLASSIFICATIONS FOR IDENTIFYING WATER RESEARCH PROBLEMS AND NEEDS,
Ohio Agricultural Research and Development Center, Wooster.
R. L. Vertrees.
Water Resources Bulletin, Vol. 21, No. 1, p 115-133, February, 1985. 4 Fig, 33 Ref, 2 Append.

Descriptors: *Research priorities, *Water resources, Planning, Water resources institutes, Organizations.

A matrix was developed of problems with the functional use of water resources (rows) and functions served by water resources research (columns). A classification of water problems and a classification of research fields also were developed to accompany the matrix. The matrix and classification schemes were used when preparing the five-year research and development plan of the Water Resources Center of The Ohio State University. They were used: (1) to classify each research project that had been supported by the Water Resources Center from 1965 through 1980, (2) to guide interviews with personnel of federal and state agencies and university faculty who assisted in defining Ohio's water research needs, (3) to organize responses received during these interviews, and (4) to arrive at a selected list of ten problems with the functional use of Ohio's water resources that were prioritized based upon opinions received from water-related officials throughout the state. Other matrices and classification schemes are reviewed that were revised and expanded upon when formulating the ones used in Ohio. Suggestions are given regarding further development of the functional matrix and accompanying classifications as well as their use in administration of the cooperative federal-state water resources research program and other federal water resources research programs. (Author's abstract)
W85-06246

PLANNING EFFECTIVE INDUSTRIAL LIQUID WASTE CONTROLS IN DEVELOPING NATIONS,
Democritus Nuclear Research Center, Athens (Greece).
A. P. Economopoulos.
Environmental Monitoring and Assessment, Vol. 4, No. 2, p 119-128, June, 1984. 4 Ref.

Descriptors: *Planning, *Developing countries, *Water pollution control, *Industrial wastes, Wastewater treatment, Wastewater disposal, Monitoring, Land use.

Environmental planning principles are described which address a problem which many developing nations face at some point along the way. This problem is alarming levels of water pollution and limited background, expertise and organization to combat it effectively. The fundamental differences between developing and developed countries hamper the successful straightforward transplantation of methodologies, design practices, legislation and standards from the latter to the former. The main objective of initial environmental planning is to provide a specific and rational solution to the immediate problems of the pollution abatement authorities. The cost important information for the formulation of the pollution abatement strategy is the knowledge of the size and location of the pollution sources as well as the identification of the receivers. A realistic environmental strategy also takes into consideration the existing economic, technical and organizational constraints. Waste control strategy for existing industries is considered. (Baker-IVI)
W85-06287

ECONOMIC, LEGAL AND INSTITUTIONAL RELATIONS INVOLVED IN DIVERSION AND OTHER INTERBASIN TRANSFERS,
Connecticut Univ., Storrs. Inst. of Water Resources.
M. Huffmire, L. Frankel, M. Altobello, and R. Laak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 161412/AS, Price codes: A10 in paper copy, A01 in microfiche. Project Completion Report, (1984). 185 p, 5 Fig, 97 Map, 8 Tab, 79 Ref, 8 Append, Project No. OWRT B-020-CONN (1), Contract/Grant No. 14-34-0001-1281.

Descriptors: *Interbasin transfer, *Water shortage, Diversion, Economic aspects, Geohydrology, Legal aspects, Water transport, *Connecticut, *Economic models.

Using economic theory, a model was constructed to illustrate how a regional water authority could allocate existing water resources to best serve a region. The model was applied to southwestern Connecticut, a region that has recently experienced rapid industrial and population growth and has, from time to time, reported water shortages. Data from 1979 were used as the model base and projections were made for the years 1985 and 2000. The conclusions reached are that with better integration of existing water sources an ample supply of water would be available to about the year 2000. After this time the region would experience a water deficit. However, the large costly river diversion schemes proposed by others are not deemed necessary. The geological and environmental part of this study indicates that stratified drift deposits closer than the proposed river diversions projects would supply the needed water, but that the land over and close to these deposits would require more stringent control to prevent further groundwater contamination. The legal problems involved in the water transfers and diversions are discussed. It is recommended that a severence tax be imposed on all water imported into a community from outside its boundaries. This would compensate the supplying area for the loss of a resource and probably foster conservation and better water management in the receiving area.
W85-06304

PROBLEM ORIENTED EVALUATION OF INSTITUTIONAL DECISION MAKING AND IMPROVEMENT OF MODELS USED IN REGIONAL URBAN RUNOFF MANAGEMENT: APPLICATION TO INDIANA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. W. Delleur, J. M. Bell, and M. H. Houck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 161438/AS, Price codes: A06 in paper copy, A01 in microfiche. Project Completion Report, Technical Report No. 164, May 1984. 102 p, 29 Fig, 30 Tab, 1 Ref, Project No. OWRT C-00090-U (5), Contract/Grant No. 14-34-0001-0498.

Descriptors: *Urban runoff, Stochastic models, Watershed management, Urban hydrology, Rainfall-runoff relationships, *Indiana.

The principal objective of the research is to evaluate, in a multidisciplinary framework, problems of regional runoff management, with special attention to Indiana. One focus of the research is on institutional issues affecting management. It was found that although 208 planning was never a smooth process in the two study regions, it may in fact have laid foundation for future water quality management programs within the regions. The other focus of the research is on models that may be used to improve runoff management. To support this work, a small watershed in West Lafayette, Indiana, was monitored with an automated data collection, data processing, and data storage system. An investigation of the effects of hydrologic conditions on the quality of urban runoff from this water-shed concluded that: the watershed generally exhibits a first flush in concentration for all pollutants monitored; and there is no apparent relationship between the quantity of previous rainfall or the length of the antecedent dry period or the time elapsed since street sweeping and the quality of stormwater runoff. The selection of parameter estimates for rainfall-runoff models is quite important. Two techniques to obtain 'optimal' estimates are compared. The results from this analysis confirm that the objective function that makes use of the maximum likelihood estimator gives improved parameter estimates. Another investigation has demonstrated the need for a general planning methodology for use in the design of dual purpose detention basins. Such a methodology is developed, tested, and appears to work very well. The general interaction of both storage and pipe costs and flowrate and pollutant constraints in relation to the overall system design is illustrated. Any general conclusions should be delayed.
W85-06306

ECONOMIC, LEGAL AND INSTITUTIONAL RELATIONS INVOLVED IN DIVERSION AND OTHER INTERBASIN TRANSFERS,
Connecticut Univ., Storrs. Inst. of Water Resources.
M. Huffmire, L. Frankel, M. Altobello, and R. Laak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 161446/AS, Price codes: A09 in paper copy, A01 in microfiche. Project Completion Report, (1984). 185 p, 5

Fig, 97 Maps, 8 Tab, 79 Ref, 8 Append, Project No. OWRT B-020-CONN (1), Contract/Grant No. 14-34-0001-1281.

Descriptors: *Interbasin transfers, *Water shortage, Diversion, Economic aspects, Geohydrology, Legal aspects, Water transport, *Connecticut, *Economic models.

Using economic theory, a model was constructed to illustrate how a regional water authority could allocate existing water resources to best serve a region. The model was applied to southwestern Connecticut, a region that has recently experienced rapid industrial and population growth and has, from time to time, reported water shortages. Data from 1979 were used as the model base and projections were made for the years 1985 and 2000. The conclusions reached are that with better integration of existing water sources an ample supply of water would be available to about the year 2000. After this time the region would experience a water deficit. However, the large costly river diversion schemes proposed by others are not deemed necessary. The geological and environmental part of this study indicates that stratified drift deposits closer than the proposed river diversion projects would supply the needed water, but that the land over and close to these deposits would require more stringent control to prevent further groundwater contamination. The legal problems involved in the water transfers and diversions are discussed. It is recommended that a severence tax be imposed on all water imported into a community from outside its boundaries. This would compensate the supplying area for the loss of a resource and probably foster conservation and better water management in the receiving area. W85-06307

DELAWARE RIVER BASIN COMPREHENSIVE (LEVEL B) STUDY.
Delaware River Basin Commission, West Trenton, NJ.
Fianl Report, May 1981., 88 p. 15 Fig, 27 Tab, 169 Ref, 1 Append.

Descriptors: *Delaware River Basin, *Regional planning, *Hydraulic gradient, *Fluid mechanics, *Dam design, *Environmental effects, *Wet climates, *Precipitation intensity, *Water users, Weather patterns, Water reuse, Recirculated water, Planning, Tocks Island Reservoir.

In the 1960s, a comprehensive plan for the immediate and the long-range development of the Delaware River Basin was developed that had as its cornerstone the Tocks Island Reservoir Project. When construction on that project was delayed indefinitely, this study was begun to revise the comprehensive plan. There is adequate water in the basin to meet needs during years of normal precipitation. Most water used within the basin is returned after treatment and becomes available for reuse. About 50 percent of the Potamac-Raritan-Magothy (P-R-M) system recharge comes from the tidal Delaware River during normal water years and 1980 levels of pumping. The percentage of river recharge could be as high as 70 percent during a drought period in the year 2000. Large withdrawls from P-R-M have caused a series of deep cones of depression which have reversed the hydraulic gradient from discharge to the estuary to recharge from the estuary. This exposes the P-R-M aquifer system to degradation from spills of toxic or hazardous materials, and intrusion of sea salts from the estuary. Water quality in most of the basin streams has improved over the last several years, although some show low DO concentrations. Increasing the flow of the Delaware River at Trenton, NJ, from 2,000 cfs to 3,475 cfs would increase the DO in Zone 2 by as much as 1 mg/l. The 1980 population of the basin was 7,240,000, and is projected to increase to 8,057,000 by the year 2000. A supplemental flow capability of about 2,800 cfs will be needed to overcome present deficiencies and meet year 2000 demands. (Hawkins-Omniplan)
W85-06336

IRRIGATED AGRICULTURAL DECISION STRATEGIES FOR VARIABLE WEATHER CONDITIONS,
New Mexico Water Resources Research Inst., Las Cruces.
R. R. Lansford, T. S. Sammis, J. T. McGuckin, R. A. Deinter, and J. A. Libbin.
New Mexico Water Resources Research Institute Report No. 170, December 1983. 51 p. 12 Fig, 8 Tab, 24 Ref, 2 Append.

Descriptors: *New Mexico, *Rainfall intensity, *Rainfall area, *Rainfall impact, *Agricultural hydrology, *Precipitation, *Model studies, *Depth-area-duration analysis, *Simulation analysis, Simulated rainfall, Evapotranspiration, Weather, Crop yield, On-site data collections, Water demand, Risks.

Steadily increasing production costs coupled with low crop prices have place many farmers in a severe economic bind. For producers irrigating from deep wells, the sharply higher energy costs for pumping have increased the uncertainty for the future. Research was conducted to develop an irrigated agricultural decision-making model that included a probabilistic precipitation prediction model, water-production functions, and an economic decision strategy dynamic programming model (DPM). The weather simulation model, which was a good estimator of yearly rainfall, tended to overestimate solar radiation but was satisfactory for other climate parameters. The irrigation scheduling model was generally consistent with the measured seasonal evapotranspiration for corn but overpredicted seasonal evapotranspiration for wheat. Comparison of the DPM with physically based irrigation models indicated that the DPM increased net returns per acre from $7 to $25 for corn with flood irrigation and $2 to $106 per acre for sprinkler systems. For wheat, the DPM increased net returns from $1 to $15 for flood irrigation and $20 to $38 for sprinkler systems. The DPM also estimated water demand functions for corn, sorghum, and wheat. The demand for water was inelastic for corn but elastic for wheat and sorghum. The DPM can be used by farmers with an on-farm microcomputer. (Hawkins-Omniplan)
W85-06340

RECOMMENDED PROCEDURES FOR EVALUATING TRADE-OFFS BETWEEN CBOD AND NBOD IN THE WASTELOAD ALLOCATIONS, (DRAFT),
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
H. Hundal, T. Jenq, and H. Litwack.
June 1983. 8 p.

Descriptors: *Chemical oxygen demand, *Oxygen depletion, *Water quality, *Wastewater facilities, *Oxygen demand, *Dissolved oxygen, *Anaerobic conditions, *Numerical analysis, Parametric hydrology, Treatment plants, Mathematical studies, Permits, Hydraulic transportation.

A principal water quality impact of discharges from treatment plants into receiving waters is the depletion of dissolved oxygen (DO) due to stabilization of carbonaceous oxygen demand (CBOD) and nitrogenous oxygen demand (NBOD). If trade-offs between CBOD and NBOD can be made without shifting the DO deficit, there could be substantial savings in what would need to be spent to modify plants to meet new permit limitations. This study develops a theoretical background and a technical procedure for processing applications for adjustment of CBOD and NBOD in the plant effluents. The extent of DO depletion due to the stabilization of CBOD and NBOD, is determined by the respective decay rates, reaeration and the hydraulic transport mechanisms specific to the water body in question. Three cases may be considered for making a trade-off in the wasteload allocations: (1) simple first order decay without reaeration and hydraulic effects; (2) stream sections (advection with plug-flow only); and (3) estuarine sections. Equations are given for each case. Generally, numerical solutions are applied to solve real time conditions when there are changes in stream parameters and time considerations. (Hawkins-Omniplan)
W85-06365

INFORMATION FOR STATE GROUNDWATER QUALITY POLICYMAKING,
Oklahoma Univ., Norman. Dept. of Geography.
R. S. Roberts, and L. M. Butler.
Natural Resources Journal, Vol. 24, No. 4, p 1015-1041, October, 1984. 7 Fig, 117 Ref.

Descriptors: *Groundwater, *Drinking water, *Water supply, *Policymaking, Decision making, Planning, Water management, Legal aspects.

An increased concern with the adequacy of regulatory programs to protect groundwater quality has accompanied the growing awareness of the susceptibiltiy of groundwater to contamination. Groundwater quality management continues to be undertaken primarily at state and local levels. The availability of information of the appropriate kind, geographic scale, and organization to effectively apply to policymaking is essential for groundwater quality management by state governments. An approach to developing a groundwater quality information base that relies on land and water use data in contrast to groundwater quality data is described and evaluated. An information base which incorporates resource use data may produce information more useful to the state policy formulation than an information base relying primarily on groundwater quality data. The current emphasis on groundwater monitoring and modeling may therefore be misguided. The limits of conventional groundwater monitoring and modeling are explored. Using examples from New England, an approach is described which is based on resource use data and discusses this approach in terms of cost, timeliness of results, and conceptualization of groundwater problems. The wider applicability of this approach is also considered. (Baker-IVI)
W85-06535

CONTINGENT VALUATION OF WATER POLLUTION CONTROL,
Waikato Valley Authority, Hamilton (New Zealand).
B. S. Harris.
Journal of Environmental Management, Vol. 19, No. 3, p 199-208, October, 1984. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Valuation, *Waikato Basin, *New Zealand, *Water pollution control, Water resource management, Economic aspects, Public participation.

In the management of natural resouces, controlling agencies are often faced with conflicting situations in which an activity is likely to improve the welfare of some people while degrading the welfare of others. The technique of contingent valuation to quantify water quality improvements is a successful means of non-market valuation for New Zealand situations. This technique can be applied to any non-market good or service about which the public has sufficient knowledge to perceive worth. Because of the relatively high cost of undertaking a contingent valuation its use should be restricted to major impacts, i.e. to investigations involving nonmarket impacts that may be significant in major, large scale evaluation. A useful development of the contingent valuation approach is the determination of optimal levels of provision for an environmental good. The controversy associated with the drainage of wetlands considered to be of national and international significance is currently being enacted in New Zealand. The conflict is between drainage, rural development and tangible economic return, and the retention of a valuable natural resource. An indication via contingent valuation of the approximate magnitude of worth of a wetland habitat, in monetary terms reflecting utility, can easily be compared with straight economic return from development. Other possible applications of contingent valuation are the provision or retention of recreation sites, native forests, and fisheries. (Baker-IVI)
W85-06605

LIBRARY U. OF I. URBANA-CHAMPAIGN

HANDBOOK OF ENVIRONMENTAL QUALITY MEASUREMENT AND ASSESSMENT: METHODS AND TECHNIQUES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W85-06897

PROJECT SUCCESS: SENSITIVITY TO PROJECT ASSUMPTIONS, 'THE MEDELLIN CASE',
Dames and Moore, Bethesda, MD.
A. Knepp, and G. E. Wood.
In: Proceedings of Stormwater and Water Quality Model Users Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 1-21, 11 Fig, 13 Ref.

Descriptors: *Model studies, *Computer models, *Water quality, *Hydrological models, *Waste management, *Rivers, *Mathematical models, Baseline studies, Nonpoint pollution sources, Decision making, Project planning, Management planning.

The effect of major planning assumptions on the predicted water quality of the Rio Medellin, a Columbian river which receives untreated sewage loads and large amounts of sediments and solid wastes, was studied using the Qual II model. The sensitivity analysis was accomplished by establishing a 'baseline' condition and examining the effects on baseline quality of modifying a single assumption or group of assumptions. Modifications of the baseline condition included variations in flow, percent wastewater collection, dilution water inflow, nonpoint source inputs, and solid waste contributions. Results showed that, in addition to the extensive point source controls recommended, decision makers should recognize that the implementation of a sewer connection program, the abatement of solid waste, and the provision of dilution water are very important to maintaining quality criteria during critical periods and are therefore important to the success of the project as currently planned. The sensitivity of projected water quality to nonpoint sources and to lower flows than used in the screening of abatement alternatives in this case was small. Preliminary results of a major planning study also indicate that a configuration of four treatment plants sited along the models portion of the Rio Medellin would cost-effectively meet specified water quality criteria.
W85-07000

CONSULTANT'S ROLE IN MANAGEMENT ADVICE FOR WATER UTILITIES,
Camp, Dresser and McKee, Inc., Boston, MA.
C. P. N. Woodcock.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 72-81, March, 1985.

Descriptors: *Water management, *Decision making, *Utilities, Planning, Consultants, Decision making, Audits, Computers.

Water utilities are in the position of having to meet new, more costly requirements while being more responsive to consumer concerns. The pressure to keep costs down is intense. Rising water rates are causing consumers to question water operation more frequently than before. There are numerous ways consultants can assist water utilities in these difficult times. Computer applications for many utility functions are proven aids, and their use will expand. Consultants can be of considerable assistance in identifying the hardware and software best suited to each utility's specific needs. With the use of a computer one can evaluate numerous options that normally would take days, including: different rates of inflation, different increases in growth of consumption, the impact on different customer classes, the impact of a new construction project, and different bond repayment options. Computers are extremely valuable in other technical applications as well as including demonstrating the impact throughout the system of: the placement of a new well, increasing the flow from existing or new sources, an interconnection with another town, optimum pumping schedules, the placement of a new storage tank, enlarging an existing storage tank, the installation of a new transmission main, or the impact of cleaning and lining a pipe vs replacing it. Another area where consultants can be of considerable aid is in the management audit. Generally, an audit will result in a report which details the utility's current practices, describes its strengths and weaknesses, and identifies corrective measures or areas where further analysis is indicated. (Baker-IVI)
W85-07062

NETWORKS PLANNING FOR WATER INVESTIGATIONS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 7A.
W85-07098

6B. Evaluation Process

NEW CANAL ON EUROPE'S MAP: THE DANUBE-BLACK SEA CANAL,
Texas Univ. Health Science Center at San Antonio. School of Public Health
A. Ghenovici.
Revue Roumaine de Geologie Geophysique et Geographie, Vol. 28, p 17-26, 1984. 7 Fig.

Descriptors: *Canals, *Danube-Black Sea Canal, Water resources development, Environmental effects, Construction, Highways, Electrical networks, Flood control, Navigation, Irrigation.

The Danube-Black Sea canal is a construction of national importance to Romania. The project was selected to use relief features and avoid the use of large surfaces of agricultural lands. The canal will be 70-90 m wide at the bottom and 7.0 m deep under normal navigation conditions. Construction on the canal started in 1975. The building of the canal called for a series of modifications in the area, including: relocation of roads, railways, electrical networks, telephone networks, water supply pipes and sewerage systems; an irrigation program; the elevation of flooded land; drainage and embankment works; retention dams; and water regulation schemes. The canal was officially inaugurated on May 26, 1984. (Baker-IVI)
W85-06419

REVIEWING THE STATUS OF CANADA'S AQUATIC RESOURCES,
M. C. Healey.
Water and Pollution Control, Vol. 123, No. 2, p 24-25, 36, March/April, 1985.

Descriptors: *Reviews, *Aquatic environment, *Water resources, *Canada, Symposium, Conferences, Great Lakes, Water pollution control.

The work of the Rawson Academy of Aquatic Science is reviewed. Thus far the Academy, which was created in 1976, has been involved in three major projects. The first is the annual presentation of an award of excellence to a professional who has made a truly significant contribution to aquatic science or management in Canada. The second is a synthesis of the aquatic resource and ecosystem information on the Great Lakes. The third project is a review of the status of Canadian aquatic resources. One aspect of this third project is a national symposium on aquatic resource issues to be held in May of 1985. A series of public lectures derived from information disseminated at the symposium will be designed to communicate the information on aquatic resource issues to a wider audience than the group of professionals likely to attend the symposium. (Baker-IVI)
W85-06429

FLOOD DAMAGE MITIGATION: A REVIEW OF STRUCTURAL AND NONSTRUCTURAL MEASURES AND ALTERNATIVE DECISION FRAMEWORKS,
Wollongong Univ. (Australia). Dept. of Economics.
D. J. Thampapillai, and W. F. Musgrave.
Water Resources Research, Vol. 21, No. 4, p 411-424, April, 1985. 2 Fig, 1 Tab, 113 Ref.

Descriptors: *Decision making, *Flood control, Flood damage, Floods, Reviews, Floodplains, Decision making, Nonstructural alternatives, Economic aspects.

The wide range of decision frameworks which are employed in the formulation of flood mitigation strategies are reviewed. This review includes an understanding of the various flood mitigation measures and their economic significance with attention given to structural and nonstructural measures. Various decision frameworks used in the derivation of flood mitigation strategies discussed include those for use with structural measures alone, including minimization of expected value of flood losses alone, decision frameworks based on linear programming and related techniques, decisions designed to minimize the expected failure of flood losses and the cost of risk taking, and decision frameworks based on stochastic dynamic programming. Decision frameworks for nonstructural measures alone include minimization of only the expected value of flood losses, decision frameworks based on discrete enumeration of costs and benefits. Additional areas considered include the inadequacies of the frameworks, and directions in which formulation of more adequate frameworks may proceed. (Baker-IVI)
W85-06495

MANAGING RIVER SYSTEMS: CENTRALIZATION VERSUS DECENTALIZATION,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4A.
W85-06536

GRAPH THEORY APPLIED TO EVALUATION OF WATER SCIENCES RESEARCH SYSTEMS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Journal of Environmental Systems, Vol. 14, No. 2, p 161-189, 1984-85. 3 Fig, 4 Tab, 46 Ref.

Descriptors: *Evaluation, *Research priorities, Financing, Coherence graphs, Research facilities, Research objectives.

Many procedures have been proposed over the past years for evaluating the degree to which the objectives pursued by research are realized. However, none of these has succeeded in entirely encompassing the problem. Thus, a new approach that is likely to improve on already existing procedures has been sought. After presenting a typology of the diverse methods used in the evaluation process, this article describes a technique which permits one to systematically determine the relationships in a system of research execution and to rapidly identify the principal components. The use of coherence graphs has facilitated the achievement of these objectives. As a case study, the method has been applied to qualitatively describe a system of university research in the water sciences. In the preliminary step, the objectives pursued by university research and the disciplines necessary for realizing projects have been itemized. The second stage involves the construction of a coherence graph by establishing relationships between the elements. A schematic representation of the relationships making up the research system is thus obtained. The graph consists of five levels: objectives, sources of financing, places where research is conducted, programs, and project disciplines. This graphic representation allows one to identify among the multiple requests for funds those that have the greatest potential to provide the desired results in accordance with the objectives retained. (Author's abstract)
W85-06697

ANALYSIS OF ISSUES CONCERNING 'ACID RAIN': REPORT TO THE CONGRESS OF THE UNITED STATES.
General Accounting Office, Washington, DC. Office of the Comptroller General.
GAO/RCED-85-13, December 11, 1984. 185 p, 3

Fig, 7 Tab, 5 Append.

Descriptors: *Decision making, *Acid rain, *Air pollution effects, *Policy making, *Cost-benefit analysis, *Economical aspects, *Environmental policy, *Evaluation, Future planning, Air pollution, Environmental effects, Water pollution control, Water pollution prevention, Water pollution sources, Environmental protection.

Intense debate continues over whether it is time for the United States to take control actions against the environmental effects of acid deposition (acid rain). Acid rain has become an international as well as a national issue because the pollutants involved (oxides of S and N) often travel far from their place of emission across state and even national boundaries. A series of observations of the General Accounting Office are presented which are based on the implications of current scientific knowledge for policy decisions on acid rain. Limited damage caused by transported acid rain has been confirmed in only a few areas of North America to date. Uncertainties about anticipated damage rates make it difficult to predict the need for and effectiveness of control actions. Mitigation actions taken where deposition occurs have limited capabilities and are not economical for large unmanaged areas such as forests. Emission controls, to be effective, would have to be implemented over a wide area. Cost-benefit analysis is of limited value in evaluating the benefits of emission control programs. Changes in the Clean Air Act would have to be made to reorient the goal for acceptable ambient air quality to focus on reducing total regional emission of pollutants. Further scientific work on acid deposition will be needed for a number of years, no matter what decisions are made on control actions in the short term. The alternatives for controlling acid rain and their economic effects are considered.
W85-06944

EFFECT OF ACIDIFICATION DAMAGES ON THE ECONOMIC VALUE OF THE ADIRONDACK FISHERY TO NEW YORK ANGLERS,
Clarkson Univ., Potsdam, NY. Dept. of Economics.
For primary bibliographic entry see Field 5C.
W85-07034

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ECONOMIC, LEGAL AND INSTITUTIONAL RELATIONS INVOLVED IN DIVERSION AND OTHER INTERBASIN TRANSFERS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 6A.
W85-06304

ECONOMIC, LEGAL AND INSTITUTIONAL RELATIONS INVOLVED IN DIVERSION AND OTHER INTERBASIN TRANSFERS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 6A.
W85-06307

MUNICIPAL USE OF EXISTING WELLS FOR SUPPLEMENTAL WATER SUPPLY IN THE PIEDMONT AND BLUE RIDGE PROVINCES OF GEORGIA,
Georgia Univ., Athens. Carl Vinson Inst. of Government.
J. E. Kundell, and R. C. Chambers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157741/AS, Price codes: A06 on paper copy, A01 in microfiche. Environmental Resources Center Report No. ERC 01-84, Georgia Institute of Technology, Atlanta, Georgia, September 1984, 78 p, 1 Tab, 1 Fig, 7 Ref, Project No. USGS G-836 (06).

Descriptors: *Georgia, *Groundwater, *Water low, *Water resources management, Ground water, Municipal water supply, Supplemental water supply, Drought contingency, Emergency supply, Piedmont ground water, Blue Ridge Mountain ground water.

Although the Piedmont and Blue Ridge Mountain provinces of Georgia are usually considered to be dependent on surface water, a great majority of the municipalities in these regions utilize wells for at least a portion of their raw water supply. A problem with expanding ground water systems in these regions is in identifying well sites that will yield relatively large quantities of water. This report examines a nonconventional alternative for providing supplemental water supply in hard rock regions by incorporating privately owned wells in the municipal systems. Consideration is given to the potential occurrence of privately owned high yielded wells in the vicinity of the municipal system, the legal and regulatory requirements that must be addressed in pursuing this nonconventional approach, and technical and economic questions that must be answered by municipalities interested in considering this potential source of water.
W85-06318

EQUITY AND EQUIVALENCE ASPECTS OF EFFLUENT AND OUTPUT TAXES,
Guelph Univ. (Ontario). Dept. of Economics.
D. A. L. Auld.
International Journal of Environmental Studies, Vol. 24, No. 1, p 55-60, 1985. 2 Fig, 7 Ref.

Descriptors: *Taxes, *Water pollution control, *Effluent taxes, Economic aspects, Equity, Waste management.

Two aspects of tax policy for pollution control are highlighted. First, persons in equally situated circumstances (in terms of pollution) are affected unequally by an output tax unless a perfectly efficient solution is followed. If this is not done, then to at least ensure equity a system of subsidies is required. Second, where there exists a cost of abatement schedule, the relationship between an effluent tax and output tax is explicit, provided the link between waste and output is given. To achieve a given level of waste abatement, a smaller effluent tax can be imposed. The choice between the two would appear to depend on compliance, monitoring, the output mix of the firm and political sensitivity to tax impositions. If it is relatively simple to monitor waste, then the effluent tax is probably the best choice for it avoids the necessity of continuous adjustment in the case of the output tax and waste abatement technology changes or the mix of output of the firm changes. (Baker-IVI)
W85-06559

ENGINEERING-ECONOMIC SIMULATION MODEL FOR REGIONAL WASTEWATER TREATMENT COST FUNCTIONS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 5D.
W85-06602

PROCEEDINGS OF SYMPOSIUM ON COST ESTIMATING FOR WATER SUPPLY PLANNING STUDIES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. Edited by Thomas M. Walski. 117 p.

Descriptors: *Cost analysis, *Cost, *Water supply, *Estimated costs, Estimating, Water policy, Regional planning.

This report contains the papers presented at the symposium 'Cost Estimating for Water Supply Studies' as conducted at the ASCE Specialty Conference, Water Supply: The Management Challenge, in Tampa, Florida, 14-16 March 1983. The proceedings include an overview chapter, description of alternative approaches from the detailed 'systems estimate' to the more general approach of 'parametric estimating.' Other topics include verification of estimating models, spatial cost estimating, estimating for small systems and large regional studies, and a method for estimating surface water intake costs.
W85-06946

PLANNING WATER SUPPLY PROJECTS: THE SYSTEMS ESTIMATE,
Means (R.S.) Co., Kingston, MA.
D. R. Lehigh.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 20-24, 8 Fig.

Descriptors: *Cost analysis, *Costs, *Estimated costs, *Systems estimates, Management planning, Water supply, Water policy.

A systems estimate can obtain a more accurate cost estimate than previously possible using either the 'Order of Magnitude,' the 'Square Foot Estimate,' or the 'Unit Price Estimate'. A system can be described as a composite of several unit price components that are interrelated, each expressed in its own unit of measure, that form a major element of a project, expressed in a common unit of measure. A systems table is composed of similar systems each having the same components, but differing from each other by some design variable such as dimensions, loading, etc. Different systems tables dealing with the same building element may be compared for costs. A numbering system has already been established for systems, called the Uniformat, which contains divisions 1 through 12, from Foundations through Sitework, respectively. A system should be listed within its division by number and the accompanying information; description, quantity, unit of measure, unit cost and total cost, almost as would be seen in a 'Unit Price Estimate'. None of the criteria necessary to select the appropriate sitework systems should require a lot of time. The estimator only needs to identify the design parameters, not complete the design. The Systems Estimate itself, not including pilot plant studies, soil investigation and preliminary information, should take no more than a day to complete.
W85-06947

DEVELOPING WATER UTILITY COST ESTIMATES INCORPORATING SPATIAL FACTORS,
Hackensack Water Co., Harrington Park, NJ.
D. L. Schlenger.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 25-46, 13 Fig, 7 Ref.

Descriptors: *Costs, *Cost analysis, *Estimated costs, *Utilities, Management planning, Water conveyance, Water users.

The objective of this paper is to provide the water supply engineer or planner with some perspectives on the spatial aspects of water supply costs. Specifically, it briefly addresses the relationship between capital and operating costs in the transmission and distribution system and the interaction between costs, prices and usage. Metropolitan water utilities provide two things. They provide a product: potable water. In delivering that water to the customers' premises, they also provide a service: transportation. The greatest portion of operating and capital costs for a water utility results from providing transportation of water to the customer. The cost of providing this transportation service has been growing at an alarming rate in recent years due to rising energy costs. As a result, the differences from one location to another in the distribution system in the cost of providing water have become more acute. Cost estimates that recognize these spatial differences are important for: 1) Long run capital planning of the transmission and distribution system; 2) Energy management programs to minimize operating costs while maintaining adequate pressure throughout the distribution system; and 3) Rate setting when rates can vary from one location to another. Finally, it discusses an approach to analyzing operating cost data so as to assess the impact of capital expenditures.

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W85-06948

VERIFICATION OF MAPS COST ESTIMATING PROCEDURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski, and A. K. Linsey.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 47-57, 1 Fig, 8 Ref.

Descriptors: *Cost analysis, *Costs, *Estimated costs, *Systems analysis, Management planning, Regional planning, Long-term planning, MAPS.

The purpose of this study was to verify the MAPS costs estimating procedure against an independently determined set of cost data. From this kind of analysis it is possible to: a) determine the accuracy of the individual modules, b) identify and correct minor shortcomings of the program, and c) identify potential major program modifications and additions. The geometric mean percent error for the 35 facilities was 13.9%. Existing guidance in Corps of Engineers regulations and manuals on cost estimating indicates that estimates are considered accurate if they fall within 25% of actual costs. The MAPS cost estimates for 75% of the facilities fall within this 25%-range. The cost estimate for only one facility differs by more than 50%. The correlation coefficient between actual and MAPS costs was 0.967. Comparison of the MAPS cost functions with other cost functions showed a high degree of consistency. As a result of this study, many of the shortcomings of the program were identified and corrected. In the case of water treatment plants, the program has been upgraded independently since this study.
W85-06949

ESTIMATION OF COSTS FOR SMALL WATER SYSTEMS,
Weston (Roy F.), Inc., West Chester, PA.
A. K. Deb, and W. G. Richards.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 58-74, 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Cost analysis, *Costs, *Water supply, *Estimated costs, Management planning, Water delivery, Water distribution.

The WATer MANagement (WATMAN) model has been expanded in this study so as to cover both large and small water systems. It is a particularly versatile tool for estimating preliminary design costs for small water systems as data appropriate to small systems and alternative technology, especially for bottled water distribution and point-of-use treatment, was collected and used to derive cost information. Cost functions for estimating capital and operations for small water systems have been developed and incorporated into the model. WATMAN is flexible enough to simulate almost any configurations of up to ten water systems and a variety of unit processes in order to conduct preliminary designs and economic evaluations of alternative technologies available to utilities. Several technologies considered especially appropriate to small systems were examined including alternate sources, conventional additional treatment, package plants and equipment, regionalization, and dual water systems, point-of-use treatment, and bottled water distribution.
W85-06950

DEVELOPING COST ESTIMATING METHODS FOR SURFACE-WATER INTAKE STRUCTURES,
Weston (Roy F.), Inc., West Chester, PA.
K. Cable, and J. S. Condra.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 75-91, 10 Fig, 1 Tab, 8 Ref.

Descriptors: *Cost analysis, *Costs, *Estimated costs, Intake gates, Management planning, Surface water, Intakes.

Surface-water intake structure design is highly site-specific and hence the costs depend on a large number of variables. A simple correlation of intake cost with design flow or total system cost will not provide accurate estimates due to the variability in designs for the intake system. Therefore, a more complex procedure involving several site-specific characteristics is needed to estimate reasonable costs for surface-water intakes. Presented in this paper are: 1) existing approaches for developing planning level cost estimated for intake structures and/or raw water pumping facilities, 2) the procedure developed by the authors for preparing quick estimates, 3) comparisons of costs generated by this method with costs of actual projects, and 4) implications of the estimating procedure. This method can generate reasonably accurate planning level cost estimates with minimal effort, and allows for a wider application of the estimation procedure than previously developed procedures.
W85-06951

APPLICATION OF PARAMETRIC ANALYSIS TO WATER SUPPLY,
H. K. Burbridge.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 92-112, 9 Fig.

Descriptors: *Parametric analysis, *Cost analysis, *Costs, Water supply, Estimated costs, Management planning.

The purpose of this paper is to introduce the parametric analysis concept as it may apply to water supply, and its use as a management tool of considerable power. Models presented are: 1) ESTEK, 2) FAST-C, 3) FAST-E, and 4) Hayes, Seay, Mattern and Mattern (HSMM), with mention of the possible applications of these models to various government and private sector projects.
W85-06952

COST ESTIMATING FOR REGIONAL WATER SUPPLY STUDY,
Benham Group, Inc., Oklahoma City, OK.
M. D. Lee.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 113-117.

Descriptors: *Costs, *Cost analysis, Estimated costs, Management planning, Regional planning.

The purpose of this paper was to examine the issues relating to water resources and to develop multipurpose plans for solving problems, such as flooding and inadequate water supplies in the metropolitan Tulsa, Oklahoma region. The planning process was an iterative one of formulating alternative plans, evaluating them, revising the alternatives, reevaluating them until the best plan could be identified. The cost evaluation was accomplished by means of a computer program entitled Methodology for Areawide Planning Studies (MAPS). The resulting estimates included capital costs as well as the costs of operation and maintenance. The pipeline costs were calculated for an array of pipe diameters in order to minimize the sum of the capital cost and the operating cost. The final estimates were realistic and accurate, and the use of the program permitted investigation of a large number of alternatives. The final report included plans that would best serve the supply needs of the Tulsa Urban Study area, using existing and potential water supply sources within a reasonable distance of the area.
W85-06953

PLANNING LEVEL COST ESTIMATING: SCIENCE, ART, OR WITCHCRAFT,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 5-19, 6 Fig, 41 Ref.

Descriptors: *Cost analysis, *Costs, *Water supply, *Estimated costs, Management planning, Estimating, Planning.

Planning level cost estimating is defined, its characteristics are described, and the phases of preparing a planning level estimate and the interactions between the phases are discussed. The problem of tradeoffs between detail and accuracy is analyzed, cost functions and the data used in preparing them are presented and, finally, the relationship between planning and estimating is discussed. Development of a planning level cost estimate is a different process than development of estimates based on detailed plans and specifications. Because it is part of an iterative process, planning level estimating requires an approach that yields estimates quickly and reproducibly while accounting for the effects of the most important design parameters. Some guidelines are presented in this paper for developing cost functions.
W85-06954

6D. Water Demand

CONSUMER ATTITUDES TOWARD PUBLIC WATER SUPPLY QUALITY: DISSATISFACTION AND ALTERNATIVE WATER SOURCES,
Southern Illinois Univ. at Carbondale.
L. L. Curry.
Illinois State Water Survey Circular 158, 1983, 31 p, 9 Tab, 64 Ref. 1 Append.

Descriptors: *Public opinion, *Attitudes, *Operating policies, *Taste, *Odors, *Drinking water, *Potable water, *Water quality management, *Water quality standards, Marketing, Fluoridation, Fluorides.

Consumer attitudes were surveyed to determine their perception of drinking water quality. Bottled water buyers and home water treatment unity users were polled to discern what led these consumers to reject or alter the available public drinking water. Analysis of the data reveals that those in the control group (who used neither bottled water or home units) stated most often that they were satisfied with the quality of their drinking water. Fifty-eight percent of the control group responded positively, as compared to the bottled water group, of which 75.8 percent stated that they were not satisfied. Similarly, 78.4 percent of the home unit group expressed dissatisfaction with water quality. When queried about the reasons for their decision to buy bottled water or a home filter unit, 57.6 percent of the bottled water group and 39 percent of the home unit group responded that it was for health reasons. About one-third of both the bottle water and the home unit groups stated that the high salt content of public water led them to purchase alternative water sources. Nine percent of the bottled water group, 2.0 percent of the home unit group, and 4.7 percent of the control group considered fluoride addition to be a problem and 12.1 percent, 9.8 percent, and 18.6 percent, respectively, considered chlorine treatment to be deterimental to health. The bottled water and home filter buyers also designated taste, odor, hardness and color as factors in their dissatisfaction with public water supplies. (Hawkins-Omniplan)
W85-06347

TRANSFER FUNCTION MODELS OF DAILY URBAN WATER USE,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. R. Maidment, S.-P. Miaou, and M. M. Crawford.
Water Resources Research, Vol. 21, No. 4, p 425-432, April, 1985. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Water use, *Urban areas, *Austin, *Texas, *Model studies, Rainfall, Air temperature, Seasonal variation.

A time series model of daily municipal water use as a function of rainfall and air temperature is developed. Water use data from 1961 to 1981 in Austin, Texas indicate that base use constitutes three fourths and seasonal use one fourth of the total annual volume of water used. Base use comprises 40% and seasonal use 60% of the peak daily water use rates. In Austin, a change in base use occurred in 1970 which was equivalent to two and a half years of normal growth in base use at that time. Daily water use data from 1975 to 1981 in Austin indicated that seasonal water use is nonlinearly related to air temperature. For the Austin daily water use the effect of a rainfall on a given day is to cause a drop in that day's seasonal water use to 40% of the previous day's use, if the rainfall amount is greater than 0.05 inches. The complete model describes 97% of the variability of daily water use data, much more than reported in any other daily water use study. (Baker-IVI)
W85-06496

MUNICIPAL DEMAND FOR WATER IN KUWAIT: METHODOLOGICAL ISSUES AND EMPIRICAL RESULTS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Agricultural Economics and Rural Sociology.
M. H. Al-Qunaibet, and R. S. Johnston.
Water Resources Research, Vol. 21, No. 4, p 433-438, April, 1985. 1 Fig, 4 Tab, 42 Ref.

Descriptors: *Water demand, *Kuwait, Municipal water, Water conservation, Public participation, Pricing, Water conservation, Utilities, Costs.

This study employed the use of a demand function for municipal water derived from the Stone-Geary utility function, thereby permitting explicit consideration of the minimum amount of water necessary for daily needs. The study revealed that even in an oil-rich country like Kuwait, people do respond to changes in the prices of public services, at least in the case of municipal water. Thus, in a country which is largely dependent on an expensive source of fresh water supplies, namely, desalination of sea water, the price of municipal water may be an effective tool that the water utility can use to control water consumption. Doing so will help reduce or defer system expansion, reduce pumping costs, and increase the life of present supplies. It is estimated that the subsistence water use level in Kuwait is about 42 L per capita per day and the results suggest that people will be cooperative in conservation until that level is reached. (Baker-IVI)
W85-06497

EFFECTS OF INSTREAM FLOW REQUIREMENTS ON WATER SUPPLY RELIABILITY,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. N. Palmer, and R. M. Snyder.
Water Resources Research, Vol. 21, No. 4, p 439-446, April, 1985. 11 Fig, 1 Tab, 19 Ref. Dept. of the Interior project 143-34-10E-3391-3074.

Descriptors: *Water supply development, *Water management, *Instream flow requirements, *Water demand, Water supply, Model studies, Computer models, Simulation, Reservoir capacity.

To evaluate the impacts of instream flow requirements (IFR) on municipal water supply performance a computer simulation model was used with synthetic inflow sequences to investigate changes in indices of system performance with various instream flow and management strategies. This study indicates that instream flow requirements have significant impact on the ability of a municipal water supply system to meet water demands. Depending on the quantity of the requirement and the existence of other demands, the impact can decrease the performance of the system by an order of magnitude. For the water supply system examined, reservoir capacity expansion greatly improved the ability to supply municipal water demands. Such expansions are costly. The establishment of IFR should be considered in this socioeconomic context. The benefits accruing from IFR are not quantifiable in economic terms under the current IFR methodology. This places those responsible for establishing reasonable and prudent IFR in a difficult situation in prescribing restrictions that may have significant economic impacts with little economic justification. The indices suggested for determining the impacts of IFR are flexible and provide alternative evaluations of the information. (Baker-IVI)
W85-06498

CLIMATIC CONSTRAINTS TO WATER RESOURCE DEVELOPMENT IN THE SUDANO-SAHELIAN ZONE OF NIGERIA,
Bayero Univ., Kano (Nigeria). Dept. of Geography.
E. A. Olofin.
Water International, Vol. 10, No. 1, p 29-37, March, 1985. 2 Fig, 6 Tab, 22 Ref.

Descriptors: *Nigeria, *Water resources development, *Climatic zones, *Sudano-Sahelian zone, Tropical regions, Developing countries, Rainfall, Wind, Water conservation, Evapotranspiration, Drought, Dam construction.

Climatic variables, particularly rainfall and evapotranspiration, constitute great constraints to both natural water availability and water resource development in the Sudano-Sahelian zone of Nigeria. The climatic variations and drought conditions which constitute the greatest climatic constraints in the zone cannot be eliminated, and their occurrences cannot be predicted accurately. It is for this reason that water resource development (both ground and surface) becomes highly essential in minimizing the water deficiency and hardships which usually accompany the variations and droughts. The development of water resources through the construction of dams, reservoirs, canals, wells and boreholes is also adversely affected by certain climatic variables. The effects of these phenomena can be minimized through better designs of dams, reservoirs and canals to check excessive evaporation from these water bodies, and through catchment area protection, as well as other conservational techniques, to check the effect of high rainfall and wind intensities. When these measures are taken, the effects of the climatic constraints on water resource development in the zone will have been minimized to a tolerable level. (Baker-IVI)
W85-06546

PHARMACOPEIA REQUIREMENTS AND WATER STANDARDS IN THE UNITED STATES OF AMERICA,
Vaponics, Inc., Plymouth, MA.
V. C. Smith.
Journal of Environmental Sciences, Vol. 27, No. 6, p 21-26, November/December, 1984. 10 Fig, 11 Ref.

Descriptors: *Water quality control, *Requirements, *United States Pharmacopeia, Standards, Public health, Pharmaceutical industry, Water treatment.

The standards for the various types of water to be used by the pharmaceutical industry are set by governmental agencies and consensus standards committees in the United States. Essentially, all of these different standards are drawn up as a result of the agreement of technical committees made up of representatives of the various government agencies, scientific institutions and industrial representatives on the technical committees. Since all of the standards related to water purity involve the removal of contaminants, these contaminants are described and the method of removal discussed briefly. These methods include distillation, demineralization, reverse omsosis, ultrafiltration and membrane filtration, adsorbants and prefiltration. Various test procedures recognized as methods of testing for various impurities are noted with specific reference to pyrogen detection. There are various grades of water specified by the regulations of the Food and Drug Administration as promulgated by the US Pharmacopeia XX. These grade include water for injection, bacteriostatic water for injection, sterile water for inhalation, sterile water for injection, sterile water for irrigation, and purified water. Requirements which must be met by the distribution piping systems are noted. (Baker-IVI)
W85-06627

CROP WATER REQUIREMENTS FOR RAINFED AND IRRIGATED WHEAT IN CHINA AND KOREA,
California Univ., Los Angeles. Dept. of Geography.
W. H. Terjung, H.-Y. Ji, J. T. Hayes, P. A. O'Rourke, and P. E. Todhunter.
Agricultural Water Management, Vol. 8, No. 4, p 411-427, February, 1984. 10 Fig, 1 Tab, 24 Ref.

Descriptors: *Water requirements, *Irrigation requirements, *Wheat, *China, *Korea, Water use, Model studies, Climate, Evapotranspiration, Optimization, Sensitivity analysis.

The parametric crop water use model (WATER) was applied for winter wheat to China and its environs in order to examine the evapotranspiration requirements under rainfed conditions and the associated irrigation water applications necessary for optimal production. A network of 241 stations provided climatic data averaged over a 20 year period. Highest ET under full irrigation (first growing season) was observed in the north-western inland sections of China and the eastern portions of the Tibetan Plateau, while lowest ET occurred in the southeast; under rainfed conditions, these tendencies nearly reversed. About 400 mm of irrigation water was required in the northwest in order to achieve near-optimum yields in contrast with no such water requirements in the central east of China. A sensitivity analysis was conducted to determine the errors introduced by faulty, uncertain, or missing station data. (Author's abstract)
W85-06687

HANDBOOK ON THE BISCAYNE AQUIFER WATER MANAGEMENT, WATER CONSERVATION HEALTH AND COST OF DRINKING WATER.
Environmental Coalition of Broward County, Inc., Fort Lauderdale, FL.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118539. NSF/OSS-82002, 1982. National Science Foundation, Washington, DC. Brion Blackwelder, Brenda Marinace, and Joseph E. Podgor, editors. 192 p, 1 Fig, 4 Tab, 30 Ref. Contract/Grant No. OSS727074.

Descriptors: *Water supply, *Water demand, *Water management, *Planning, *Water resources development, *Water pollution, *Water quality, Biscayne Aquifer, *Florida, Aquifers, Groundwater, Water conservation, Okeechobee Lake, Everglades, Drinking water, Groundwater pollution, Water use, Urban areas, Agriculture, Irrigation, Water policy, Municipal water, Public health, Water treatment, Standards, Water analysis, Regulations, Water costs.

Information is presented from scientists, planners, and citizens concerning water resources in southeast Florida. Local groundwater and the Everglades-Okeechobee system are described and pollution of local groundwater, water consumption by urban and agricultural areas, methods of water conservation inside and outside the home, and the sharing of water resources with natural systems are discussed. The problems of growth and water supply are assessed, as are water standards, especially those relating to carcinogens such as trihalomethanes. Tap water, bottled water, home treatment units, vended water, and the cost of water from alternative sources are examined. (Author)
W85-06906

SAHEL: THE CHANGING RAINFALL REGIME AND THE 'NORMALS' USED FOR ITS ASSESSMENT,
Missouri Univ.-Columbia. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 2B.
W85-07066

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6E. Water Law and Institutions

CONSTRAINTS ON WATER-RESOURCE DEVELOPMENT IN ENGLAND AND WALES: THE CONCEPT AND MANAGEMENT OF COMPENSATION FLOWS,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
J. Sheail.
Journal of Environmental Management, Vol. 19, No. 4, p 351-361, December, 1984. 24 Ref.

Descriptors: *Water resources development, *Compensation flows, *England, *Wales, Legal aspects, Reservoir operation, Institutional constraints, Legislation.

Reservoirs have always been regarded as one of the most striking forms of resource development and environmental change. By reference to a wide variety of agreements reached over the levels and methods of compensation discharge, the paper illustrates how the concept of compensation flow was first perceived and introduced to reservoir management, and how it was developed and implemented subsequently. In doing so, the paper will demonstrate how engineering and environmental data were acquired and used within the prevailing institutional framework for scrutinizing such questions over the last 150 years. (Author's abstract)
W85-06178

TREATING WATER INSTITUTIONS AS ENDOGENOUS VARIABLES: DEMONSTRATION OF A CONCEPTUAL MODEL,
Economic Research Service, Fort Collins, CO. Natural Resource Economics Div.
M. L. Livingston.
Water Resources Bulletin, Vol. 21, No. 1, p 23-29, February, 1985. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Institutional constraints, *Conceptual models, *Water rights, Legal aspects, Regulation, Water allocation, Water use, Economic aspects, Public policy, Colorado, Instream use, Legislation.

Institutional innovation is central to many water resource problems. (In this context 'institutions' refers to the laws and regulations governing water allocation and use.) Yet, typically, economic analyses treat institutions as exogenous and fixed. Unfortunately, this conventional assumption does not allow economists to address many modern problems. This paper develops an economic framework in which institutions are treated as endogenous. The model accounts for (1) factors that stimulate calls for formal institutional change, (2) the role of interest groups in policymaking, and (3) actual institutional change as it impacts choice domains and thus economic performance. The model is compared to a specific case of change in Colorado's water institutions, namely, instream water rights legislation in the 1970's. The empirical evidence is generally consistent with model hypotheses. The model promises to be useful to scholars and policymakers interested in institutional innovation. (Author's abstract)
W85-06235

DINOSAUR NATIONAL MONUMENT: THE EVOLUTION OF A FEDERAL RESERVED WATER RIGHT,
Environmental Management Support, Silver Spring, MD.
N. J. Bassin.
Water Resources Bulletin, Vol. 21, No. 1, p 145-149, February, 1985. 6 Ref.

Descriptors: *Water rights, *Dinosaur National Monument, *Colorado, Instream flows, Natural flow doctrine, Minimum flow, Legal aspects, National parks.

Dinosaur National Monument, in northwestern Colorado, has become a test case in the establishment of a federal reserved water right to instream flows. For the first time, the Interior Department was forced to rigorously defend its claims in a watershed where the federal government did not control the upstream reaches. Inadequate quantification of minimum flow requirements, court orders, and an apparent Congressional ban on the spending of Water Resources Program funds by the Park Service to quantify its water rights have already placed the Service in a difficult position to protect instream flows for maintaining the ecological integrity of the Monument. As late as 1983, administrators of the Park Service were divided over their legal strategy, many wanting to pursue a policy of claiming 'natural, historic' flows rather than 'minimum' flows. The conditional right to instream flows granted to the Park Service in 1978 was subject to quantification within five years. That deadline has been extended, but it is not likely that the case will reach final settlement this decade. Until the design and conduct of federal water rights quantifications better integrate public policy and law with science, the principle lesson from Dinosaur may have to be repeated. (Author's abstract)
W85-06248

EVALUATION OF LEGAL AND INSTITUTIONAL ARRANGEMENTS ASSOCIATED WITH GROUND WATER ALLOCATION IN THE MISSOURI RIVER BASIN STATES,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
D. J. Aiken.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-161404/AS, Price codes: A05 in paper copy, A01 in microfiche. Project Completion Report, Nebraska Water Resources Center, Lincoln, Dec 1984. 88 p. Project No. BuRec C-80138-P, Contract/Grant No. 14-34-0001-8412 (3).

Descriptors: *Missouri River Basin, Nebraska, Groundwater, *Groundwater management, *Legal aspects, *Institutional constraints, Water law, Resource allocation, Administrative agencies, Groundwater allocation, Groundwater law, Groundwater administration.

Key ground water allocation issues include: (1) the legal theory for allocating and acquiring ground water rights; (2) well interference conflict resolution policies; (3) ground water depletion policies; (4) resolution of conflicts between surface and ground water users; and (5) integration of water allocation and ground water quality protection policies. In most Missouri river basin states a state license or permit is required before ground water can be used for most purposes. By denying or conditioning the permit, the state can control ground water development and use. Well interference conflicts (and to a lesser degree, groundwater depletion and surface-ground water conflicts) are anticipated in many basin states by conditioning ground water permits with requirements limiting interference with existing ground water users. Ground water depletion policies are not well defined, although several states legislatively prohibit withdrawals exceeding ground water recharge. Several basin states have 'critical area' legislation which allows special regulation of ground water development and use when ground water depletion is occurring. Surface-ground water conflict resolution policies are anticipated to some extent in some basin states by conditioning ground water use permits with requirements limiting interference with existing surface water uses. Most basin states protect ground water quality through well drilling regulations. Several states also have well abandonment and check valve requirements.
W85-06300

INTERORGANIZATIONAL RELATIONS AND DECISION MAKING AMONG SECTION 208 WATER QUALITY MANAGEMENT PLANNING AGENCIES,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
H. R. Potter, and H. M. Schweer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 161420/AS, Price codes: A04 in paper copy, A01 in microfiche. Partial Completion Report, Technical Report No. 165, May 1984. 62 p, 13 Tab., 19 Ref, Project No. OWRT C-00090-U(4), Contract/Grant No. 14-34-0001-0498.

Descriptors: Water quality management, *Institutions, Water quality, *Water law, *Indiana, Planning.

This is a study of mandated interorganizational relations (IOR). This is in contrast to most IOR studies that have assumed voluntary relations among organizations. Specifically the focus is on organizations involved in a federally mandated water quality management planning program. Data are from interviews with 39 persons in 33 organizations in three loci: (a) a designated planning area, (b) a non-designated planning area and (c) persons in positions with state wide responsibilities. The greatest involvement was in the designated area, among state and federal organizations, and among agricultural and environmental voluntary organizations. There was little involvement by local government and industry. Multi-level organizations were more committed to public participation, were most likely to get additional program funding and to participate in joint programs than single level organizations. There was considerable variation in interorganizational relations. Information sharing was frequent, and was positively related to incompatibilities with other organizations. Resource sharing and joint programming were less frequent, and were positively related to each other. Commitment to public participation was positively related to the number of contacts with other organizations. The number of organization staff available to work on the program was a greater problem than staff expertise. Length of time necessary for program planning and implementation, continuity and sources of funds, and local support are three major factors that stand out as important to modify in fed.-state-local relations in future programs.
W85-06305

MODEL CODE ON PLANNING FOR AND ALLOCATIONS OF WATER TO PUBLIC WATER SYSTEMS,
East Tennessee State Univ., Johnson City. Dept. of Environmental Health.
V. A. Sikora.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157584/AS, Price codes: A05 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center, Tennessee University, Knoxville, Technical Completion Report 96, UT Pub. no. R01 2550-29-003-84, January 1984. 91 p, Project No. BuRec B-055-Tenn (1), Contract/Grant No. 14-34-0001-1266.

Descriptors: *Resource allocation, *Water allocation, Water law, Financing, *Tennessee, 208 Planning Process, Institutional constraints, Water supply, Administrative regulation, Planning, Governmental initiations.

The purpose of this study was to produce a model code on the state, regional and local planning for and allocation of water to Tennessee public water systems. The method of code construction began with a thorough review and evaluation of federal and state statutes, common law and regulations affecting model code with a narrative interpretation was then prepared incorporating provisions assuring adequate water supplies and encouraging water conservation and reuse, providing planning guidelines and authority to manage the available water sources, and requiring coordination with other federal and state water resource planning agencies. Later the draft was reviewed by a number of state, regional and local officials. The final code is a blend of effective water planning and management provisions and concepts from other states. Incorporated into the code are state and regional planning provisions, and enforcement of water supply development and expansion based on the plans. Water conservation and reuse are required throughout the code. Also water shortage and emergency management authority is created and delegated to appropriate bodies.
W85-06309

MUNICIPAL USE OF EXISTING WELLS FOR SUPPLEMENTAL WATER SUPPLY IN THE

PIEDMONT AND BLUE RIDGE PROVINCES OF GEORGIA,
Georgia Univ., Athens. Carl Vinson Inst. of Government.
For primary bibliographic entry see Field 6C.
W85-06318

STATE WATER LAW: LEGAL ALTERNATIVES AND CONSEQUENCES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Water Resources Research Center.
W. R. Walker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157840/AS, Price codes: A19 in paper copy, A01 in microfiche. Completion Report, (1984). 443 p, Project No. BuRec B-129-VA (1), Contract/Grant No. 14-34-0001-1274.

Descriptors: *Water allocation, *Water law, *Water management, *Water permits, Water policy, Water rights, Legal aspects, Water use, Reasonable use, Consumptive use, Water quality management, Well regulations, *Virginia.

Virginia's water law, especially its water quantity management framework based on the common law riparian doctrine, is an inadequate legal structure for responding to problems caused by rapid changes in population and technology. This report presents a series of legislative alternatives for modifying Virginia's administrative structure for water management, establishing a permit system for consumptive uses, regulating the construction and operation of wells, and protecting water quality. Many of the provisions in the proposed water management framework are modifications of tried and tested permit systems in other eastern and western states, such as Florida, Iowa, Mississippi, and Washington. Brief commentaries follow many of the proposed legislative alternatives, and 12 background appendices provide additional information on the concepts discussed in the report, such as water management districts, the public trust doctrine, the reasonable-beneficial use standard, and administrative water rights inspection.
W85-06327

WATER CODE OF THE BASIN.
Delaware River Basin Commission, West Trenton, NJ.
October 1982. 67 p. 2 Fig.

Descriptors: *Delaware River Basin, *Water use, *Water control, *Conjunctive use, *Government interrelations, *Jurisdiction, *Regional planning, *Legal aspects, Competing use, State jurisdiction, Federal jurisdiction, Political aspects, Interagency cooperation.

The Delaware River Basin Commission consists of representatives of the federal government and the states of New Jersey, Delaware, New York, and Pennsylvania. Maryland is also within the jurisdiction of the commission but is not a signatory state. The water code is comprised of both policy and specific water quality standards. Section 1.1 of the code sets forth the fundamental intergovernmental relations for planning of projects, while Section 1.10 sets forth the policy against which specific projects must be tested for inclusion within the Comprehensive Plan. Article 2 sets forth the basic policies required for the conservation, development, and utilization of the water resources of the Delaware River Basin. These policies include the commission's role in federal water supply projects and its repayment obligations for the non-federal share of the federal investment cost of such projects. Legal entitlements and charges for water are explained. Legislatively mandated goals are set forth in Article 3. Other sections of the code establish the commission's policy on water quality, use and protection of underground waters, and environmental review of projects. Some policies adopted by the commission are used to test projects which may be proposed by any person or agency, and are subject to review under Section 3.8 of the compact. An example are those policies relating to regional approaches to waste treatment. Administrative guidelines are in separate administrative manuals. (Hawkins-Omniplan)
W85-06335

SPECIAL GROUNDWATER STUDY OF THE UPPER DELAWARE RIVER BASIN, STUDY AREA III, VOLUME II.
Wright (R.E.) Associates, Middletown, PA.
Report (1982). 79 p. 3 Fig, 71 Ref, 1 Append.

Descriptors: *Delaware River Basin, *Groundwater management, *Water use, *Legal aspects, *Riparian rights, *Competing uses, *Pumping, *Groundwater level, *Property rights, *Groundwater mining, Water supply development, Drawdown, Selective withdrawal, Water management, Regional planning.

Currently, about 1,000 mgd of groundwater is pumped from wells within the Delaware River Basin. The quantity of groundwater extracted in an average year exceeds the average annual flow of the Lehigh River near White Haven, PA. In the eastern U.S., surface water law and management have historically been based upon the doctrine of riparian rights, in which all land owners adjacent to a body of surface water have equal water rights. Today there are conflicts due to variation in laws and policies toward the use of groundwater in the basin. The special studies of Areas I, II and III of the basin have shown that overproduction, or groundwater mining, has occurred in some portions. A commonly employed management tool involves setting maximum drawdown limits within either individual wells or wellfields to establish conditions beyond which the water resources will not be depleted. This type of restriction could be used to maintain a certain hydraulic gradient that would not induce groundwater flow from areas of poor water quality. Regulation of groundwater use can be achieved by restricting the well density within a groundwater basin. Groundwater associated with mine pools, being a potentially viable resource that could be used for low-flow augmentation, should be examined to determine its true potential. The most practical means of implementing a unified groundwater regulatory system within the basin is to institute a basinwide groundwater mangement plan. (Hawkins-Omniplan)
W85-06338

MARINE POLLUTION UNDER THE LAW OF THE SEA CONVENTION,
Queen Mary Coll., London (England).
A. E. Boyle.
American Journal of International Law, Vol. 79, No. 2, p 347-372, April, 1985. 150 Ref.

Descriptors: *Legal aspects, *Water pollution control, *Marine environment, *Law of the Sea Convention, Regulations, Enforcement, Standards, International law.

Three elements of the Law of the Sea Convention as its relates to marine pollution are examined: the distribution, content and control of prescriptive jurisdiction; the attribution of competence to enforce applicable standards; and the allocation of risk through principles of state responsibility and related concepts of liability, notification and intervention. These issues are central to the development of the new concept of a duty to protect and preserve the marine environment and to any attempt to evaluate the adequacy and completeness of the Convention's approach to marine pollution. The primary significance of the pollution provisions of the Law of the Sea Convention is their formulation of structure of principles governing all aspects of marine pollution prevention and control. Based on the general duty of protecting and preserving the marine environment, this structure is comprehensive as to sources and forms of pollution and in requiring states to take all necessary measures to prevent, reduce and control marine pollution. In addressing issues of regulation, enforcement and cooperation, it reflects a fundamental shift from power to duty as the central controlling principle of the legal regime of the marine environment, and a transition from a regime based on obligations of responsibility for damage to one based on obligations of regulation and control. (Baker-IVI)
W85-06366

NONTRIBUTARY, NONDESIGNATED GROUND WATER: THE HUSTON DECISION,
T. Rice.
University of Colorado Law Review, Vol. 56, No. 1, p 135-156, Fall, 1984. 134 Ref.

Descriptors: *Groundwater, *Colorado, *Nontributary groundwater, Legal aspects, Legislation, Prior appropriation, Water allocation.

In the Huston decision the Colorado Supreme Court held that the state's nontributary, nondesignated (or S.B. 213) groundwater is not subject to prior appropriation. By rejecting the constitutional doctrine traditionally followed in allocating surface and tributary waters, the court acknowledged that nonrenewable groundwater must be protected from rapid depletion. Yet Huston added nothing substantive to Colorado water law. The court created no comprehensive plan to control the resource. Instead the court perpetuated the haphazard regulatory system responsible for today's confusion in Colorado groundwater management. This Note argues that the Colorado General Assembly must act immediately to conserve S.B. 213 water. Current state law neither adequately protects vested rights nor defines procedures for acquiring rights to S.B. 213 reserves. First, an examination is offered of the historical developments which resulted in the Huston decision. The legislative action that followed the case is then considered along with arguments that the legislature must reform the current regulatory scheme for all nontributary, nondesignated ground water. (Baker-IVI)
W85-06367

REGULATING HAZARDOUS AND MIXED WASTE AT DEPARTMENT OF ENERGY NUCLEAR WEAPONS FACILITIES; REVERSING DECADES OF ENVIRONMENTAL NEGLECT,
Natural Resources Defense Council, Inc., Washington, DC.
B. A. Finamore.
Harvard Environmental Law Review, Vol. 9, No. 1, p 83-141, 1985. 351 Ref.

Descriptors: *Hazardous wastes, *Waste disposal, *Radioactive wastes, *Regulations, Environmental effects, Legal aspects, Waste management.

The continuing battle over the regulation of mixed waste water appears to be the latest conflict in a decades-old struggle by the Department of Energy (DOE) and its predecessor agencies to shield their waste disposal practices from outside regulation. DOE operates approximately 30 different nuclear weapons facilities areound the US, ranging from relatively small weapons conponent production plants to major multipurpose operations located on reservations covering more than 500 sq mi. The evolution of the regulatory scheme for managing hazardous and mixed waste at DOE nuclear weapons facilities is described. The arguments presented in Legal Environmental Assistance Foundation (LEAF) v Hodel are summarized and the district court's opinion in the case is discussed. DOE's current implementation of the LEAF v. Hodel decision is analyzed, with particular emphasis on the regulation of mixed wastes. (Baker-IVI)
W85-06528

JUDICIAL RECOURSE AGAINST FOREIGN AIR POLLUTERS: A CASE STUDY OF ACID RAIN IN EUROPE,
Harvard Law School, Cambridge, MA.
M. Pallemaerts.
Harvard Environmental Law Review, Vol. 9, No. 1, p 143-209, 1985. 281 Ref.

Descriptors: *Acid rain, *Legal aspects, *International law, Air pollution, Litigation, Torts, United Kingdom, Norway.

The opportunities for private litigation by acid rain victims in European countries against foreign sources of long-range transboundary air pollution is explored. Such private actions would aim not only to secure compensation or injunctive relief, but also to establish the illegality of transboundary air pollution, to draw public attention to the mag-

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nitude of acid rain damage, and to increase pressure on the involved governments to reach effective solutions. Public international law on transfrontier pollution is discussed generally and long-range transboundary air pollution specifically to see if it could be usefully invoked in private actions. The rules of private international law are examined as they relate to transnational torts and the domestic rules of tortious liability of two European countries, the United Kingdom and Norway, which have been selected because of their primary importance of the acid rain issue in Europe. (Baker-IVI)
W85-06529

ENDANGERED SPECIES ACT AND WESTERN WATER RIGHTS,
Chicago-Kent Coll. of Law, IL.
A. D. Tarlock.
Land and Water Law Review, Vol. 20, No. 1, p 1-30, 1985. 142 Ref.

Descriptors: *Water rights, *Endangered Species Act, *Legal aspects, Legislation, Clean Water Act, Federal jurisdiction, Property rights, Beneficial use.

Like many environmental laws, the Endangered Species Act is paradoxical. If its scientific justification is correct, movement should be occurring towards institutions that practice integrated ecosystem management on a wide geographical scale instead of concentrating efforts on the protection of an arbitrary and limited number of species and their habitats. The integration into western water law of the values represented by the Endangered Species Act and section 404 of the Clean Water Act will not be easily accomplished. The first step is to recognize that it is legitimate for the federal government to claim water rights under these acts. These acts represent a federal decision to add to the list of beneficial uses served by the water resources. The issue is not whether such rights can be claimed, but under what circumstances and in what manner they can be asserted. The effects of the federal government's regulatory property rights under the acts are considered. (Baker-IVI)
W85-06531

GARRISON DIVERSION: CONSTRAINTS ON CONFLICT RESOLUTION,
Indiana Univ. at Bloomington. Dept. of Political Science.
L. K. Caldwell.
Natural Resources Journal, Vol. 24, No. 4, p 839-863, October, 1984. 1 Fig, 33 Ref.

Descriptors: *Garrison Diversion, *Legal aspects, *Manitoba, *North Dakota, *Missouri River, Water distribution, Water management, International law, Social aspects, Economic aspects, Environmental effects.

For two decades diversion of Missouri River water from the Garrison Dam to east-central North Dakota has generated controversies at local, state, national, and international levels. The major controversy has been international involving the federal governments of Canada and the United States, and the governments of the Province of Manitoba and the state of North Dakota. A discussion is offered which focuses on the need for better institutional arrangements to clarify issues, forecast consequences, and identify alternative courses of action in transboundary environmental disputes. Specific topics considered include the ramifying tendencies of large public works; issues in controversy; the propriety of public action when conflict exists among the people affected; the equity of allocating economic, social, and ecological burdens among the people affected; the adequacy of criteria to evaluate the technical, economic, social, and ecological impact of the Garrison Project; the obligations of the United States under the Boundary Waters Treaty; the ethics and politics of international environmental relationships. (Baker-IVI)
W85-06532

SURFACE RIGHTS IN ARTIFICIAL WATERCOURSES,
Colorado Univ. at Boulder. School of Law.
J. N. Corbridge, Jr.
Natural Resources Journal, Vol. 24, No. 4, p 887-928, October, 1984. 258 Ref.

Descriptors: *Water rights, *Legal aspects, *Artificial watercourses, Dam construction, Water use, Water management.

The solution of problems arising out of the creating of artificial watercourses requires an analysis of the rules governing both public and private rights in artificial waters. These rules do not lend themselves perfectly to the solution of the distinct problems presented by artificial water, but because courts have often likened the law of artificial waters to that of natural waters, analysis of artificial water problems requires some understanding of the legal principles pertaining to natural waters. The application of these principles to problems dealing with rights in natural waters is examined. A number of situations involving artificial waters are then analyzed, with specific reference to the existing law and, in some cases, suggesting reform. Nonconsumptive surface uses, both by the public and by adjacent landowners, is the focus of the discussion. The rules applicable to surface rights in natural watercourses are a complex product of common law and statutory development, and vary widely between one jurisdiction and another. The phrase artificial watercourse has been employed to describe a wide variety of factual situations. The courts have found the rules associated with natural watercourses helpful in allocating surface rights in some artificial watercourse situations, but not in others. Reliance on a complex network of common law riparian rules is arguably not an effective method of allocating surface rights to either natural or artificial waterbodies. (Baker-IVI)
W85-06533

POLLUTION CONTROL BY EFFLUENT CHARGES: IT WORKS IN THE FEDERAL REPUBLIC OF GERMANY, WHY NOT IN THE U.S.,
Washington Univ., Seattle. Dept. of Economics.
For primary bibliographic entry see Field 5G.
W85-06534

CONTINUING SAGA OF PYRAMID LAKE: NEVADA V. UNITED STATES,
W. C. Scott.
Natural Resources Journal, Vol. 24, No. 4, p. 1067-1082, October, 1984. 110 Ref.

Descriptors: *Pyramid Lake, *Nevada, *Federal jurisdiction, *Water rights, *Indian reservations, Orr Ditch, Truckee River, Water use, Irrigation water, Litigation, Negotiation.

In 1859 the Secretary of the Interior set aside 322,000 acres in and around Pyramid Lake as a reservation for the Paiute Indians. Fifteen years later the official Pyramid Lake Reservation was established. Shortly thereafter a policy of encouraging the development of arid western land was begun. This led to a conflict and for almost six years the government and various defendants gathered and exchanged information about water right claims in the Truckee River, which empties into Pyramid Lake. Work was started on the Orr Ditch litigation. When a decision was reached, the report awarded the Reservation an 1859 priority date in the Truckee for 58.7 cu ft/sec and 12,412 acre ft of water annually to irrigate 3,130 acres of delta land. The Project was awarded a 1902 priority date for 1,500 cu ft/sec to irrigate to the extent possible 232,800 acres of land. In 1926 the district court issues a temporary restraining order declaring the water rights as proposed in the report. A prolonged drought stimulated interest in concluding the Orr Ditch litigation and led to the start of settlement negotiation in 1934. The project was represented by the Truckee-Carson Irrigation District (TCID). The decision allowed the diversion of a substantial amount of Truckee River water into the Carson River Basin, practically destroying Pyramid Lake and its fishery. As a consequence, the United States in 1973 filed suit in the Federal District court on behalf of the reservation seeking additional rights to the Truckee River. The Court ruled that the Orr Ditch decree barred the Pyramid Lake Tribe's claims against TCID. Since the Tribes are now encouraged to negotiate and settle, rather than litigate, the extent of their water rights, the Court's decision raises some serious questions. The Tribes must now consider whether they will ever be able to raise a claim for additional water rights after having entered into a settlement agreement. More importantly, the Tribes will have to decide whether it is wise to pursue their current strategy of settlement if they cannot depend on the government to provide adequate representation of their interests. (Baker-IVI)
W85-06537

EVALUATION OF PUBLIC NOTIFICATION REQUIREMENTS IN CALIFORNIA,
California Univ., Berkeley. School of Public Health.
W. H. Bruvold, L. Wardlaw, and J. M. Gaston.
Journal of American Water Works Association, Vol. 77, No. 3, p 40-43, March, 1985. 5 Tab, 6 Ref.

Descriptors: *California, *Drinking water, *Water quality control, *Notification, *Public opinion, Attitudes, Public awareness, Maximum contaminant levels, Water pollution.

The public notification requrements of violations of maximum contaminant levels (MCLs) in drinking water were evaluated through a scientific sampling of residents of 15 California communities. Each community had recently notified consumers of an MCL violation. The sampling assessed public awareness of the notification, the effects the media used had on awareness and knowledge of the problem and recommended solutions to the problem, and the attitude of the respondents regarding the notification requirement and its effectiveness. This assessment of the value of the requirement points to ways in which the stated objectives could be reached more successfully. It is proposed that future objectives of notification efforts should be to make 90% of the consumers aware of the notification and 67% knowledgeable regarding the contaminants of concern and the long term solutions. The present research indicates that public notification programs can attain these objectives if they distribute written messages to the entire population served, describe the problem in nontechncal language, describe the nature of the contaminant of concern and its related health effects, and describe the underlying problem facing the water system and the nature of the long term solution required. (Baker-IVI)
W85-06583

EXTRA EFFORT WINS WATER QUALITY PAYOFFS,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5D.
W85-06817

NEW TACTIC AGAINST HAZARDOUS WASTE,
New Jersey Dept. of Environmental Protection, Trenton.
R. E. Hughey, and A. J. McMahon.
EPA Journal, Vol. 11, No. 3, p 16-17, April, 1985. 2 Fig.

Descriptors: *Legislation, *New Jersey, *Water pollution control, *Hazardous wastes, Fines, Regulations, Legal aspects.

The purpose of New Jersey's Environmental Cleanup Responsibility Act (ECRA) is to determine the environmental acceptability of properties, establish responsibility for remedial actions at contaminated sites, and assure potential buyers that the property they are purchasing is free of significant contamination. The unique driving element of ECRA is the penalty section. First, fines up to $25,000 per day per violation may be collected, and anyone who knowingly gives false information may be held personally liable for the penalty. Second, the Department is authorized to void any sale where the selling party fails to submit a negative declaration or cleanup plan. Finally, the purchaser may void a sale for any violation of ECRA

and may recover any damages. Examples of the use of the law in actual cases are presented. (Baker-IVI)
W85-06818

WATER LAW,
Cook Coll., New Brunswick, NJ.
W. Goldfarb.
Butterworth, Boston. 1984. 223 p.

Descriptors: *Water law, *Legal aspects, *Water rights, Appropriation, Surface water, Groundwater, Diversion, Water transfer, Interbasin transfers, Drainage, Channel improvement, Water resources development, Water supply development, Federal jurisdiction, Bureau of Reclamation, Army Corps of Engineers, Soil Conservation Service, Tennessee Valley Authority, Licenses, Land use, Public rights, Public access, Instream flow, Recreation, Floodplains, Wetlands, Effluent limitations, Construction, Leachates, Oil spills, Acid precipitation, Water conservation, Agriculture, Municipal water, Judicial decisions, Clean up, Clean Water Act, Water pollution, Industrial wastes, Weather modification, Nonpoint source pollution, Safe Drinking Water Act.

This book has four sections. Part I, the law of water diversion and distribution, includes the legal classification of water, water diversion doctrines (riparian system, Eastern permit systems, and prior appropiation), groundwater doctrines, federal and federal-state diverison law, interbasin and interstate transfers, drainage law, and water distribution organizations (irrigation and municipal water supply). Part II, water resources development and protection, discusses the federal government's role (Bureau of Reclamation, Corps of Engineers, Soil Conservation Service, Tennessee Valley Authority, Nuclear Regulatory Commission, and Federal Energy Regulatory Commission) and limitations on the governments's involvement. Part III, nontransformational uses, discusses the use of rivers and streams, use of lakes, access to beaches and marine facilities, recreation, programs, floodplains protection, wetlands protection, weather modification, acid precipitation, and conservation and reuse of water. Part IV, water treatment and land use, includes the Clean Water Act, ocean dumping, groundwater discharges, oil and hazardous substances cleanup, drinking water protection, and common law remedies.
W85-06933

GUIDE TO GROUND-WATER STANDARDS OF THE UNITED STATES.
Ecological Analysts, Inc., Sparks, MD.
API Publication 4366, American Petroleum Institute, Washington, DC. July 1983. 80 p.

Descriptors: *Water law, *Legal aspects, *Standards, *Groundwater, *Water quality control, *Regulations, Clean Water Act, Safe Drinking Water Act, National Interim Drinking Water Regulations, Sole Source Aquifer, Injection wells, Toxic Substance Control Act, Federal Insecticide Fungicide Rodenticide Act, Resource Conservation and Recovery Act, Comprehensive Environmental Response Compensation and Liability Act, Monitoring, Classification, Drinking water, Permits, Wells, Aquifers.

Information on federal and state regulations concerning the use and protection of groundwater is organized. An overview of technical and regulatory concepts and terminology is followed by a summary of federal programs, which provide the basis for state regulations. For each state the following information is supplied: groundwater classification, groundwater quality standards, drinking water standards, groundwater appropriation, controlled use or special permit areas, well construction standards, underground injection control, groundwater monitoring at waste management facilities, sole source aquifers, references, state contacts, and tables of numerical and narrative standards.
W85-06940

COMPLYING WITH NPDES PERMIT LIMITS: WHEN IS A VIOLATION A VIOLATION,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. E. Herricks, D. J. Schaeffer, and J. C. Kapsner.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 109-115, February, 1985. 43 Ref.

Descriptors: *Regulations, *Permits, *Enforcement, *Water pollution control, Water quality control, Monitoring, Liability, Statistical analysis, Sampling, Detection limits, Legal aspects.

National Pollution Discharge Elimination System (NPDES) compliance audits are based on effluent monitoring by EPA and state agencies and data provided through the self-monitoring of NPDES permit holders. Compliance with water quality standards is assessed through ambient water quality monitoring by state and federal agencies using samlping networks or special studies. Both monitoring programs have been the basis of critical Government Accounting Office (GAO) reports. Regulatory authorities must recognize the nature of both data they collect and the data reported to them. In addition, these authorities, and the state legislatures must recognize the consequences of statistical reality. The failure of the law as implemented to incorporate the statistical properties of natural systems, and the concomitant failure to recognize that variability is intrinsic to measurement deprives present environmental statutes of the rational basis needed to support strict liability. Until both natural systems and the harm done to them can be accurately measured, it may be inappropriate to impose penalties without regard to some form of fault. The recent GAO reports do not help find an answer because they do not recognize the problem. Further, the courts have not yet faced the question in the context of either an enforcement action or a challenge to agency standard setting. However, it is only a matter of time before the vulnerability of EPA on this issue is exposed. (Baker-IVI)
W85-07038

LOSSES FROM EFFLUENT TAXES AND QUOTAS UNDER UNCERTAINTY,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5G.
W85-07089

6F. Nonstructural Alternatives

GROUNDWATER MANAGEMENT PLAN FOR STUDY AREA 1, COASTAL PLAIN FORMATIONS,
Camp, Dresser and McKee, Inc., Boston, MA.
H. O. Banks.
Final Report, March 1982. 376 p, 57 Exhibits, 48 Ref.

Descriptors: *Groundwater management, *Management planning, *Coastal plains, *Aquifers, *Interstate rivers, *Aquifer characteristics, *Piezometers, Administration, Rivers, Surface-groundwater relations, Catchment areas, Interstate commissions, Delaware River.

The management was studied the groundwater resources of the coastal plain portion of the Delaware River Basin. Two primary tools were developed for regional analyses and evaluations of the response of the aquifer system: a coarse Mass Balance Model of three aquifer groups, and a more detailed finite element model of the Potomac-Raritan-Magothy. Among the management strategies examined were redistribution, surface water substitution, and a combined redistribution/substitution method. The combined method represents the most attractive case examined. Under this strategy, piezometric levels in the Camden cone would rise to roughly twenty feet below sea level and the rate of movement of the deep salt front would be slowed to less than one-half its current rate. A net flow from the aquifer to the river would be maintained downstream of Camden, thereby minimizing the threat of salt of organic contamination. Piezometric levels near Wilmington would also rise to roughly twenty feet below sea level. A critical component of the proposed groundwater management plan is the establishment of nine management zones based primarily on hydrogeological considerations including outcrop areas, variations in estuary water quality, and channel bed permeabilities. The plan describes the zone-specific recommendations and calls for relocated future groundwater withdrawals away from stressed areas and substituting surface water where possible. (Hawkins-Omniplan)
W85-06334

FLOOD DAMAGE MITIGATION: A REVIEW OF STRUCTURAL AND NONSTRUCTURAL MEASURES AND ALTERNATIVE DECISION FRAMEWORKS,
Wollongong Univ. (Australia). Dept. of Economics.
For primary bibliographic entry see Field 6B.
W85-06495

6G. Ecologic Impact Of Water Development

IMPACT OF SMALL-SCALE DAMS ON FISHES OF THE WILLAMETTE RIVER, OREGON AND AN EVALUATION OF FISH HABITAT MODELS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
H. W. Li, C. B. Schreck, R. A. Tubb, K. Rodnick, and M. Alhgren.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157782/AS, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute, Oregon State University, Publication WRRI-91, Nov. 1983. 81 p, 13 Fig, 17 Tab, 59 Ref, Project No. OWRT B-077-ORE (1), Contract/Grant No. 14-34-0001-1259.

Descriptors: *Dams, *Fish, *Anadromous fish, Habitats, *Aquatic habitats, Habitat models, *Fish habitat models, Hydroelectric power, Willamette River, *Oregon.

Two aspects of the potential effects of small-scale hydroelectric dams on fish communities in the Willamette River were examined. The first study was to determine whether or not models of habitat assessment based solely upon physiological tolerances would be suitably accurate for prediction of impact. It was found that ecological processes such as interspecific competition greatly limit the accuracy of habitat models based solely on physical variables. Also, distributional patterns of fishes differed among streams, presumbly due to different limiting factors which shift fish behavior. A multivariate approach was developed to define habitat selection, by denoting habitat availability and habitat occupation based on microhabitat characteristics. The second study was to determine physical and ichthyofaunal characteristics for unimpounded streams and for streams impounded by various types of small-scale dams. Also, the types of impacts of small-scale dams were identified and the predictive capacity of habitat suitability models was evaluated. In general, larger dams caused more negative impact due to diminution of flow, a greater amount of siltation, and a larger impounded area. Small dams in areas subjected to low summer flows may be beneficial, offering pool refuge for cutthroat trout. Predators of juvenile anadromous salmoid fishes are attracted to tailraces below dams and may cause a bottleneck to seaward migration.
W85-06321

CHANNEL CHANGE WORKSHOP PROBLEM NUMBER 3, ELK RIVER, KANSAS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
E. H. Grissinger.
Report FWS/OBS-81-148, September 1981. Reprint from: Proceedings: Workshop on Downstream River Channel Changes Resulting from Diversions or Reservoir Construction. p 209-221, 3 Figs, 11 Refs.

Descriptors: *Drainage systems, *Channel flow, Watersheds, Elk River, Kansas, Streams, Paleocli-

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matology, Erosion, *Channel morphology, *Channel erosion, Sedimentation, Mississippi, Iowa.

The Elk River, Kansas is typical of many streams in the Mississippi drainage system. It has a deep channel incised into late to postglacial valley-fill deposits. At present, the distribution and properties of these valley-fill deposits are undefined and this lack of information prevents reliable prediction of channel adjustments resulting from significant watershed changes. Studies in northern Mississippi and western Iowa, which have established the significance of comparable valley-fill deposits, have been used as case examples. This case history application is based on preliminary results indicating the valley-fill units were deposited in response to paleoclimatic controls. Alternate scenarios are presented based upon vegetative or stratigraphic controls and upon hydraulic-induced or gravity-induced bank failure.
W85-06354

FUNDAMENTALS CONCERNING ECOLOGICAL-AND-ECONOMICAL ESTIMATION OF THE WATER AND WATER-ADJACENT ECOSYSTEMS FUNCTIONING CHANGES UNDER THE INFLUENCE OF ANTHROPOGENIC FACTORS (OSNOVNYE POLOZHENIYA EKOLOGO-EKONOMICHESKOI OTSENKI IZEMENII FUNKTSIONIROVANIYA VODNYKHI OKOLOVODNYKH EKOSISTEM POD VOZDEISTVIEM ANTROPOGENNYKH FAKTOROV),
O. N. Taran, and V. M. Tregobchuk.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 55-61, 1985. 7 Ref.

Descriptors: *Environmental effects, *Economic aspects, *Hydroelectric plants, *Water management, Ecological effects, Ecosystems, Construction.

The effects of anthropogenic factor (hydroelectric and water management) on water and near-water ecosystems can be positive or negative, depending on which of the possible construction and usage options is chosen. An economic-ecological evaluation of the effects of hydroelectric development and water management on aquatic ecosystems is needed that would reduce negative effects from projects as much as possible. Methodological recommendations are made concerning ecological and economic estimation of the water and water-adjacent ecosystem changes resulting from the water management and powerplant construction. (Moore-IVI)
W85-06378

EFFECTS OF WINTER WARM RESERVOIR RELEASE ON BENTHIC STREAM INVERTEBRATES,
Bergen Univ. (Norway). Zoological Museum.
G. G. Raddum.
Hydrobiologia, Vol. 122, No. 2, p 105-111, 1985. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Environmental effects, *Regulated flow, *Invertebrates, *Reservoir releases, *Thermal pollution, Holmevassana River, Tverrana River, Naustdalsana River, Norway, Rivers, Water resources development, Reservoirs, Aquatic insects.

Possible changes in life history, drifting patterns and differences in abundance of insect larvae caused by river regulation are presented. Benthos were investigated during the summer seasons of 1971 and 1972 in three small mountain rivers, Holmevassana and Tverrana (regulated) and Naustdalsana (natural) 950-1050 m a.s.l. in Norway. Holmevassana became free of ice and snow in the winter due to the increased flow and higher temperature of the released water. In the other two rivers the flow was too small to break up the ice and snow cover. Similar groups and species of fauna were recorded in each water body, but differences in abundances were noted. The most conspicuous difference was the drifting pattern of chironomid larvae, which reflected changes in winter growth. In Holmevassana River the drift of larvae was highest in the daytime during July and August. In Tverrana River, larval drift was highest at night in July, but changed to daytime in August and September. The earlier development of insects in Holmevassana, caused by the winter warm conditions can put adult insects into terrestrial environments, to which they are not adapted. In such cases the imagos can be immobilized to a great extent on snow-covered fields before reproduction. (Baker-IVI)
W85-06385

DECLINE OF STRIPED BASS IN THE SACRAMENTO-SAN JOAQUIN ESTUARY, CALIFORNIA,
California State Dept. of Fish and Game, Stockton.
For primary bibliographic entry see Field 5C.
W85-06403

STRIPED BASS, TEMPERATURE, AND DISSOLVED OXYGEN: A SPECULATIVE HYPOTHESIS FOR ENVIRONMENTAL RISK,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W85-06404

SUMMER MORTALITY OF STRIPED BASS IN RESERVOIRS OF THE UNITED STATES,
Oklahoma Univ., Kingston. Biological Station.
W. J. Matthews.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 62-66, January, 1985. 1 Fig, 2 Tab, 4 Ref. FWS contract 14-16-0009-82-018.

Descriptors: *Striped bass, *Mortality, *Reservoirs, Seasonal variation, Limnology, Multivariate analysis, Reservoir fisheries.

A survey of 80 reservoirs in the United States with striped bass Morone saxatilis populations indicated some summer mortality of the species in 27 (34%) of the impoundments. Most of the reported mortality was of medium sized to large adults (> 5 kg). More mortality was reported in July-September than in other months. Reservoirs for which summer striped bass mortality was reported had significantly greater mean surface area, volume, maximum depth, and depth of water release than those without reports of striped bass mortality. However, the presence or absence of reported striped bass mortality bore no discernible relationship to reservoir morphometric or limnological features when 20 such characteristics were examined by multivariate analysis. The results suggest overall that summer mortality of striped bass is widespread geographically in reservoirs of the United States, but its occurrence is highly variable and by no means universal. (Author's abstract)
W85-06405

SUMMER SELECTION OF THERMAL REFUGES BY STRIPED BASS IN ALABAMA RESERVOIRS AND TAILWATERS,
Alabama Dept. of Conservation and Natural Resources, Montgomery. Game and Fish Div.
For primary bibliographic entry see Field 2H.
W85-06407

EFFECT OF REGULATION OF THE NILE RIVER DISCHARGE ON THE OCEANOGRAPHIC CONDITIONS AND PRODUCTIVITY OF THE SOUTHEASTERN PART OF THE MEDITERRANEAN SEA, (UTJECAJ REGULACIJE DOTOKA RIJEKE NIL NA OCEANOGRAFSKA SVOJSTVA I PRODUKCIJU JUGOISTOCNOG DIJELA SREDOZEMNOG MORA),
Institute of Oceanography and Fisheries, Alexandria (Egypt).
W. F. Wadie.
Acta Adriatica, Vol. 25, No. 1/2, p 29-43, 1984. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Nile River, *Mediterranean Sea, *Aquatic productivity, Plankton, Seasonal variation, Dams, Environmental effects, Dam construction, Fish migration,.

Before the damming of the Nile River, the southeastern part of the Mediterranean Sea was one of the most productive areas in the Mediterranean Sea (Gorgy and Shaheen 1964; El-Zarka and Koura, 1965; Gorgy, 1966; Halim et al., 1967). The Nile discharge was the main reason for the high biological productivity of the shelf waters of the southeastern part of the Mediterranean Sea. The life cycle of sea organisms in this area depends mainly on the river discharge, particularly on the seasonal dynamics of plankton and pelagic fish migration. Therefore, the high decrease in the river discharge after 1965 affects greatly the physical, chemical and biological conditions in the southeastern part of the Mediterranean Sea. (Author's abstract)
W85-06423

EVALUATION OF TILAPIA SPP. IN LAKE MANZALAH AS POND FISHES, (PROCJENA TILAPIA SPP. U JEZERU MANZALAH KAO RIBNJACARSKIH VRSTA),
Institute of Oceanography and Fisheries, Alexandria (Egypt).
N. F. Bishara.
Acta Adriatica, Vol. 25, No. 1/2, p 87-99, 1984. 8 Tab, 10 Ref.

Descriptors: *Lake Manzalah, *Egypt, *Land reclamation, *Environmental effects, Fisheries, Lakes, Fish farming.

Lake Manzalah, the largest brackish delta lake of Egypt, is subject to large land reclamation projects which have diminished its area. There is now an intention to convert the periphery of this lake, which extends for about 300 km, into fish farms to compensate for the decrease in fish production. This study was made on Tilapia aurea and T. nilotica in winter 1980 and spring 1981, to evaluate their potential as pond fishes in the proposed fish farms. Age analysis was carried out to show difference in growth for the fish in two seasons and for both sexes. Sample standard deviation and the population standard deviation were calculated for length and weight in two species. Length-weight equations and the differential rate of increase in fish weight per unit length were calculated, together with the survival rate of fish. From this information, recommendations for the successful culture of T. aurea and T. nilotica in fish farms constructed on the periphery of Lake Manzalah are given. (Author's abstract)
W85-06424

FORMATION OF ICHTHYOFAUNA IN THE SASYK RESERVOIR UNDER CONDITIONS OF FRESHENING (FORMIROVANIE IKHTIOFAUNY SASYKSKOGO VODOKHRANILISHCHA V VSLOVIYAKH OPRESNENIYA),
V. A. Tkachenko, and A. N. Voloshkevich.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 47-50, 1984. 1 Tab, 9 Ref.

Descriptors: *Fish populations, *Species composition, *Sasyksky Reservoir, Reservoirs, Lagoons, Water resources development, Environmental effects.

Formation of a freshwater reservoir in the place of the marine lagoon resulted in radical reconstruction of ichthyofauna. The Sasyksky reservoir studied in 1981 to 1982 contained 42 fish species, mainly freshwater ones. Such food fishes as roach, bleak, carp-bream, sichel, goldfish, common carp, pike-perch and common perch are predominant among fish fry and older age groups. Due to the formation of valuable food fish schools commercial fishing is, at present, strictly forbidden. Fish species of low value whose reserves are under utilized may be caught. (Author's abstract)
W85-06468

SAVE THE EVERGLADES,
S. Douglas.
Oceans, Vol. 18, No. 2, p 3-9, March, 1985. 6 Fig.

Descriptors: *Everglades, *Wildlife habitats, *Florida, *Wilderness areas, Wildlife management, Water resources development, Environmental effects, Wetlands, Roads, Canals.

Efforts are underway in Florida to stop the damage occurring to the Everglades. The Everglades proper, that 100 miles of saw grass marsh stretching south from Lake Okeechobee, is only the downstream end of the 9,000 square mile Kissimmee Basin, Lake Okeechobee/Everglades ecosystem. Included in the Save the Everglades plan are commitments to reestablish the value of the Kissimmee River, involving either complete or partial elimination of canal C-38 and a restoration of the marshlands; restore a ninety-five-square mile area in Palm Beach County known as the Holey Land and Rotenberger tracts, now drained and fallow; manage the deer herd in Water Conservation Area 3 so it can better survive high water levels; remove the scar of Alligator Alley, a state road cutting across the peninsula which now acts as a barrier to sheet flow and breaks up animal habitats; restore Everglades National Park, including the support of an emergency plan for more equitable water delivery into the park; and preserve the Florida panther in the Big Cypress Preserve, Fakahatchee Strand, and Everglades National Park. (Baker-IVI)
W85-06563

CALIFORNIA APPROACH TO PLUMBING,
C. Caufield.
New Scientist, Vol. 105, No. 1444, p 24-27, 21 February, 1985. 7 Fig.

Descriptors: *Water resources development, *San Joaquin Valley, *San Francisco Bay, *California, Environmental effects, Irrigation, Groundwater pollution, Water supply development, Water demand, Water use, Salinity, Wildlife habitats, Seawater intrusion.

California has developed what has been called the most sophisticated plumbing system in the world. Half of the 35 billion cu m of water used in the state is shipped hundreds of km from the north to the south. Rivers that naturally ran from east to west have been reversed by electrical pumps. Shipping water around is the biggest single consumer of electricity in California. One result of this massive manipulation of water is an extraordinarily productive agriculture. Salinity is, however, always a problem with irrigated soils. To rescue salt soils in the San Joaquin Valley may cost twice as much as providing the irrigation water in the first place. Another problem is a serious depletion of groundwater resources. California is losing 25 billion cu m of groundwater a year. Overuse stimulated by low prices is damaging the largest inland estuarine system in the US, the Sacramento-San Joaquin Delta, once a wild marshland. In 1977 seawater had come so far up the delta that several temporary rock dams had to be built to protect water destined for the south. Another problem is caused by pollutants entering the delta. Water projects which have halved the influx of fresh water to the bay have reduced natural flushing. (Baker-IVI)
W85-06567

HIGH STAKES FOR REVIVING HYDROELECTRIC POWER,
G. Robertson.
New Scientist, Vol. 105, No. 1445, p 8, 28 February, 1985. 2 Fig.

Descriptors: *Hydroelectric plants, *Scotland, *Grudie River, *Talladale River, Water resources development, Environmental effects, Powerplants.

Scotland is switching from oil and nuclear power back to hydroelectricity. However, the plan to build the first hydroelectricity scheme in the past 20 years is having difficulty. Some conservationists see the plan as good while others view it as destroying some of Scotland's most spectacular scenery. The waters of the Grudie and Talladale rivers will be used to generate electricity in two small power stations, with a total capacity of around 10 megawatts. The rivers flow into Loch Maree, in the heart of an area newly designated by the Nature Conservancy Council as a Site of Special Scientific Interest. Officials for the Lock Ewe District Salmon Fishery Board also object saying these rivers are much more important for salmon and sea trout than had been realized. Most of the pipe work is to be placed underground and the power stations are to be well screened. The crux of the matter is whether the project makes economic sense. The need for the appointment of an expert committee of inquiry to review the development of hydroelectric generation in Scotland has been recognized. (Baker-IVI)
W85-06568

STREAM-WATERSHED RELATIONS IN THE MISSOURI OZARK PLATEAU PROVINCE,
Missouri Agricultural Experiment Station, Columbia.
M. M. Smart, J. R. Jones, and J. L. Sebaugh.
Journal of Environmental Quality, Vol. 14, No. 1, p 77-82, January/March, 1985. 3 Fig, 5 Tab, 28 Ref.

Descriptors: *Water chemistry, *Watersheds, *Streams, *Missouri, Chlorophyll a, Nutrients, Land use, Forests, Pastures, Urban areas, Water quality, Algae.

Water chemistry and algal chlorophyll values in Missouri Ozark streams were more strongly related to land-use practices on the watershed than bedrock geology or soil association. In general, concentrations of nutrients, chlorophyll, and most major ions were lowest in streams draining forests, intermediate in streams draining pastures, and highest in streams draining urban areas. In streams draining both forest and pasture areas, there was an exponential increase in the concentration of total P, total N, NO3(-)-N, Na(+), Cl(-), and suspended chlorophyll a with an increase in percent pasture area on the watershed. These relations help identify the relative importance of land use on water chemistry and algal chlorophyll values, explain differences among streams in the region and enable one to approximate the impact of forest-pasture conversion on streams not yet affected. (Author's abstract)
W85-06620

AGRICULTURE IN CHINA - A DETERIORATING SITUATION,
Leiden Rijksuniversiteit (Netherlands). Sinological Inst.
For primary bibliographic entry see Field 4C.
W85-06630

DAMNATION OF PARADISE,
L. Alexis.
Ecologist, Vol. 14, No. 5/6, p 206-215, 1984. 4 Fig, 80 Ref.

Descriptors: *Sri Lanka, *Mahaweli Scheme, *Water resources development, Dam effects, Environmental effects, Public health, Water shortages, Disease, Salinization, Deforestation, Economic aspects, Political aspects.

In the desperate search for a large-scale technological solution to Sri Lanka's increasing food and employment requirements, the government has embarked on a multi-billion dollar, five dam project that will threaten ecological stability in a large portion of the country's interior and is already causing social problems. Numerous critics have spoken out against the scheme, but the state appears unwilling to listen. In order to get a clearer picture of the tremendous effects that the Accelerated Mahaweli Project is having upon the Mahaweli Ganga's numerous, complex, ecological systems, the course of the river is traced, examining some of the impacts caused by each of the projects in the overall scheme. Specific parts of the total project examined include the Three Peneplains, the Kotmale Dam, the Polgolla Diversion, the Victoria Dam, the Randenigala Project, the Madura Oya Project, the resettlement scheme, and the H Area scheme. The following problems are expected to arise due to the overall project: increased waterborne disease, water shortages, salinization, deforestation, landslides in Kotmale Valley, high foreign debts, loss of flora and fauna, and corruption and bribing of local officials. (Baker-IVI)
W85-06631

MYTH OF THE BENIGN SUPERDAM,
E. Goldsmith, and N. Hildyard.
Ecologist, Vol. 14, No. 5-6, p 217-220, 1984. 1 Fig, 23 Ref.

Descriptors: *Environmental effects, *Water resources development, *Dam construction, Dam effects, Water quality control, Environmental impact, Ecology, Public rights, Salinization, Irrigation, Economic aspects.

Several requirements are suggested which, if followed, in constructing dams, would provide water on a sustainable basis and without incurring intolerable social and ecological costs. No dam should be built until an adequate assessment of its likely environmental effects has been undertaken and made available to the public. Water development projects should only be undertaken if they can be shown to benefit large sectors of the population. The scheme should favor labor-intensive rather than capital-intensive economic activities. Future water development schemes should permit the production of food crops for feeding the local population rather than for growing export crops. Schemes should not be built which would compromise public health and safety in ways that would be viewed as unacceptable to the people affected. Schemes should not be built if they adversely affect national parks, heritage sites, areas of scientifc and educational importance, tropical rainforests or areas inhabited by wild animals threatened with extinction. Dams should only be built where it can be guaranteed that they will not silt up within a hundred years. Dams should not be built when their associated irrigation schemes are likely to lead to the salinization of agricultural land. Emphasis on funding should be towards sustainable long-term resource enhancement rather than short-term resource exploitation. Dams should not be built if they displace indigenous peoples from their homes and destroy their cultures. If these recommendations had to be met, few, if any, dams would be built. (Baker-IVI)
W85-06632

POLITICS OF DAMMING,
E. Goldsmith, and N. Hildyard.
Ecologist, Vol. 14, No. 5/6, p 221-231, 1984. 3 Fig, 46 Ref.

Descriptors: *Water resources development, *Environmental effects, *Political aspects, Economic aspects, Dam construction, Decision making, Planning, Developing countries.

Dams and other large-scale water projects have been given the go-ahead on the basis of some cursory ecological appraisals. In some cases the appropriate studies were undertaken only after building work had begun. Examples are provided to make the point. James Bay, Canada, was approved before any ecological or economic cost-benefit studies had been undertaken. No studies were undertaken on the ecological effects of the Kindaruma and Kamburu dams on Kenya's Tana River before construction work began. The introduction of modern canal irrigation to the Helmand Valley of Afghanistan was undertaken without any consideration of the possibility that the land might become salinized. The sole environmental study of West Africa's Selingue dam on the Mali-Guinea border dealt briefly with the tourist potential of the reservoir, its possible harm to water quality in the region and seismic stability. The role of politics in decision making for dam construction is described. (Baker-IVI)
W85-06633

TRANSFORMATION OF THE OB RIVER CHANNEL DOWNSTREAM OF THE NOVOSIBIRSK HYDROELECTRIC STATION,
A. B. Veksler, and V. M. Donenberg.
Hydrotechnical Construction, Vol. 18, No. 9, p 437-443, September 1984. 3 Fig, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 46-50, September, 1984.

Descriptors: *Water resources development, *Environmental effects, *Novoskbirsk Hydroelectric Station, *Ob River, Channels, Rivers, Discharges, Excavation, Hydraulic regime, Construction.

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Investigations of processes of transformation of the Ob channel in the lower pool of the Novosibirsk hydrostation convincingly show the need for timely consideration of the consequences caused by man's interference in the life of the river. The preparation of a scientifically founded forecast of channel transformation when designing hydrostations should include an assessment of the effect on the fluviomorphological process of quarry excavations, training works, and construction of intake and outlet works. Insufficient consideration of these factors and the lack of due supervision of works affecting the course of the fluviomorphological process under conditions of a river with a regulated flow can be the cause of irreversible channel transformations and changes in the hydraulic regime which can effect substantial complications for various branches of the economy. (Baker-IVI)
W85-06710

QUANTITY AND QUALITY OF SESTON IN AN IMPOUNDED AND A FREE-FLOWING RIVER IN VIRGINIA, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Entomology.
For primary bibliographic entry see Field 2H.
W85-06791

EFFECTS OF FLOODING ON VEGETATION AT SALAMONIE RESERVOIR,
Miami Univ., Oxford, OH. Dept. of Botany.
P. T. Arnold, and R. E. Brown.
Proceedings of the Indiana Academy of Sciences, Vol. 93, p 153-159, 1983. 4 Fig, 15 Ref.

Descriptors: *Flooding, *Vegetation, *Salamonie Reservoir, *Indiana, Species diversity, Trees, Shrubs, Flood frequency, Water level fluctuations, Ecological effects.

Salamonie Dam was built primarily for flood control purposes on the Salamonie River in the upper Wabash Basin. The normal annual variation in water level is 25 ft. Salamonie Reservoir experienced very high water levels in two previous years. Vegetation was studied along three transects parallel to the shoreline at four sites on the north shore and one site on the south shore of the reservoir. Due to the widely varying habitats found at Salamonie Reservoir, areas with medium and low flooding frequency often had large differences in species composition between the study sites. These differences were much less pronounced and often absent in an area of high flooding frequency. At Salamonie Reservoir, the impact of high flooding frequencies appears to overshadow most of the other parameters that determine the species composition of an ecosystem. The tolerance of trees and shrubs to flooding at Salamonie is similar to studies in several other localities. Salix spp. and Populus spp., commonly referred to as 'resistant' in previous studies, experience very little mortality in the Salamonie floods. Due to their adaptations toward inundation, they have been recommended often for the protection of periodically flooded banks. There was a widespread mortality of Robinia in the highest inundation levels. Since Robinia is commonly planted at Salamonie for wildlife forage purposes, it may be appropriate to avoid planting it in frequently flooded areas. (Cutty-IVI)
W85-06847

EFFECT OF FLOODING ON SMALL MAMMAL POPULATIONS AT SALAMONIE LAKE,
Huntington Coll., IN. Dept. of Biology.
R. E. Brown, and P. T. Arnold.
Proceedings of Indiana Academy of Science, Vol. 93, p 167-172, 1983. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Flooding, *Mammals, *Animal populations, *Salmonie Lake, *Indiana, Rodents, Shrews, Environmental effects, Behavior, Dam effects.

Salamonie Dam, completed in 1966, was built primarily for flood control purposes on the Salamonie River in northeastern Indiana. At summer pool the lake covers 2860 acres, and at flood control pool, the lake would cover 9340 acres. Flooding in March of 1983 provided an opportunity to investigate and compare the movements of several species of shrews and rodents into recently flooded land. An earlier study was carried out by a snap trapping program between May 25 and July 2, 1982 at Salamonie Lake in Huntington and Wabash Counties. The study provides base-line data for any subsequent investigations which may be made in the same area. A total of 28 rodents (3 species) and 6 shrews (2 species) were caught in 1476 trapnights. Results by species and trap sites are tabulated. An examination of the data indicates that three species of rodents reinvaded the flooded areas for relatively great distances as water receded. These particular species have been known in the past to be good swimmers. (Baker-IVI)
W85-06848

AQUATIC BIRDS OF THE WHITE RIVER, UINTAH COUNTY, UTAH,
Bio-Resources, Inc., Logan. UT.
B. B. Steele, and S. B. Vander Wall.
Great Basin Naturalist, Vol. 45, No. 1, p 113-116, January, 1985. 2 Tab, 5 Ref.

Descriptors: *Environmental effects, *Waterfowl, *Population dynamics, *White River, *Utah, Dam effects, Reservoirs, Birds, Water resources development.

Abundance, seasonal use, and species composition of waterfowl and other aquatic birds are described along a 32.8 km stretch of the White River, Uintah County, Utah at the site of the proposed White River Dam. Waterfowl were most abundant during spring migration in April. During winter, late summer and fall, even waterfowl abundance was low and relatively constant at 0.31 to 0.36 birds/river km. Only the Canada Goose breeds in the study area. Several other species of aquatic birds were recorded. Great Blue Herons were fairly common transients in spring and summer, but do not breed in this area. Aquatic habitat along the White River is apparently important to the waterfowl primarily during spring migration, although the Canada Goose nests in moderate numbers. The Spotted Sandpiper also breeds there. In terms of total numbers of waterfowl, the White River is not as important as reservoirs and other impoundments near the Green River. If the White River Dam is built, changes in the abundance and composition of the aquatic bird fauna of the White River will depend on three factors: colonization of plants on the margin and bottom of the reservoir, decreased turbidity of the water, and changes in populations of aquatic organism including fish, insects, plankton, that are components of the aquatic food web. Decreased turbidity, and changes in prey populations as well as the presence of open water will be responsible for the major changes in the aquatic avifauna. (Baker-IVI)
W85-06870

HANDBOOK OF ENVIRONMENTAL QUALITY MEASUREMENT AND ASSESSMENT: METHODS AND TECHNIQUES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. E. Henderson.
Instruction Report E-82-2, May 1982. Final Report. 350 p, 3 Append: Append A - 7 p; Append B - 280 p, 18 Fig, 25 Tab; Append C - 58 p, 696 Ref.

Descriptors: *Environmental effects, *Planning, Mathematical studies, Checklists, Maps, Networks, Model studies, Evaluation, Economic aspects, Water resources, Water management, Water analysis, Aquatic habitats, Habitats, Wildlife.

Environmental analysis techniques for planning and evaluation are presented. Generic types of environmental analysis methods include matrix-based methods, checklists, map/overlay methods, network analysis, comprehensive assessment and evaluation, and modeling. Technique profiles are given to support planning steps. An appendix contains measurement and evaluation techniques for use in Environmental Quality Evaluation Procedures with (a) technique profiles that describe methods, techniques, and procedures for characterizing ecological, cultural and aesthetic factors and (b) Profile Characteristics Matrices.
W85-06897

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 7: MANAGEMENT OF ECOLOGICAL DATA IN LARGE RIVER ECOSYSTEMS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. P. Farrell, A. D. Magoun, K. Daniels, C. H. Pennington, and R. H. Strand.
Miscellaneous paper E-80-1, February 1982. Report 7 of a Series. 35 p, 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Environmental effects, *Aquatic habitats, *Data processing, *Computer programs, Mississippi River, Statistical analysis, Graphic analysis, Automation, Data storage and retrieval, Data collections.

A graphical display system was developed to expedite the research data management system for a large study on aquatic habitats on the Lower Mississippi River. PROC VIVIPLOT is a Statistical Analysis System procedure which produces copy-ready figures. From this, a data file is generated to drive several other plots. To minimize error propagation in coding variables, nonsense codes (alphanumeric codes with no imbedded information) were used in place of smart codes.
W85-06899

AQUATIC BIOTA OF BANK STABILIZATION STRUCTURE ON THE MISSOURI RIVER, NORTH DAKOTA,
National Fishery Research Lab., La Crosse, WI.
R. M. Burress, D. A. Krieger, and C. H. Pennington.
Technical Report E-82-6, May 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 102 p, 1 Fig, 35 Tab, 20 Ref, Append, Cooperative Agreement No. 14-16-0009-78-946.

Descriptors: *Rivers, *Bank stabilization, *Environmental effects, *Dikes, *Aquatic animals, *Aquatic habitats, *Invertebrates, *Fish, Habitats, Benthos, Missouri River, North Dakota, Oligochaetes, Dipterans, Caddisflies, Insects, Algae, Erosion control, Stream banks.

Biological and physical samples were collected from nine habitats on the Missouri River near Washburn, North Dakota. The habitats were six bank stabilization structures (earth core dike, hard point dikes, revetments, wing dikes, and L-head dikes) and three natural locations. Benthic samples included 11 families, numerically dominated by oligochaetes (63%) and dipterans (34%). Mud or mud-fine sand substrates yieled 93% of the organisms collected. Densities of benthic organisms were greatest at two locations that included extensive areas of backwater (L-head dike and wing dike) and least at a revetted location where the substrate was largely fine sand. Rock fauna samples included 22 families, 60% dipterans, 33% trichopterans, and 7% oligochates. The average number of dipterans, trichopterans, and ephemeropterans tended to increase with current velocity to 70 cm/sec, but oligochaetes were most numerous at current speeds of 11-30 cm/sec. Maximum density of rock fauna occurred at the stone-face earth core dike. Densities of rock fauna were highest where algal growth on the rocks was heaviest and current velocity greatest; lowest where algal growth was sparse and current velocity was low. Dike fields had the most diverse fish community. Among the 26 species of fish collected, five species comprised nearly 2/3 of the catch: carp (18.3%), white bass, (15.6%), white sucker (13.7%), yellow perch (10.2%), and river carpsucker (7.8%).
W85-06902

DUCK BREEDING ECOLOGY AND HARVEST CHARACTERISTICS ON GRAND RIVER MARSH WILDLIFE AREA,

Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 2H.
W85-06903

STUDY OF CUTOFF BENDWAYS ON THE TOMBIGBEE RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. H. Pennington, J. A. Baker, F. G. Howell, and C. L. Bond.
Technical Report E-81-14, November 1981. Final Report. 139 p, 43 Tab, 13 Fig, 62 Ref.

Descriptors: *Environmental effects, *Channel improvements, *Aquatic life, *Meanders, *Rivers, Oxbow lakes, Tombigee River, Tennessee-Tombigbee Waterway, Waterways, Canals, Water quality Sediments, Phytoplankton, Algae, Aquatic plants, Water willow, Macrophytes, Mollusks, Invertebrates, Fish, Aquatic animals, Bendways.

Biological and physical data were collected in four bendways at various stages of being cut from the main navigation channel during construction of the Tennessee-Tombigbee Waterway. The substrate of the study area showed changes from a sand-gravel-fines mixture toward sand-fines. Areas within some bendways were accumulating sediment, particularly in the upper areas. Few significant changes in water quality were measured. Phytoplankton composition and chlorophyll concentrations varied little among the bendways. Phytoplankton were more numerous in the bendways than in the river itself. Aquatic macrophytes were scarce and scattered; water willow was most often encountered. The macroinvertebrate community was consistent among the bendways. Although 60 families were found, 9 accounted for over 90% of the benthos. Eighteen species of Unionid mollusks (including the rare Pleurobema) and the Asian clam were collected. In the two bendways closed during the survey period the common fish were shad, sunfish, crappy, and bass. The bendways with more riverine habitats contained minnows, catfish, and sucker. The cutoff bendways were expected to provide fish and wildlife habitats not found along the main channel.
W85-06928

EFFECT OF PEAT MINING ON FISH AND OTHER AQUATIC ORGANISMS IN THE UPPER MIDWEST.
Camp, Dresser and McKee, Inc., Milwaukee, WI. Environmental Sciences Div.
For primary bibliographic entry see Field 4C.
W85-06936

BIOLOGICAL AND ECONOMIC IMPACT OF STREAM ALTERATION IN THE VIRGINIA PIEDMONT,
Virginia Cooperative Wildlife Research Unit, Blacksburg.
J. B. Whelan, O. Maughan, L. A. Shabman, and M. Mauney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-128025. FWS/OBS-81/33, July 1982. Fish and Wildlife Service, Kearneysville, WV. Eastern Energy and Land Use Team. 47 p, 2 Fig, 17 Tab, 25 Ref, 1 Append. Contract/Grant No. 14-16-0008-1146.

Descriptors: *Channeling, *Ecological effects, *Vegetation, Cost-benefit analysis, *Wildlife, *Streams, *Land use, *Agricultural watersheds, *Wildlife habitats, Stream stabilization, Environmental effects, Benthos, Birds, Fish, Cropland, Watersheds, Species diversity.

A 31 month study was made of the effects of channelization on the aquatic/riparian wildlife resources and agricultural land-use patterns of several Peidmont streams. Recently channelized streams lacked overstory cover but had an abundant understory cover. Unchannelized streams had a larger diversity of plants plus a larger percentage of trees over 46 m tall. No major differences in water quality parameters were noted between channelized and control streams. Channelized streams had greater deposits of sand. Evenness diversity for fish and benthic communities was lower in channelized streams. Channelized streams had increased populations of Chironominae tolerant of unstable sand substrates. The shallow surface discharge impoundments associated with channelized streams appeared to have highly localized impact on the downstream benthic macroinvertebrate and fish communities. During the bird breeding season, bird species richness and diversity increased with age since channelization of the stream. No significant differences were found among study sites for either total number of small mammals or their species diversity indices. Recommendations for stream channeling are given that minimize environmental disturbances. The Roanoke Creek Watershed Work plan projected a favorable cost-benefit ratio but failed to encourage large-scale cropping of bottomland areas.
W85-06956

ENVIRONMENTAL EFFECTS OF TENNESSEE-TOMBIGBEE PROJECT CUTOFF BENDWAYS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. H. Pennington, and J. A. Baker.
Miscellaneous Paper E-82-4, U.S. Army Environmental and Water Quality Operational Studies, August 1982. Final Report. 24 p, 4 Fig, 56 Ref.

Descriptors: *Bendways, *Fish populations, *Macroinvertebrates, *Phytoplankton, *Bottom sediments, *Aquatic habitats, *Aquatic plants, *Baseline studies, Bass, Macrophytes, Fathead minnows, Sucker, Crappie, Sunfish, Mollusks, Species composition, Fluvial sediments, Impoundments, Navigable rivers, Chlorophyll.

Biological and physical data were collected from four bendways within the river portion of the Tennessee-Tombigbee Waterway before the bendways were severed from the main navigational channel. Sediment analysis and bottom profiles showed that the substrate composition of some of the bendways is changing, in general from sand-gravel-fines mixtures to sand-fines mixtures. Few significant differences were found in water quality, chlorophyll concentrations or phytoplankton composition among bendways. Aquatic macrophytes were scattered and uncommon in the four bendways. Water-willow (Justica sp.) was most commonly encountered. A consistent macroinvertebrate assemblage characterized the four bendways. Variations in importance of macrophyte families among bendways were attributed to differences in substrate type and current velocities. Based on overall ichthyofaunas, two groups of bendways were delineated that corresponded to impoundment and riverine habitats. Where impoundment conditions prevailed, shad, sunfish, crappies and bass were dominant. Riverine and lacustrine habitats were faunistically similar to riverine habitats which were dominated by minnows, catfish, and suckers.
W85-06965

BALTIMORE HARBOR AND CHANNELS DEEPENING STUDY: CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
M. A. Granat, and L. F. Gulbrandsen.
Technical Report HL-82-5, February 1982. Final Report. 174 p, 14 Fig, 18 Tab, 100 Plates.

Descriptors: *Salinity, *Environmental effects, *Channel improvement, *Channel flow, *Harbors, *Bays, *Hydraulic models, *Model studies, Tides, Channels, Navigation, Flow velocity, Models, Dredging, Salinity currents, Ecological effects, Water resources development.

A series of base tests using the verified Chesapeake Bay model were conducted for the Baltimore Harbor and approach navigation channnels at 42 ft plus a 2-ft dredging tolerance (base) and at the newly authorized 50-ft depth plus a 2-ft dredging tolerance (plan). Velocity measurements were taken at 13 selected stations while salinity and tide height measurements were collected at 68 and 10 locations, respectively. No major plan-to-base velocity differences were apparent in steady state comparisons; however, slight trends in velocity characteristics may indicate subtle variations in the hydrodynamics of the system. Appreciable salinity differences were found in the bay entrance and York Spit Channel area, generally with saltier surface values during the plan test. The James and York Rivers showed appreciable salinity intrusion decreases during the plan test. Major salinity differences were found at upper bay stations from Kent Island and above. The water column during the plan test was more stratified with fresher surface values and saltier mid-depth and bottom values compared with the base test. The largest salinity variations occured in the deepened channel of the Patapsco River. Salinity differences were found to decrease with distance from the deepened channels and at shallower water stations.
W85-06968

LARVAL FISH OF SELECTED AQUATIC HABITATS ON THE LOWER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. V. Conner, C. H. Pennington, and T. R. Bosley.
Technical Report E-83-4, February 1983. Final Report. 45 p, 10 Fig, 14 Tab, 45 Ref.

Descriptors: *Mississippi River, *Fish, *Species diversity, *Larvae, *Aquatic habitats, *Dikes, *Ecological effects, *Environmental effects, *Seasonal variation, Shad, Minnows, Silverside, Bluegills, Sucker, Carpsucker, Drum, Sunfish, Embankments.

A study was made of the effects of dike fields, revetted banks, and other habitats on fish larvae of the Lower Mississippi River (miles 505-525) from April through October 1980. The seasonal changes in the local distribution of ichthyoplankton within a dike field were also characterized. Qualitatively, a basic dichotomy was observed among the six main-stem locations sampled. During high and moderate river stages, shad dominated the collections at all main-stem locations. During periods of lower river stages, drum, carpsucker, and minnows dominated main-channel locations. The Lower Cracraft Dike Field exhibited greater larval fish diversity and abundance at open water stations than nearshore stations when river stage conditions were high to moderate. When the river stage conditions were moderate to low, the diversity of fish was also low at all major habitats. Under low water conditions the dike field ichthyoplankton showed two communities. Fish inside the middle bar were mainly shad, bluegills, and silverside. The community along the riverside of the middle bar was similar to that of the main channel.
W85-06969

MOVEMENT, TRANSPORT, AND SCOUR OF PARTICULATE ORGANIC MATTER AND AQUATIC INVERTEBRATES DOWNSTREAM FROM A PEAKING HYDROPOWER PROJECT,
Arizona Univ., Tucson.
W. Matter, P. Hudson, J. Nestler, and G. Saul.
Technical Report E-83-12, May 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 59 p, 22 Fig, 2 Tab, 54 Ref, 1 Append.

Descriptors: *Hydroelectric plants, *Invertebrates, *Water quality, *Organic matter, *Benthos, *Environmental effects, *Reservoir releases, Lake Hartwell, Savannah River, Hypolimnion, Particulate matter, Rivers, Detritus, Powerplants, Electric power production, Peaking capacity, Insects, Phytoplankton, Multipurpose reservoirs, Chlorophyll, Periphyton, Zooplankton, Aquatic plants, Macrophytes, Oligochaetes, Algae, Tailwater, Ecological effects, Benthic fauna, Benthic flora, *Aquatic habitats.

The Savannah River below Lake Hartwell, Georgia-South Carolina, receives hypolimnetic water discharged from the reservoir for peak power generation. Invertebrates and particulate organic material (POM) in the water column were collected during a 24-hr release cycle at sites 1.0, 4.5, and

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12.5 km downstream from the dam. Water released during generations reached a maximum discharge of 688 cu m per sec. River discharge was less than 10 cu m per sec during nongeneration periods. Highest POM concentrations were associated with the initial downstream surge of water at the start of power generation; values were 200 to 400 times greater than those during nongeneration periods. POM concentrations rapidly decreased to less than one tenth of the initial surge levels during high flow. Much of the POM originated in the tailwater, and concentrations increased at successive downstream sites. Of the drifting invertebrates, 80 to 93 percent originated in the reservoir; the rest, primarily Oligochaeta, Diptera, and Ephemeroptera, were from the tailwater. Densities of benthic invertebrates were highest during passage of the initial release surge, whereas densities of invertebrates originating in the reservoir peaked 2 to 3 hr after the initial surge at each station, during maximum release. Densities of drifting benthic organisms decreased rapidly after the initial surge and increased with increasing distance downstream. (Author)
W85-06973

SEASONAL AND SPATIAL DISTRIBUTION OF ZOOPLANKTON IN A FLOOD CONTROL RESERVOIR AND TAILWATER,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
J. F. Novotny, and R. D. Hoyt.
Miscellaneous Paper E-83-3, October 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 19 p, 4 Fig, 23 Ref.

Descriptors: *Zooplankton, *Ecological effects, *Crustaceans, *Aquatic populations, *Population density, *Environmental effects, *Reservoir operation, Seasonal variation, Reservoirs, Predation, Rotifers, Aquatic habitats, Population dynamics, Tailwater.

Zooplankton, when available, may be an important food source for fish fry in lotic habitats. The effects of flood control reservoir operation on the downstream transport of reservoir zooplankton (both microcrustaceans and rotifers) were quantified by examining zooplankton abundances in Barren River Lake, Kentucky, and three downstream stations from August 1980 - August 1981. The decrease noted in microcrustacean and rotifer abundance downstream from the dam was attributed to predation, physical destruction, and lack of suitable habitat. During stratification (May - September), the abundance of zooplankton was greater in the tailwater than in the reservoir hypolimnion; this difference in abundance suggests that water and associated organisms were being withdrawn from upper levels in the reservoir--as well as from the hypolimnion, where most of Barren River Lake's releases come from and which normally harbors few viable zooplankters. The unstratified reservoir usually contained higher densities of zooplankton than the tailwater. The results of the study led to the conclusion that implementation of operational procedures to increase discharge of reservoir zooplankton to the tailwater may not be warranted since the complexity of factors determining reservoir zooplankton dynamics precludes their use as a reliable food source for tailwater biota. (Author's abstract)
W85-06984

EFFECTS OF PERMANENTLY RAISED WATER TABLES ON FOREST OVERSTORY VEGETATION IN THE VICINITY OF THE TENNESSEE-TOMBIGBEE WATERWAY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. V. Klimas.
Miscellaneous Paper E-82-5, U.S. Army Environmental and Water Quality Operational Studies, August 1982. Final Report. 31 p, 2 Tab, 131 Ref.

Descriptors: *Trees, *Water table rise, *Water stress, *Environmental effects, *Ecological effects, *Forests, *Oxygen depletion, *Impoundments, Water table fluctuations, Water table, Environmental impact statement, Reviews, Roots, Root zone, Oxygen deficit, Saturated soils, Saturation.

The probable effects of raising the water table on trees in the vicinity of planned impoundments along the Tennessee-Tombigbee Waterway are investigated. Raised water tables can detrimentally affect trees by causing oxygen depletion in the root zone. The ability of a tree to withstand this type of stress may be related to tree species, rooting depth, soil conditions, and the timing, duration, and frequency of encroachment of the water table into the root zone. Occasionally, trees may exhibit improved growth as a result of raised water tables, but this response may be short-lived. The forest communities likely to be most sensitive to partial root-zone saturation are those typically found on well-drained upland sites. Swamp forest communities are generally much less sensitive to increases in site moisture status and may show only decreased long-term growth and reproduction. In complex floodplain forest communities responses to raised water tables may range from near-complete mortality in areas where permanent surface saturation occurs to no effect or growth rate increases in areas where very minor subsurface water table rises occur. Except in areas where extreme stresses are anticipated, only very general impact predictions may be made.
W85-06993

DREDGE INDUCED TURBIDITY PLUME MODEL,
William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
A. Y. Kuo, C. S. Welch, and R. J. Lukens.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 111, No. 3, p 476-494, May, 1985. 7 Fig, 5 Tab, 11 Ref. US Army Corps of Engineers, Norfolk District contract DACW 65-78-C-0029.

Descriptors: *Dredging, *Turbidity, *Plumes, *Sediments, *Model studies, Channels, Environmental impact, Suspended sediments.

A model was developed to describe the turbidity plume induced by dredging a ship channel using an hydraulic dredge. The model predicts the suspended sediment concentration within the plume and the resulting sediment deposition alongside the dredged channel. The model applies to a dredging operation in a water body in which the current is primarily along the channel axis and the channel depth is large enough that no significant suspended sediment reaches water surface. Results of field measurements were compared with model results. The model describes the qualitative feature of prototype data and the calibrated model parameters agree with independent observations by other investigators. (Author's abstract)
W85-07078

INDUSTRIAL DEVELOPMENT WITHOUT ENVIRONMENTAL POLLUTION: ROLE OF ENVIRONMENTAL IMPACT ASSESSMENT (EIA),
Cremer and Warner Ltd., London (England).
E. Turner.
Asian Environment, Vol. 6, No. 4, p 27-36, 1984. 7 Ref.

Descriptors: *Environmental impact statement, *Water resources development, *Environmental effects, Management, Planning, Decision making, Water management.

The idea of the Environmental Impact Assessment (EIA) grew out of the emotionally charged era of the mid to late nineteen sixties with the chilling revelations about DDT in food chains, Minimata disease and various limitations in our living space. Some countries have published guidelines as to what is required in the preparation of an EIA. Even in countries where no formal procedures are laid down ad hoc arrangements are made for the environmental assessment of major projects. In a comprehensive EIA the breadth of topics to be covered is very wide. The actual disciplines and expertise are dictated by the nature of the project and its intended location. The study team should be professionally independent of both the developers and the controlling authorities to avoid any bias in judgement. To be useful the EIA must be an interactive process. There has to be cooperative teamwork between industrial developers, controlling authorities and the EIA Study Team. There are two main criticisms of EIAs. First, they delay projects and escalate costs. Second, they divert qualified professionals from productive work. Matters to be considered in designing an EIA are discussed, including deciding what to study, choosing the right team, a management plan, and a definition of the baseline data requirements. (Baker-IVI)
W85-07111

7. RESOURCES DATA

7A. Network Design

OPTIMAL SAMPLING STRATEGIES FOR SOURCE IDENTIFICATION IN ENVIRONMENTAL EPISODES,
Iowa Univ., Iowa City. Dept. of Geography.
For primary bibliographic entry see Field 5A.
W85-06283

DEVELOPING OBJECTIVES FOR THE GROUND WATER QUALITY MONITORING NETWORK OF THE SALINAS RIVER DRAINAGE BASIN,
Geological Survey, Menlo Park, CA.
P. Showalter.
Ground Water Monitoring Review, Vol. 5, No. 2, p 37-45, 1985. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Groundwater, *Monitoring networks, *Salinas River basin, *California, *Water quality management, Networks, Planning.

Objectives are described that were developed and applied to design a groundwater quality monitoring network for the Salinas River drainage basin in central California. Four agencies worked together: the USGS as network designer, the Central Coast Regional Water Quality Control Board as network manager, and Monterey and San Luis Obispo county agencies as data providers. After investigating the basin's groundwater quality problems, a list of objectives was developed. These objectives were written as concise statements. The network designers and managers arranged the objectives in the order of importance and set priorities for them. An ideal network was designed to meet all of the monitoring objectives. In the ideal network exercise, budget and manpower constraints were ignored. Each monitoring location was chosen for a specific objective or group of objectives. The ideal network was compared with the existing network to identify where both more and less monitoring was needed. Then a proposed network was chosen. The ideal and existing networks were composited to produce the proposed network, but budget and manpower were considered. To keep the network at a realistic size, monitoring was only recommended to meet the most important objectives. Existing monitoring sites were retained to meet any of the objectives. (Author's abstract)
W85-06830

ANALYTICAL METHODS FOR THE PREDICTION OF LEACHATE PLUME MIGRATION,
Oklahoma State Univ., Stillwater. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W85-06831

LYSIMETERS ALLOW QUICKER MONITORING OF HEAP LEACHING AND TAILING SITES,
Environmental Services International, Denver, CO.
For primary bibliographic entry see Field 5G.
W85-06838

Group 7A—Network Design

PRECIPITATION GAGE NETWORK OPERATIONS FOR WINTERTIME RESEARCH IN THE CENTRAL SIERRA NEVADA,
Atmospherics, Inc., Fresno, CA..
For primary bibliographic entry see Field 2B.
W85-06925

NETWORKS PLANNING FOR WATER INVESTIGATIONS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Journal of Environmental Systems, Vol. 14, No. 4, p 355-372, 1984-85. 4 Fig, 2 Tab, 30 Ref.

Descriptors: *Data acquisition, *Networks, *Planning, Netherlands, Great Britain, Groundwater, Surface waters, Wastewater, Precipitation, Monitoring.

The systematic acquisition of basic data is indispensable for all levels involved in the preparation of environmental interventions. In effect, data acquisition networks concerning water resources provide the bases on which managers and investors alike depend for determining the viability of industrial, urban, or agricultural development. Data acquisition networks permit consideration of the present and future availability of water as a function of technology. Data must be collected on surface water, groundwater, wastewaters, and precipitation. The data acquisition network must permit not only an evaluation of the quantity and quality of actual water reserves but also the determination of water availability in space and time. The methods for acquiring water quality data are analyzed, based on a case study of methods employed in Great Britain and in the Netherlands. The groups responsible for the data acquisition network are described by analyzing their objectives, techniques, successes and failures, efficiency, financial backing, personnel, and methods of data treatment. In Great Britain, the central government exercises an important control over administrative activities in the basin. The basin administrations have been given a key role in the collection and analysis of basic data and information. The Netherlands was among the first to set up governmental services to protect the environment: RID (drinking water); RIZA (wastewater treatment); and RIV (in charge of monitoring water supplies). (Moore-IVI)
W85-07098

7B. Data Acquisition

MICROCLIMATE OF A RAINFALL SHELTER,
Texas Agricultural Experiment Station, Temple. Blackland Research Center.
For primary bibliographic entry see Field 2I.
W85-06185

REGIONAL-SCALE ESTIMATES OF SURFACE MOISTURE AVAILABILITY FROM GOES INFRARED SATELLITE MEASUREMENTS,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
T. N. Carlson, F. G. Rose, and E. M. Perry.
Agronomy Journal, Vol. 76, p 972-979, November-December, 1984. 7 Fig, 1 Tab, 18 Ref.

Descriptors: *Moisture availability, *Satellite technology, *Infrared imagery, *Kansas, *Nebraska, Remote sensing, Measuring instruments, Soil water, Surface temperature, Precipitation.

A method for obtaining remotely a measure of surface moisture, called moisture availability, is derived here using satellite infrared surface temperature measurements in conjunction with a numerical boundary layer model. Results are presented largely in the form of a statistical comparison between rainfall and soil moisture patterns. The analyses demonstrate a statistically significant log-linear relationship between moisture availability, as determined from satellite infrared measurements, and the antecedent precipitation for the region of eastern Kansas and Nebraska during two summers of drought, 1978 and 1980. This result is remarkable in view of the fact that the temperature measurements are spatial averages of an immensely complex surface and substrate consisting of a wide variety of land use types and vegetation. Consistent results were obtained within the 1980 cases, and an inference can be made that the 1978 and 1980 ground conditions were different. The similarity of the results using day-night and morning-afternoon image pairs suggest that polar-orbiting satellites, such as the NOAA vehicles, would also provide satisfactory measurements for determining regional-scale patterns of soil moisture availability. (Baker-IVI)
W85-06188

SOIL SURFACE PSYCHROMETER FOR MEASURING HUMIDITY AND STUDYING EVAPORATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
V. A. Seymour, and T. C. Hsiao.
Agricultural and Forest Meteorology, Vol. 32, No. 1, p 61-70, July, 1984. 5 Fig, 11 Ref. California Dept. of Water Resources Contracts B53844 and B53812.

Descriptors: *Psychrometers, *Humidity, *Evaporation, *Soil surface, Soil water potential, Measuring instruments, Evapotranspiration, Model studies.

A field instrument is presented for determining soil surface humidity. The instrument, based on thermocouple psychrometry, is able to measure the humidity above surfaces of saturated salt solutions fairly accurately except at the highest relative humidities where the estimates were a few percentage points lower than theoretical values. Tests over soil of known water potential, hence known relatively humidity, were conducted at similar high humidities and the results showed an underestimation of similar magnitude. Field trials demonstrated that it is possible to measure the daily course of vapor pressure of the soil surface and of the bulk air as the soil dries, and to use those values to obtain the cumulative vapor pressure difference through the day. The cumulative differences appears to be a good predictor of evaporation from a soil surface in the field under natural crop conditions. (Baker-IVI)
W85-06197

PORTABLE EVAPORIMETER FOR RAPID MEASUREMENT OF THE EVAPORATION RATE OF WATER,
RCA Labs., Princeton, NJ.
For primary bibliographic entry see Field 2D.
W85-06199

QUANTIFYING EFFECTS OF ATMOSPHERIC CO2 ENRICHMENT ON STOMATAL CONDUCTANCE AND EVAPOTRANSPIRATION OF WATER HYACINTH VIA INFRARED THERMOMETRY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2D.
W85-06202

EFFECT OF VEGETATION ON SOIL MOISTURE SENSING OBSERVED FROM ORBITING MICROWAVE RADIOMETERS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2G.
W85-06215

CALIBRATION OF NEUTRON MOISTURE METERS ON STONY SOILS (NOTE),
Ministry of Agriculture and Fisheries, Ashburton (New Zealand). Winchmore Irrigation Research Station.
R. V. Stocker.
Journal of Hydrology, (New Zealand), Vol. 23, No. 1, p 34-36, 1984. 1 Tab, 2 Ref.

Descriptors: *Moisture meters, *Soil properties, *Soil water, Measuring instruments, Moisture content.

A technique is described to calibrate neutron moisture meters in soils with stone content up to 60%. The slope of the relationship between neutron count ratio and soil water content of a neutron moisture meter varies by up to 10% for a range of Canterbury stony-soil types. The method of calibration is to measure the count ratio on an in situ soil and then to determine the volumetric moisture content of the measured soil. This is repeated over a range of soil moistures to derive a linear regression between soil moisture and count ratio. Installation and procedure are described in a sample case. (Baker-IVI)
W85-06435

MISSISSIPPI RIVER OUTFLOW PATTERNS SEEN BY SEASAT RADAR,
Hawaii Inst. of Geophysics, Honolulu. Planetary Geosciences Div.
For primary bibliographic entry see Field 2L.
W85-06519

TIME DOMAIN REFLECTOMETRY FIELD MEASUREMENTS OF SOIL WATER CONTENT AND ELECTRICAL CONDUCTIVITY,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W85-06539

EXPERIENCE IN THE USE OF SATELLITE PHOTOGRAPHS FOR ENGINEERING-GEOLOGICAL CHARACTERIZATION OF CONSTRUCTION SITES OF HYDRAULIC STRUCTURES,
A. L. Strom.
Hydrotechnical Construction, Vol. 18, No. 2, p 53-55, February, 1984. 2 Fig, 5 Ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 2, p 13-15, February, 1984.

Descriptors: *Remote sensing, *Satellite technology, *Geology, Dam construction, Site selection, Reservoir siting, Earthquakes, Seismic properties, Soil properties, Satellite photography.

The selection of an optimal site is of decisive importance when constructing important hydraulic structures, especially large dams. Satellite photographs of a local level of generalization have been successfully shown to provide the necessary detail for determining many characteristics of various sites. Results are provided from satellite photos for regional and detailed characterization of engineering-geologic conditions of a valley of one of the rivers of Central Asia distinguished by a complex geological structure and, presumably an extremely high level of seismicity. The good geomorphologic expression of active faults makes it possible to identify them on the satellite photos with sufficient certainty without conducting field verification. A greater number of dislocations were detected than has been previously described in the literature. Some of them were found in the immediate vicinity of narrow stretches of the valley which with respect to their morphology are favorable for constructing dams. This attests to the increased seismic danger of such stretches, which made it possible to eliminate them from further consideration. On the basis of an analysis of satellite photos and the literature data on the geology, neotectonics, and seismicity in the investigated region, the most probable zones of occurrence of foci of strong earthquakes were established. Detailed photointerpretation made it possible to obtain an idea not only about fault tectonics and structure of the unconsolidated cover but also about jointing of the rock mass and to distinguish blocks markedly differing both in the density of joints and faults and in the number of their systems. Since jointing to a considerable extent determines such important characteristics of a rock foundation as its seepage and elastic-strength properties, the data obtained are quite important both for comparing the investigated area with other sites and for selecting the best site within it. (Baker-IVI)
W85-06589

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NIMBUS-7 SMMR POLARIZATION RESPONSES TO SNOW DEPTH IN THE MIDWESTERN U.S.,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2C.
W85-06636

SURFACE TEMPERATURE VARIABILITY PATTERNS WITHIN IRRIGATED FIELDS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 3F.
W85-06688

MODIFICATIONS TO ELECTROLYTIC RESPIROMETER SYSTEMS FOR PRECISE DETERMINATION OF BOD EXERTION KINETICS IN RECEIVING WATERS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
C. W. Hickey, and J. W. Nagels.
Water Research, Vol. 19, No. 4, p 463-470, 1985. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Respirometer, *Biochemical oxygen demand, Kinetics, Benthic oxygen, Dissolved oxygen, Toxicity, Water quality control, Monitoring.

Modifications to a commercially available electrolytic biochemical oxygen demand device, required to provide a system capable of obtaining reliable results at low levels of BOD are described. The electrolytic respirometric system produced is independent of atmospheric pressure and temperature fluctuations. Major sources of error in measurement have been minimized with careful initial temperature equilibration followed by operation with a high oxygen mass transfer coefficient, a high liquid to gas ratio within the reactor system, and with the potassium hydroxide trap removed to prevent carbon dioxide depletion. Nomographs have been presented to allow the calculation of the maximum deficit and the apparent lag time for respirometric gas exchange systems. Some apparent lag must result in such systems because of the oxygen depletion needed to trigger the electrolysis cell. (Baker-IVI)
W85-06734

FAMILY OF PNEUMATICALLY-OPERATED THIN LAYER SAMPLERS FOR REPLICATE SAMPLING OF HETEROGENEOUS WATER COLUMNS,
New Hampshire Univ., Durham. Dept. of Botany and Plant Pathology.
A. L. Baker, K. K. Baker, and P. A. Tyler.
Hydrobiologia, Vol. 122, No. 3, p 207-211, March, 1985. 5 Fig, 4 Ref.

Descriptors: *Samplers, *Thin layer samplers, Stratification, Microstratification, Water analysis.

Characteristics and field performance of a series of four pneumatically-operated thin layer samplers (TLS) are described. All models of TLS employ 60 ml transparent plastic syringes. The samplers can be operated from small boats, and permit sampling at 2.5-cm intervals with little or no disturbance of stratified systems such as oxyclines or redoxclines of meromictic lakes, or microstratification of flagellates in sheltered epilimnia. Performance of the samplers is illustrated by the examples of distribution of in vivo fluorescence attributable to a population of chloromonad flagellates, and vertical profiles of pH, measured electrochemically in the field, and of dissolved oxygen, in a lake. Multiple-row versions of the samplers permit replicate sampling at close intervals in a two-dimensional array, for statistical purposes or for simultaneous sampling of more than one chemical, physical, or biological parameter, with the assurance that the horizontal relationships among parameters are maintained. (Rochester-IVI)
W85-06787

APPLICATION OF LANDSAT SATELLITE DATA FOR MAPPING AQUATIC AREAS IN NORTH-EASTERN FINLAND,
Oulu Univ. (Finland). Dept. of Astronomy.
J. Raitala, H. Jantunen, and J. Lampinen.
Aquatic Botany, Vol. 21, No. 3, p 285-294, March, 1985. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Satellite technology, *Mapping, *Finland, *Lake Yli-Kitka, *Lake Posionjarvi, Multispectral scanners, Computers, Remote sensing, Vegetation, Wetlands, Aquatic plants, Turbidity.

Aquatic phenomena and complexes were extracted from Landsat multispectral scanner (MSS) data obtained from images of western Lake Yli-Kitka and Lake Posionjarvi, Finland. Lake subscenes of the Landsat MSS data 206-13 of 15 July 1979, consisting of four spectral bands (Band 4, 500-600 nm, Band 5, 600-700 nm, Band 6, 700-800 nm, and Band 7, 800-1, 100 nm) were cut and processed using the Univac 1100/22 computer system and relevant calculation packages. Classes identified by symbols and used for delineation of areas within the lakes were, for Yli-Kitka, open lake (with four subgroups based on depth, Secchi disc depth, and vegetation), shallow muddy-bottomed wetlands, wetlands vegetated with helophytes in shallow water, and densely vegetated shore, including some geolittoral mixed pixels. For Lake Posionjarvi, three classes were used: turbid, dystrophic open lake, shoaly with sparse nymphaeids; extremely turbid water, shallow vegetated area with muddy bottom; and complex of small islets and shallow water, densely vegetated, shallow, with a muddy shore. The mapping method is valid for large surface areas only. In some cases it seemed to be impossible to separate thin aquatic vegetation from turbid water. The need for aquatic area classification and mapping improvement mostly arises from the large (0.5 ha) pixel area on the surface, and the width of MSS sensor spectral bands, which allow only surface complexes of large area to be identified. The main application of Landsat mapping should be in preparing multitemporal studies over large areas. (Rochester-IVI)
W85-06805

COMPARISON OF SAMPLING MECHANISMS AVAILABLE FOR SMALL-DIAMETER GROUND WATER MONITORING WELLS,
IEP, Inc., Worthington, OH.
For primary bibliographic entry see Field 2F.
W85-06834

EFFECT OF TILT ON SEDIMENT TRAP EFFICIENCY,
Lamont-Doherty Geological Observatory, Palisades, NY.
W. D. Gardner.
Deep-Sea Research, Vol. 32, No. 3, p 349-361, March, 1985. 5 Fig, 2 Tab, 30 Ref.

Descriptors: *Tilt, *Sediment traps, *Hudson River, *New York, Sediment transport, Sediment sampler, Trap efficiency, Boundaries.

Cylindrical traps with an aspect ratio of 5.2 were tilted from 0 degrees to 70 degrees upstream and downstream in the Hudson River with currents ranging between 2 and 62 cm/s. Particle flux in the tilted traps increased with tilt up to about 45 degrees where overcollection reached a maximum factor of three but decreased beyond 45 degrees when traps were tilted downstream. There was no discernible velocity effect on the total flux collected with tilted traps. In a recirculating flume, dye used as a water tracer revealed the existence of boundary layers within traps. The exchange of particles across the boundaries appears to play an important role in controlling the collection rate of particles and the conditions during which traps over- and under-collect particles. The tilt effect on traps is important, not only where high velocities can cause a mooring to lean, but also where high-frequency internal waves might pass either moored or freefloating traps since the vertical velocity component of an internal wave can cause an effective tilt of the traps. (Author's abstract)
W85-06850

AERIAL SURVEY TECHNIQUES TO MAP AND MONITOR AQUATIC PLANT POPULATIONS: FOUR CASE STUDIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
E. A. Dardeau.
Technical Report A-83-1, January 1983. Final Report. 49 p, 16 Fig, 4 Tab, 11 Ref.

Descriptors: *Aerial photography, *Aquatic plants, *Infrared imagery, *Aquatic populations, *Mapping, *Plant populations, *Case studies, *Macrophytes, Surveys, Watermilfoil, Hydrilla, Submerged plants.

From 1977 to 1981, the U.S. Army Engineer Waterways Experiment Station conducted numerous aerial survey studies in conjunction with the U.S. Army Corps of Engineers Aquatic Plant Control Research Program to develop unique photointerpretation and mapping procedures and computer software for processing aerial survey maps of aquatic macrophyte populations. Four of these studies are highlighted in this report. At the Lewis Creek Reservoir, Texas, a comparison was made of automated and manual techniques to compute areal coverage of hydrilla on two scales of aerial photography. A comparison of boat and aerial surveys of giant cutgrass was conducted at Lake Seminole, Alabama-Florida-Georgia. At Gatun Lake, Panama, the growth of hydrilla in a tropical environment was studied by aerial techniques. At Lake Osoyoos, Washington, the changes in a community dominated by Eurasian watermilfoil were studied over a 1-yr period. These four case histories provide examples of the use of three scales/ranges of nominal scale of aerial photography to detect and map the distribution of submerged aquatic plant populations. Photointerpretation of smaller scale imagery (1:24,000) was more difficult than the scales used in the case studies. Regardless of scale, submerged populations were easier to detect on color than on color infrared imagery. Emergent plants were easier to detect on aerial imagery than submerged plants.
W85-06955

INSTRUMENT FOR THE IMMEDIATE QUANTIFICATION OF BACTERIA IN POTABLE WATERS,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5A.
W85-07130

APPLICATION OF A SIMPLIFIED METHOD FOR RECOVERY OF YERSINIA ENTEROCOLITICA FROM SURFACE WATERS,
Aquila Univ. (Italy). Ist. d'Igiene.
For primary bibliographic entry see Field 5A.
W85-07135

7C. Evaluation, Processing and Publication

MATRIX AND ACCOMPANYING CLASSIFICATIONS FOR IDENTIFYING WATER RESEARCH PROBLEMS AND NEEDS,
Ohio Agricultural Research and Development Center, Wooster.
For primary bibliographic entry see Field 6A.
W85-06246

POWER OF THE ELECTRONIC WORKSHEET: MODELING WITHOUT SPECIAL PROGRAMS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
For primary bibliographic entry see Field 2F.
W85-06828

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 7: MANAGEMENT OF ECOLOGICAL DATA IN LARGE RIVER ECOSYSTEMS,
Army Engineer Waterways Experiment Station,

Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W85-06899

COMPUTER-ASSISTED DATA PROCESSING AND ANALYSIS SYSTEM FOR GROUND-BASED METEOROLOGICAL DATA COLLECTION,
Atmospherics, Inc., Fresno, CA..
R. Allan, S. Barnes, M. Solak, and T. Henderson.
Technical report AISCP-842, June 1984. 47 p, 11 Fig, 2 Photos, 7 Ref, 5 Append. Contract/Grant No. 9-07-85-V0020.

Descriptors: *Data acquisition, *Data processing, *Weather modification, *Computers, Computer programs, Sierra Cooperative Pilot Project, Quality control, Meteorological data collection, Data collections, Graphical analysis, Statistical analysis.

A computer system was developed to aid in processing and analysis of data collected from ground-based instrument systems in the Sierra Cooperative Pilot Project. Included are the primary programs used in data processing and analysis, quality control in data processing, and a complete listing of all programs used in the project.
W85-06924

BASIC HYDROLOGY,
Memorial Univ. of Newfoundland, St. John's.
For primary bibliographic entry see Field 2A.
W85-06931

8. ENGINEERING WORKS

8A. Structures

EMPINGHAM DAM - DESIGN, CONSTRUCTION AND PERFORMANCE,
For primary bibliographic entry see Field 8D.
W85-06174

EMPINGHAM RESERVOIR - SEEPAGE CONTROL MEASURES,
For primary bibliographic entry see Field 8E.
W85-06175

CURRENT STATE AND PROBLEMS OF IMPROVING OPERATIONAL MONITORING OF THE SAFETY OF HYDRAULIC STRUCTURES,
E. K. Aleksandrovskaya.
Hydrotechnical Construction, Vol. 18, No. 9, p 405-409, September, 1984. 3 Tab, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 20-23, September, 1984.

Descriptors: *Safety, *Hydraulic structures, *Hydraulic equipment, *Monitoring, Measuring instruments, Dams, Automation, Inspection.

The experience of on-site observations and investigations at large dams, particularly at the Krasnoyarsk and Sayano-Shushenskoe, shows that the main problems of improving the organization and conduction of such observations and investigations to increase their effectiveness are as follows. The development of an optimal (unified for construction and operational monitoring) layout of the telemetric monitoring and measuring apparatus (MMA), should lead to a reasonable reduction of the number of instruments. Provision must be made for high quality installation of MMA and equipment of the control panels at all hydrostations under construction. The quality of sensors and frequency meters being manufactured must be improved. The development of automated systems providing for both automation of measurements and processing and analysis of the data of on-site observations with delivery of signals about emergency and preemergency situations must be accelerated. Skilled inspection of the safety of hydraulic structures must be provided starting from the instant of the first filling of the reservoir. (Baker-IVI)
W85-06707

POINTE COUPEE PUMPING STATION SIPHON UPPER POINTE COUPEE LOOP AREA, LOUISIANA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120159. Technical Report HL-82-21, September, 1982. Final Report. 35 p. 9 Tab, 6 Photos, 9 Plates, 15 Ref.

Descriptors: *Hydraulic models, *Pumping plants, *Siphons, Deflection, Model Studies, Head loss, Tailwater.

Hydraulic models were used to evaluate the hydraulic performance of the Pointe Coupee, Louisiana, pumping station siphon. A trap design was developed to ensure maintenance of the priming seal and to prevent excessive negative pressures at the siphon crown. The diameter of the siphon was reduced to obtain adequate priming velocities. Use of deflectors to induce priming was also tested. Pressure fluctuations and head losses were measured in the model. There is a definite scale affect in modeling a water and air mixture. The priming times in prototypes will be less than those observed in models. Conversely, the discharge that will wash out priming seal may be underestimated by a model. It is prudent, therefore, to provide a safety factor in the design of a vented trap's height. Siphon models should be constructed large enough to ensure reasonable air transport and to minimize scale effects. The recommended design siphon operated satisfactorily for the entire range of expected tailwaters and discharges.
W85-06961

SUMMARY REPORT: MODEL-PROTOTYPE COMPARISON STUDY OF DIKE SYSTEMS, MISSISSIPPI RIVER; POTAMOLOGY INVESTIGATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. J. Franco.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120144. Technical Report HL-82-11, May 1982. Final Report. 55 p. 30 Plates.

Descriptors: *Dikes, Prototypes, River mechanics, Hydraulic models, Mississippi River, Model studies.

Movable-bed model studies were conducted on seven of the most complex and troublesome reaches of the Mississippi River to obtain some quick general indications of the effectiveness of plans proposed for the improvement and stabilization of those reaches. The studies were conducted in an existing facility with little or no adjustment of the models and in some cases without a base test. Because of the limited size and shape of the facility, only a relatively short reach of the river including the problem could be reproduced in each model with little or no overbank areas. The horizontal scale varied with each depending on its size and shape and was much smaller with a higher distortion of the linear scales than is considered desirable for studies of this type. An analysis of the model results compared with developments in the river based on an evaluation of considerable prototype data indicated that the types of models used predicted most of the principal trends that actually occurred in the river with the plans tested. The degree of accuracy of the models varied and depended on the model adjustment, characteristics of the reach, flow conditions, and similarity between plan tested and actual construction. The analysis of model and prototype data permitted an evaluation of the performance of various types of dikes and dike systems and some of the principles involved in the developments within alluvial streams.
W85-06962

USER'S GUIDE: COMPUTER PROGRAM FOR DESIGN OR INVESTIGATION OF ORTHOGONAL CULVERTS (CORTCUL),
Dawkins (William P.), Stillwater, OK.
W. P. Dawkins.
Instruction Report K-81-7, March 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 191 p, 20 Fig, 3 Tab, 5 Ref, 3 Append. Contract/Grant No. DACW39-80-M-0334.

Descriptors: *Computer programs, *Computers, *Culverts, Design criteria, Design standards, Concrete, Stress analysis, Reinforced concrete.

This user's guide describes a computer program called 'CORTCUL' that can be used for design or investigation of orthogonal, reinforced concrete culverts by either working stress design (WSD) or strength design (SD) procedures. In the design mode, the program determines the required thicknesses and reinforcement areas for given soil loadings and culvert opening sizes. In the investigation mode, material stresses or factors of safety are calculated for specified structural geometries and loadings. The program was developed from specifications furnished by the Corps of Engineers' Computer Aided Structural Engineering (CASE) Task Group on Culverts and Conduits. It is written in Fortran and data may be provided either interactively from the user's terminal during execution or from a previously prepared data file. Input data are checked for consistency at the time of entry. Results generated in the design mode are presented in three parts: design thickness, design reinforcement areas, and design member load/force data. Investigation results are separated into two parts: summary of results and member load/force results.
W85-06985

RIPRAP STABILITY UNDER WAVE ACTION,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-07079

SCALING THE WEIGHT OF BREAKWATER ARMOR UNITS,
Memorial Univ. of Newfoundland, St. John's. Faculty of Engineering and Applied Science.
J. J. Sharp.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 111, No. 3, p 594-597, May, 1985. 4 Ref.

Descriptors: *Mathematical equations, *Model studies, *Breakwaters, Waves, Kinetics, Viscosity, Density, Oceans, Slopes, Froude number, Gravity, Velocity.

A mathematical equation is presented for calculating the weights of individual model armor units. Some general conclusions regarding the formulation of model laws are also presented. In some equations the implication is made that the density ratio should be the same in model and prototype. This is not necessarily so in practice. There is much evidence to suggest that this requirement may, within certain limits, be relaxed when dealing with densimetric flows. If the density ratio is permitted to vary, then great care should be taken in using any dimensionless parameter containing it, as a basis for formulating a model law. From the analysis as presented it is fairly obvious that it is not permissible to use a particular term for compounding, and then drop it from the list of model laws if the compounded term is to be used as a model law itself. Such compounded terms may arise directly from the dimensional analysis without having undergone any formal compounding process. Terms of this type are particularly prevalent if the analysis is performed using a reduced gravitational acceleration as is common in densimetric studies. This study has served to indicate the danger of using such terms of modeling without having due regard to their composition or to the other terms appearing in the dimensionless list. (Baker-IVI)
W85-07081

HYDRODYNAMIC PRESSURE ON SHORT-LENGTH GRAVITY DAMS,
Johns Hopkins Univ., Baltimore, MD.
A. A. Rashed, and W. D. Iwan.

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Journal of Engineering Mechanics, Vol. 110, No. 9, p 1264-1283, September, 1984. 10 Fig, 3 Tab, 7 Ref.

Descriptors: *Hydrodynamic pressure, *Gravity dams, Vibration, Ground motion, Mathematical equations, Compressibility, Waves.

Analytical expressions are derived for the hydrodynamic pressures generated in reservoirs behind short-length gravity dams, and resulting from vibrational motions of the dam and ground motions. The dams have vertical upstream faces. The reservoirs are assumed to have rectangular cross-sections, constant depths and to extend to infinity in the upstream direction. Water compressibility is taken into consideration, and solutions of the three-dimensional wave equation are obtained under both flexible and rigid boundary assumptions. The formulas obtained are used to calculate the hydrodynamic pressure for a range of geometries, and the results are presented in a form that clearly shows its dependence on the various parameters of the problem. The effect of the length to height ratio of the dam, and the significance of the cross-stream and vertical components of ground motion on the pressure response are investigated. (Author's abstract)
W85-07102

8B. Hydraulics

EFFECTIVE USE OF COOLING LAKES AND COOLING TOWERS IN HYBRID COOLING SYSTEMS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
T. W. Sturm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157675/AS, Price codes: A05 in paper copy, A01 in microfiche. Environmental Resources Center Report No. ERC 07-84, Georgia Institute of Technology, Atlanta, September 1984, 62 p, 1 Fig, 1 Tab, 23 Ref, Project No. USGS G-836 (07).

Descriptors: *Cooling lake, *Cooling tower, Evaporation, Hybrid cooling, *Power plant, *Stratification, Water resources.

The research summarized in this report analyzes the consequences of the use of hybrid cooling systems for the dissipation of waste heat from thermoelectric power generation. The hybrid cooling system studied consists of a combination of cooling towers and a cooling lake to receive a specified heat load. A transient computer simulation model of both the cooling lake stratification and the cooling tower thermodynamic performance is developed. The model is calibrated and verified with field data. Simulations of various combinations of cooling lake and cooling tower capacities for a given power plant heat load are conducted to determine the effect on lake thermal structure, total water loss by evaporation, and power plant intake temperatures. An optimum strategy for hybrid cooling system design is suggested based on these simulation results.
W85-06314

CHARTS FOR WATER HAMMER IN HIGH HEAD PUMP DISCHARGE LINES RESULTING FROM PUMP FAILURE AND CHECK VALVE CLOSURE,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
E. Ruus, and B. Karney.
Canadian Journal of Civil Engineering, Vol. 12, No. 1, p 137-149, March, 1985. 10 Fig, 4 Ref.

Descriptors: *Pipelines, *Water hammer, *Pump failure, *Check valves, Valves, Failure, Pressure head, Pumps, Computers, Inertia.

Maximum pressure head drops and rises resulting from pump failure and subsequent check valve closure are calculated and plotted for a simple pump discharge line at pump end, midpoint, and three-quarter point. Basic parameters such as pipeline constant, pipe wall friction, complete pump characteristics, and pump inertia constant are accounted for in the analyses. Computer studies indicate that pipe friction, pipeline constant, and pump inertia have a major effect on pressure head drops and rises. Friction substantially increases the downsurge condition. Friction largely reduces upsurge. In pipelines with large fricton, the upsurge may never reach the initial steady state hydraulic grade line. Studies also indicate that whereas for large pump inertia the pressure head rise or drop at the midpoint is only moderately larger than one-half of the rise or drop at pump end, for small pump inertia this difference is much greater. For very small pump inertia, the pressure head drop or rise at midpoint approaches the values at pump end. This increase in pressure head drop and rise for very small pump inertia is even more pronounced at the three-quarter point. (Baker-IVI)
W85-06552

OPTIMALLY CONTROLLED HYDRODYNAMICS FOR TIDAL POWER IN THE SEVERN ESTUARY,
Bristol Polytechnic (England). Dept. of Computer Studies and Mathematics.
S. C. Ryrie, and D. T. Bickley.
Applied Mathematical Modelling, Vol. 9, No. 1, p 2-10, February, 1985. 5 Fig, 15 Ref.

Descriptors: *Hydrodynamics, *Tidal powerplants, *Estuaries, *Severn Estuary, *England, Barrages, Model studies, Tidal energy, Design criteria, Mathematical equations.

A representation of the hydrodynamics of a wedge-shaped tidal estuary, involving the integration of a set of ordinary differential equations, is developed and applied to the Severn Estuary, with an energy-extracting barrage present on a line from Brean Down to Lavernock Point. An attempt is made to model the interaction between an optimized energy-extracting tidal barrage and the tidal dynamics of the estuary in which it is situated. The hydrodynamic model used is sufficiently simple to allow the successful formulation of the optimal control, while still giving a realistic description of the tidal dynamics of the estuary. This model has been used in conjunction with numerically accurate characteristics for the machinery of the proposed Severn Barrage, operating in ebb general mode. The major effect of tidal dynamics on the scheme studied is the reduction in tidal range immediately outside the barrage by between 7 and 10%. This leads to a reduction in predicted energy output of between 10 and 17% from that found by a flat-surface model using the existing tidal regime of the estuary. The basin itself, when used in ebb generation mode, appears to be little affected by tidal dynamics, as far as these affect energy output. This appears to be due to the fact that disturbances produced at the barrage travel up the basin and back in a time much less than the duration of generation. In this sense, the basin of the proposed Severn Barrage scheme is too deep and short to allow its tidal dynamics greatly to affect energy output, when ebb-generation is being used. It may be possible to take advantage of the tidal dynamics of the basin by using other operating modes, particularly if pumping is included. (Baker-IVI)
W85-06560

PRESSURE TRANSIENTS CAUSED BY SLAMS AND BURSTS IN WATER PIPELINES,
E. P. Evans, and P. V. Sage.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 1, p 58-70, February, 1985. 13 Fig, 11 Ref.

Descriptors: *Pipelines, *Water hammer, *Pressure, Valve slams, Pipe bursts, Earthquakes, Pump failure, Water distribution, Water mains.

A data steered modular waterhammer program is described which can be used to predict transient behavior in many different closed conduit systems. The program is based on the concentrated cavity conceptual model. Particular problems in two such systems are identified and described. The first problem arises from the routing of a large gravity main conveyor in a seismically active area. Protection has to be provided against possible earthquake induced pipeburst. In particular, the possibility of transient amplification in the smaller branches must be guarded against. The second problem concerns the subject of reflux valve slam, the slam ocurring after pump failure on a high head scheme. In each problem, it is evident that the physical behavior of hydraulic devices, whether they be over-velocity valves or pumps, reflux valves and air vessel combinations are of fundamental importance. As such, an awareness of the physical behavior of any such device will always be the design engineer's main consideration whatever techniques of analysis are available. (Baker-IVI)
W85-06576

HYDRAULIC FORCES ON RAILS FOR VERTICAL LIFT, HIGH HEAD GATES,
For primary bibliographic entry see Field 8C.
W85-06579

TRANQUIL AND RAPID FLOWS IN SMOOTH-WALLED AND REINFORCED-CONCRETE FLUME CHANNELS,
O. M. Aivazyan.
Hydrotechnical Construction, Vol. 18, No. 2, p 96-104, February, 1984. 4 Fig, 1 Tab, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 43-47, February, 1984.

Descriptors: *Hydraulic resistance, *Hydraulic roughness, *Reinforced concrete, *Tranquil flow, *Rapid flow, Flumes, Channels, Hydraulic gradient, Hydraulic radius, Darcy coefficient.

The hydraulic resistance characteristics of tranquil and rapid flows in smooth-walled and reinforced-concrete flume channels were investigated. A quantitative correlation relating the hydraulic resistance to the hydraulic gradient and the hydraulic radius was derived based on the data obtained from laboratory-scale smooth-walled flumes and actual reinforced-concrete flume channels. A quantitative correspondence between the predicted values and the observed values from various prototype pipes and flumes was found. Based on the analysis performed, it is noted that: (1) in the case of tranquil flow in smooth-walled flumes, a law of resistance qualitatively coinciding with the law of smooth pipes is observed; (2) in the case of tranquil flow in reinforced-concrete channel flumes the Darcy coefficient (C) increases with increased relative roughness; and (3) in the case of rapid flow in smooth-walled flumes and reinforced-concrete channel flumes the Darcy coefficient decreases with increased relative roughness. (Shieh-IVI)
W85-06597

ENTRANCE RESISTANCE OF ENVELOPED DRAINAGE PIPES,
Bangladesh Agricultural Development Corp., Jessore.
M. A. Sekendar.
Agricultural Water Management, Vol. 8, No. 4, p 351-360, February, 1984. 3 Fig, 5 Tab, 13 Ref.

Descriptors: *Drainage pipes, *Entrance resistance, *Enveloped pipes, Drain spacing, Flow resistance, Pipes, Subsurface drainage.

Envelope materials protect drainage pipes from silting up, and also have the hydrological function of reducing the entrance resistance. In most drainage equations applied for calculating drain spacing, an ideal drain is assumed and hence the entrance resistance is not taken into account. The entrance resistance and the effective radius of corrugated PVC drain pipes without envelope and with six different prewrapped envelopes were evaluated in a sand tank experiment. By applying the theory of resistances, the entrance resistance of the naked pipe was found to be 0.0136 days/m. The entrance resistance of naked drain pipe was reduced by the use of all envelopes and reduced considerably with a highly permeable voluminous envelope material. With envelopes, the values were 0.0024 to 0.0067 days/m, depending on the types of envelope. The effective radius of the naked pipe was 0.47 cm for a drain pipe with an actual radius of 3.0 cm. This value increased to between 1.20 and 2.50 cm when envelope material was used. The values of the

calculated entrance resistances were substituted in the steady state drainage equations under normal field conditions to evaluate the effect on drain spacing. Use of envelope materials theoretically allows an increase in drain spacing, but not appreciably. (Moore-IVI)
W85-06682

EFFECT OF MOLE SUBMERGENCE ON THE LIFE OF MOLE CHANNELS,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experiment Unit.
G. L. Harris.
Agricultural Water Management, Vol. 8, No. 4, p 361-374, February, 1984. 9 Fig, 2 Tab, 16 Ref.

Descriptors: *Mole drainage, *Submergence, *Mole channels, Subsurface drainage, Pumped drainage, Hydrologic properties, Mole failure.

It has been suggested that submergence of mole channels in field drainage systems will cause their premature collapse and lead to a failure of the system. Limited experience on Field Drainage Experimental Unit's sites has not supported this view. An experiment was set up on a clay soil with a good moling potential, and where a previous moling had lasted up to 5 years. In a pumped drainage scheme submergence was examined to determine if it was a cause of mole channel failure. Isolated plots were subjected to short (usually less than 3 h) and long periods (up to 20 days) of submergence. The hydrological performance and the condition of the mole channels was monitored for 5 years. Short periods of submergence did not appear to have a substantial effect on the mole drainage system and a 4-5-year life of the mole channels could be expected. Longer periods of submergence did not cause any immediate deterioration but the gradual collapse of the roof and side walls, which was the normal mode of failure, became more accentuated. This effect reduced the life of the mole channels to 3-4 years, although 3 years after moling the watertable control of the submerged plots was substantially better than similar adjacent undrained land. (Author's abstract)
W85-06683

DETERMINATION OF THE FLOW RATE IN A PRESSURE PIPE BY MEASURING THE VELOCITY AT ONE POINT OF A CONVERGENT NOZZLE EXIT SECTION,
B. M. Levin, and A. N. Lopatin.
Hydrotechnical Construction, Vol. 18, No. 9, p 427-437, September, 1984. 11 Fig, 1 Tab, 20 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 39-46, September, 1984.

Descriptors: *Flow rates, *Pipes, *Convergent nozzle exit, Pressure conduits, Velocity, Flow measurement, Hydraulic systems, Turbulence.

The flow rate of a fluid flowing in a hydraulic system is a factor determining the efficiency of its action and is also one of the main regulation and control parameters. The optimal parameters of a convergent nozzle were determined experimentally. The manufacture of conical convergent nozzles is considerably simpler than the manufacture of special nozzles, the generatrices of which are defined by complex curves. Convergent sections of a pressure pipe can be used for simplifying and improving the determination of flow rate by the velocity area method. In the exit section of the convergent nozzle the velocity can be measured practically at any point of the cross section. Such a possibility simplifies the measurement technique, increasing the accuracy of determining the flow rate. Measurement of the velocity and fluctuations of the longitudinal velocity component by a laser-Doppler flowmeter made it possible to determine a number of turbulent characteristics after the exit section of the convergent nozzle. The maximum intensity of turbulent fluctuations of the longitudinal velocity component occurs at a distance of 200 to 300 micro-m from the wall and amounts to 10-12% in the range of Reynolds numbers of the flow 800,000-900,000. In the core of the flow the intensity of turbulence is 2%. These values are an order less than in a uniform turbulent air flow. (Baker-IVI)
W85-06709

USE OF SWIRLED FLOWS IN TUNNEL SPILLWAYS,
B. A. Zhivotovskii.
Hydrotechnical Construction, Vol. 18, No. 9, p 443-446, September 1984. 3 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 50-52, September, 1984.

Descriptors: *Tunnel spillways, *Swirled flow, Spillways, Hydroelectric plants, Kinetic energy, Energy dissipation, Velocity, Cavitation, Tunnels.

In tunnel spillways of high-head hydrostations the water velocity can reach values of 50-70 m/sec at heads of 300-400 m. Under these conditions a number of problems related to hydraulics of tunnel spillways arise. The main problems are: protection of the tunnel lining from cavitation erosion and dissipation of the excess kinetic energy of the flow in the conduit. For high head hydrostations the problem arises of dissipating the excess kinetic energy of the flow inside the tunnel or reducing the velocity and, consequently, the capacity of the tunnel spillway. An effective method of dissipating the kinetic energy of the flow is that of using a swirled flow behind a swirl gate. In the case of a swirled flow in a pressure tunnel spillway an intense dissipation of the kinetic energy of the flow and a marked increase of pressure on the conduit wall are provided, which lessens or eliminates the danger of cavitation. Suggestions on the development of the method with the use of swirled flows, in particular, devices for dissipating the excess kinetic energy of the flow inside the tunnel and a spillway device combining the functions of kinetic energy dissipation and discharge regulation are examined. One of the important problems in the operating of these devices is the effectiveness of dissipating the energy of the flow. (Baker-IVI)
W85-06711

MODEL-PROTOTYPE COMPARISON STUDY OF DIKE SYSTEMS, MISSISSIPPI RIVER: POTAMOLOGY INVESTIGATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. J. Franco.
Technical Report HL-82-10, May 1982. Final Report. 343 p, 123 plates.

Descriptors: *Model studies, *Stream stabilization, *Dikes, *Navigable rivers, *Project planning, *Prototype tests, *Water resources development, Stable channels, Projections, Predictions, Prototypes, Alluvial rivers.

In connection with the Mississippi River Commission Potamology Program, movable-bed model studies were conducted of seven of the most complex reaches of the Mississippi River to assess the effectiveness of plans proposed for the stabilization of those reaches. Because of the limited size of the test facility, only a relatively short reach of the river including the problem could be modeled with little or no overbank areas. The linear scales were distorted to an undesirable extent. Analysis of model results showed that qualitative predictions could be made of most of the principal trends that actually occurred in the river with the plans tested. The degree of accuracy of the models varied and depended on the model adjustment, characteristics of the reach, flow conditions, and similarity between plan tested and actual completed structures. The analysis of model and prototype data allowed an evaluation of the performance of various types of dikes and dike systems as well as an assessment of the principles involved in the developments within alluvial streams.
W85-06892

FILLING AND EMPTYING SYSTEM, WALTER BOULDIN LOCK, AND LOCK CULVERT VALVE FOR COOSA RIVER WATERWAY, ALABAMA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. F. George.
Technical Report HL-84-8, September 1984. Final Report. 156 p, 6 Fig, 36 Tab, 7 Photos, 44 Plates.

Descriptors: *Hydraulics, *Valves, *Locks, *Flow control, Hydraulic models, Model studies, Hydraulic engineering, Walter Bouldin Lock, Coosa River Waterway, Alabama, Waterways, Culverts.

A 1:25-scale model of the Walter Bouldin Lock, Coosa River, Alabama, and a 1:15-scale model of the lock culvert valve were used to study the filling and emptying system, which consisted of a bottom longitudinal flood culvert system. Culverts in each lock wall are connected to a crossover culvert with a horizontal splitter wall dividing flow to upstream and downstream tuning forks where equal divisions lead into the two longitudinal floor culverts in each end of the lock chamber. Filling and emptying time in the prototype was estimated from the model studies to be 12.7 min and 14.1 min, respectively. The key to energy dissipation and control was the unsymmetrical baffling around the floor culvert manifolds. The system is insensitive to misoperation of the valves. The reverse tainter valve for controlling the flow entering and leaving the locks is a vertically framed valve with 18-in.-deep T-beams separating the skin plate from the main horizontal girders. The average horizontal and vertical forces exerted on the trunnions ranged up to 1500 kips and 580 kips, respectively, with a lift of 130 ft. The dynamic loads on the hoist mechanism were considered excessive. Modifications to the valve did not reduce the dynamic loads, leading to the conclusion that a significant change in design may be necessary for valves subjected to lift loads as high as 130 ft.
W85-06896

KAHOMA STREAM CHANNEL IMPROVEMENT PROJECT, MAUI, HAWAII: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 4A.
W85-06904

MISSISSIPPI SOUND WAVE-HINDCAST STUDY: MAIN TEXT AND APPENDICES A AND B,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2E.
W85-06912

EROSION CONTROL OF SCOUR DURING CONSTRUCTION; REPORT 5: EXPERIMENTAL MEASUREMENTS OF REFRACTION AND DIFFRACTION DOWNCOAST OF AN OBLIQUE BREAKWATER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
L. Z. Hales.
Technical Report HL-80-3, September 1984. 140 p, 16 Fig, 19 Tab, 9 Photos, 50 Plates, 37 Ref, 2 Append.

Descriptors: *Hydraulics, *Erosion control, *Coastal engineering, *Breakwaters, *Wave height, *Shore protection, Scour, Water currents.

A hydraulic model was used to study the wave heights downcoast of an obliquely oriented (60 degrees) shore-connected breakwater under the combined effects of refraction and diffraction. The theoretical and experimental data compared favorably for the wave heights tested in the shadow zone, but they diverged with an increase in incident wave height farther downcoast out of the shadow zone.
W85-06920

JET ENTRAINMENT IN PUMPED-STORAGE RESERVOIRS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
P. J. Roberts.
Technical Report E-81-3, March 1981. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Wa-

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terways Experiment Station, Vicksburg, MS. 63 p, 14 Fig, 35 Ref, 1 Append.

Descriptors: *Hydraulics, *Literature review, *Entrainment, *Reservoirs, *Pumped storage, *Flow characteristics, *Jets, Plumes, Model studies, Mathematical models, Stratified flow, Stratification, Buoyancy.

A literature review of mathematical models for predicting jet entrainment in pumped storage reservoirs revealed that no single model was adequate in all cases. However, each flow situation can be classified and entrainment predicted using the techniques described in this report. Flows were classified according to primary and secondary systems, producing 16 possible flow types. The primary classification scheme depended on the source buoyancy and boundary proximity in which 4 classes exist (buoyant immersed jet, nonbuoyant immersed jet, buoyant boundary jet, and nonbuoyant boundary jet). The secondary classification depended on the ambient stratification (stratified or uniform) and source geometry (slot or round orifice). Each situation was reviewed separately and a method for predicting entrainment presented.
W85-06921

SOUTH FORK TILLATOBA CREEK DROP STRUCTURE, MISSISSIPPI: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. E. Hite, and G. A. Pickering.
Technical Report HL-82-22, September 1982. Final Report. 78 p, 3 Fig, 1 Tab, 37 Photos, 21 Plates.

Descriptors: *Hydraulic structures, *Erosion control, *Stream erosion, *Bank erosion, *Channel erosion, *Flow control, Tillatoba Creek, Mississippi, Bank stabilization, Stilling basins, Riprap, Spillways, Weirs, Detention basins, Hydraulic models, Model studies, Drop structures.

A two-stage reinforced concrete grade control structure was proposed to prevent the rapid channel degradation and severe stream bank erosion in the South Fork of Tillatoba Creek, Mississippi. Tests were conducted on a 1:29-scale section model of the low-stage structure and a 1:25-scale model of the grade control structures to evaluate the proposed design. Flow conditions were improved by modifying the original design. Energy dissipation in the low-stage structure stilling basin was improved by adding a trajectory curve type of drop. Approach wing walls improved flow conditions in the high- and low-stage structure stilling basins. The widths of the exit channels for both structures were reduced. The preformed scour hole was eliminated, and stable riprap designs were devised.
W85-06923

LOS ESTEROS SPILLWAY, PECOS RIVER, NEW MEXICO: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
B. P. Fletcher.
Technical Report HL-82-24, October 1982. Final Report. 56 p, 11 Fig, 1 Tab, 15 Photos, 15 Plates.

Descriptors: *Hydraulic structures, *Spillways, *Dams, *Flow control, Deflection, Hydraulic models, Model studies, Los Esteros Spillway, Pecos River, New Mexico, Erosion, Surges, Turbulent flow, Rock fill, Reservoirs, Maximum flow, Ravines.

Tests to investigate the hydraulic performance of the Los Esteros Spillway and discharge channel were conducted using a 1:80-scale model. Emphasis was placed on the development of a design that would pass flows as high as 430,000 cfs without subjecting the downstream dam embankment to excessive surges and current velocities. Approach flows and flows passing over the crest were satisfactory for all anticipated discharges. Discharges above 225,000 cfs induced adverse currents, surges, and stone failure on the downstream face of the dam. Portions of the ravine or discharge channel were excavated and the amount of turbulence, surges, and currents along the downstream face of the dam was reduced to an acceptable level. However, the cost of prototype excavations was considered excessive. Properly designed flow deflectors in the ravine were effective in reducing adverse hydraulic conditions at the downstream dam embankment. The deflectors shifted flow away from the dam and down the Pecos River. A fixed deflector (concrete wall) was effective but considered undesirable for economic reasons. The design adopted by the Albuquerque District consisted of a rock deflector in the ravine and a rock fill on the dam embankment constructed of material obtained from the spillway excavation. Although the model indicated that portions of the sacrificial type rock fill would be displaced when subjected to flows above 225,000 cfs, the safety of the dam was not endangered by discharges as high as the design flow of 430,000 cfs. (Author)
W85-06927

METHOD TO FORECAST SEDIMENTATION RATES RESULTING FROM THE SETTLEMENT OF SUSPENDED SOLIDS WITHIN SEMIENCLOSED HARBORS,
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 2J.
W85-06929

POLLUTION CONTROL FACILITIES PROJECT SOUTHEASTERN OAKLAND COUNTY SEWAGE DISPOSAL SYSTEM, OAKLAND COUNTY, MICHIGAN: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5G.
W85-06937

BIG CREEK FLOOD-CONTROL PROJECT CLEVELAND, OHIO: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
G. A. Pickering.
Technical Report HL-83-7, April 1983. Final Report. 51 p, 10 Fig, 10 Photos, 18 Plates.

Descriptors: *Hydraulic structures, *Flood control, *Floodways, *Model studies, Hydraulic models, Channels, Big Creek, Ohio, Hydraulic jump, Gabions, Flow control, Riprap.

Tests were conducted on a 1:40-scale model of Big Creek to investigate the hydraulic performance of a proposed floodway channel and a section of modified channel. The model reproduced the entire proposed floodway channel, a portion of the existing Big Creek main channel, and a section of modified channel downstream from the existing channel. Distribution of flow between the existing channel and the floodway channel was slightly different than anticipated, but this had no significant effect on flow conditions in either channel. Flow conditions were satisfactory in the concrete chute of the upstream end of the proposed floodway channel. A hydraulic jump formed at the lower end of the chute structure, resulting in satisfactory flow conditions at the entrance to the natural channel. The original design gabion drop structures used in the floodway to reduce the grade along the channel caused flow to concentrate near the middle of the channel, resulting in high velocities. Depths of flow in several reaches of the channel were less than anticipated. Revisions to these drop structures resulted in good flow conditions throughout the floodway channel. A concrete transition between the downstream end of a three-barrel conduit and the modified channel caused flow to concentrate in the channel which resulted in movement of the riprap immediately downstream from the transition and along the left bank. The concrete transition was removed and the area was shaped with riprap. This resulted in satisfactorily flow conditions in the modified channel. (Author)
W85-06994

EFFECTS OF VISCOSITY AND SURFACE TENSION ON SLOT WEIRS FLOW,
Naples Univ. (Italy). Dept. of Hydraulic Construction.
G. de Martino, and A. Ragone.
Journal of Hydraulic Research, Vol. 22, No. 5, p 327-341, 1984. 11 Fig, 21 Ref.

Descriptors: *Flow, *Slot weirs, *Surface tension, *Viscosity, Hydraulics, Construction, Weirs, Velocity, Head, Contraction.

An experimental investigation of the flow over vertical weirs, refered to as slot weirs on account of their markedly elongated rectangular shape, was carried out. Experiments on weirs 3 to 20 mm broad showed that, for heads greater than 6-7 cm and for each weir the coefficient of discharge remains practically constant as the head increases, the constant value being greater the narrower the weir. An increase in the influence of viscosity implies increments in the coefficient of contraction always prevailing over the decrements in that of velocity as arise from the loss of head due to viscous drag. An increase in the influence of surface tension will engender an increment in the coefficient of contraction exceeding the decrement in that of velocity, but only for values of W above a certain threshold, which is apparently a function of both the slot breadth and the head. Below such a limit, the decrements in the coefficient of velocity exceed the increments of the coefficient of contraction due to viscosity and to surface tension itself. Surface tension has, at low heads, the predominant influence on the process of motion and hence, in determining the particular behavior of the coefficient of discharge, which tends to decrease as the head is reduced. These exists, at least in the head range investigated, no threshold value of Reynolds' number, below which the influence of viscosity produces a reversal of its effects on the coefficients. The hypothesis appears justified that the singular point of contact between outflowing nappe and slot edge determines a modification of the kinematic process contraction (owing to a sudden change in direction), the contraction coefficient increments being comparatively higher the narrower the slot. (Baker-IVI)
W85-07029

TRAJECTORY OF A TURBULENT CROSS JET,
Indian Inst. of Tech., Kanpur.
K. Subramanya, and P. D. Porey.
Journal of Hydraulic Research, Vol. 22, No. 5, p 343-354, 1984. 7 Fig, 1 Tab, 18 Ref.

Descriptors: *Jets, *Turbulent flow, *Trajectories, Flow, Dispersion, Nozzles, Hydraulics, Fluid dynamics, Uniform flow.

Considerable effort has been directed in recent years towards understanding the behavior of turbulent jets discharging into streams. The trajectory of a round turbulent cross jet discharging at right angles into a uniform flow was studied. Using the experimental observations on the jet width and by momentum considerations the complete jet trajectory is shown to be given by a unique functional relationship. Using the experimental data of the present study plus other available data, the validity of the functional relationship is established. A semi-analytic approach has been used based on a properly defined drag coefficient. (Baker-IVI)
W85-07030

RIPRAP STABILITY UNDER WAVE ACTION,
Delaware Univ., Newark. Dept. of Civil Engineering.
N. Kobayashi, and B. K. Jacobs.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 111, No. 3, p 552-566, May, 1985. 7 Fig, 23 Ref.

Descriptors: *Riprap, *Wave action, *Mathematical models, Stability analysis, Mathematical studies, Coastal engineering.

A mathematical model was developed to predict the flow characteristics in the downrush of regular

waves and the critical condition for initiation of movement of armor units on the slope of a coastal structure. The analysis of water motion on the slope is based on the standing-wave solution of the finite-amplitude shallow-water equations with an implicit account of the effects of wave breaking. This simple model neglects the effects of permeability, bottom friction and water depth. In addition, use is made of an empirical runup relationship. A stability analysis of armor units is performed including the drag, lift and inertia forces acting on an armor unit which vary along the slope with time over the period of wave downrush. Comparison was made with the large-scale test data on riprap stability from an earlier study. The predicted critical stability number follows the same trend as the observed zero-damage stability number, although the agreement is qualitative. (Author's abstract)
W85-07079

STOKES AND RAYLEIGH LAYERS IN PRESENCE OF NATURALLY PERMEABLE BOUNDARIES,
Monash Univ., Clayton (Australia). Dept. of Mathematics.
For primary bibliographic entry see Field 2E.
W85-07099

CHARACTERISTICS AND MODELING OF INTAKE VORTICES,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
C. Farell, and A. R. Cuomo.
Journal of Engineering Mechanics, Vol. 110, No. 5, p 723-742, May, 1984. 7 Fig, 46 Ref, 1 Append.

Descriptors: *Vortices, *Intakes, *Model studies, Mathematical models, Free surfaces, Entrainment, Reynolds number, Froude number.

The effects of free-surface or boundary-attached vortices on the operation and performance of hydraulic structures and machinery are well recognized and of considerable concern to designers. A review and analysis of forces, equations and data for free-surface intake vortices is presented. In models which exhibit at most weak vortices entraining little air, preservation of the ratio of inertia and gravitational forces in model and prototype should assure the correct reproduction of intake circulation patterns. For large enough radial Reynolds numbers, while the vortex core flows are viscosity dependent and thus exhibit scale effects in Froude models, the effects on the gross features of the flow may be negligible. For vortices forming off a wall, the ratio of model-to-prototype core-pressure has been tentatively estimated assuming a solid fluid core. For air core vortices, small-scale Froude models may exhibit nonnegligible scale effects in the vortex cores, in particular in regard to air entrainment. (Moore-IVI)
W85-07100

CONVERGENT FLOW PATTERN AT AN ABRUPT CONTRACTION,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
For primary bibliographic entry see Field 2E.
W85-07101

HYDRODYNAMIC PRESSURE ON SHORT-LENGTH GRAVITY DAMS,
Johns Hopkins Univ., Baltimore, MD.
For primary bibliographic entry see Field 8A.
W85-07102

8C. Hydraulic Machinery

HYDRAULIC FORCES ON RAILS FOR VERTICAL LIFT, HIGH HEAD GATES,
D. G. Wardle, and D. A. Crow.
Proceedings of the Institution of Civil Engineers, Vol. 79, Part 2, p 73-85, March, 1985. 8 Fig, 8 Ref.

Descriptors: *Gates, *Rails, *Hydraulics, *Design criteria, Construction, Vertical lift gates, Head, Design criteria, Velocity, Pressure.

Where vertical lift gates are used under substantial differential water heads, it is usually necessary to minimize frictional resistances by providing the gates with wheels. A typical design procedure is to calculate the hydraulic loads transferred from the gate to the wheels, and thence to the rail, and, ultimately, to the concrete structure in which the gate is installed. Under some high velocity flow situations cases of failure of the concrete surfaces are known to have occurred as a result of the reconversion of velocity head into pressure head in joints and cracks. A similar mechanism may apply to gate rails, so consideration should be given to the hydraulic forces on the rails when the gate is partially or completely open. Tests were devised to demonstrated that a complex three-dimensional flow exists in the gate slots when vertical lift gates are in the open or partially open positions. High stagnation pressures, even approaching the full hydrostatic head, can develop in the vicinity of the downstream edge of the slot where the gate rail is fastened. The small gap behind the rail is likely to be large enough to allow the high stagnation pressures to occur behind the rail. Simultaneously, low pressures, even down to cavitating conditions, can exist on the open face of the rail next to the circulation eddy. There are likely to be significant resultant hydraulic forces on the rail tending to lift it from its mounting, and consideration must be given to the hydraulic forces when designing the fixings for such gate rails. The pressure difference across the rail should be equal to the velocity head of the flow through the gate opening. (Baker-IVI)
W85-06579

EXPERIENCE IN VIBRATION TESTS AND BALANCING ROTORS OF LARGE TURBINE-GENERATOR UNITS,
I. R. Solov'ev.
Hydrotechnical Construction, Vol. 18, No. 9, p 401-404, September, 1984. 4 Fig, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, September, 1984.

Descriptors: *Turbines, *Hydraulic equipment, *Vibrations, Rotors, Generators, Tests.

Vibration and mechanical tests of large turbine-generator units of hydroelectric stations revealed an unsatisfactory vibration state in some of them. Mechanical unbalance of rotors is one of the substantial and frequent operating defects of hydrostation units. The cause of occurrence of unbalance of the rotor is, as a rule, low-quality assembly, as a result of which distortion of the rotor shape occurs sooner or later, in the case of nonuniform wedging of the rim and also weakening of the wedging. As experience shows, mechanical unbalance of the generator rotor is not always the only cause of increased vibration of the unit. It usually occurs in combination with other defects of the unit; moveover, any change or correction of one of the defects affects the overall vibration state and wobble of the shaft of the unit. When balancing the generator rotor it is necessary to take into account all characteristics of the state of the given unit. For this a careful vibration check of the support assemblies and wobble of the shaft of the unit at various points over the length of the shafting is necessary. (Baker-IVI)
W85-06706

EXPERIENCE IN RECONSTRUCTING THE RADIAL GATE OF THE SPILLWAY AT THE VILYUI HYDROELECTRIC STATION,
A. I. Sitnyanskii.
Hydrotechnical Construction, Vol. 18, No. 9, p 414-418, September, 1984. 2 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 26-29, September, 1984.

Descriptors: *Radial gates, *Hydroelectric plants, *Vilyui Hydroelectric Station, Reservoirs, Spillways, Gates, Reconstruction, Ice.

The Vilyui hydroelectric station, having a carry-over reservoir, works for an isolated power system. A proposal to increase the normal pool level (NPL) of the hydrostation has been studied. The following problems were examined and solved during the studies: the possibility of passage of the spring and summer-fall floods at an increased NPL, reconstruction of the radial gate of the spillway, and check of the retaining structures during operation at an increased NPL. Reconstruction of the radial gate of the spillway by installing an additional gate on the sill under the existing gate proved to be an effective method of increasing the height of the gate, especially when the gate height is increased by 1.5 to 2 m and more. The capacity of the gate hoisting gear can be increased by increasing the mechanical advantage of the block and tackle with the installation of additional blocks and by increasing the capacity of the cable drum; such reconstruction increases the lifting capacity by 15-20%. A sectional strut-braced flashboard permits even under winter conditions draining the spillway sill and reliably protecting the zone of works on the sill. The use of hot water with a temperature of 50-60 degrees is an effective method of removing surface icing and fast ice on the perimeter of the gate if it is necessary to lift it in the winter, especially under conditions of the Far North. When installing a sectional strut-braced flashboard in front of a radial gate at temperatures of minus 40-50 degrees it is necessary to heat the water in the intergate space to preclude the formation of a thick ice cover and ice attached to the gate. (Baker-IVI)
W85-06708

SYNOPSIS OF INSULATION PROBLEMS AT YELLOWTAIL POWERPLANT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. C. Arbour.
REC-ERC-84-4, October 1983. 13 p, 12 Fig, 4 Tab, 1 Ref.

Descriptors: *Hydraulic machinery, *Powerplants, *Electrical equipment, *Hydroelectric powerplants, Electric powerplants, Yellowtail Powerplant, Insulation, Generators.

Unit 3 at Yellowtail Powerplant shut down on November 19, 1980, with a line-to-ground fault on phase A. Subsequent testing showed that the fault was located on the line end coil of one of the parallel groups. Examination of the faulty portion of the coil revealed that most of the strand binder material had decomposed into dust; some had disappeared entirely. The failure mode was primarily mechanical, caused by abrasion induced by electrical vibration. Corona testing on coils in other parts of the powerplant showed a number of high readings in three of the four units in the plant. As a result of the testing, plans were made to rewind the generators, starting with the most badly deteriorated units.
W85-06893

FILLING AND EMPTYING SYSTEM, WALTER BOULDIN LOCK, AND LOCK CULVERT VALVE FOR COOSA RIVER WATERWAY, ALABAMA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W85-06896

PERFORMANCE OF PLASTIC CANAL LININGS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
W. R. Morrison, and J. G. Starbuck.
REC-ERC-84-1, January 1984. 114 p, 83 Fig, 32 Tab, 39 Ref, 2 Append.

Descriptors: *Materials testing, *Seepage control, *Plastics, *Linings, *Canal linings, Irrigation canals, Polyvinyl chloride, Plasticizers, Canal seepage, Canal construction, Construction, Water loss, Leakage.

The performance of buried plastic membrane linings, primarily 10-mil PVC, was evaluated. Ten samples of linings, used for seepage control in irrigation canals, ranged in service life from 1 to 19 years. The buried plastic membrane linings evaluated in this study are providing satisfactory service for seepage control. A 20-mil membrane would

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increase service life and reduce installation problems for a cost increase of only 15%. Laboratory studies and field observations indicated that some stiffening of the PVC lining has occurred with time. This stiffening or aging was caused by the loss of plasticizer. With aging, there was generally a reduction in elongation, an increase in modulus at 100% elongation, and a decrease in resistance to impact damage at low temperatures. The rate of this aging depended on three factors: (1) the linings with a high plasticizer content aged less, (2) samples obtained from within the water prism aged less than those obtained outside the prism, and (3) samples obtained from areas where the lining had been placed over a fairly smooth subgrade aged less than those installed over a coarser base. This report also presents design criteria, construction procedures, and updated construction and material specifications for PVC linings.
W85-06910

EVALUATION OF PUMPS AND MOTORS FOR PHOTOVOLTAIC WATER PUMPING SYSTEMS,
Solar Energy Research Inst., Golden, CO.
D. Waddington, and A. Herlevich.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-019163. SERI/TR-214-1423. June 1982. 53 p. 32 Fig, 5 Tab, 8 Append. Contract/Grant No. EG-77-C-01-4042.

Descriptors: *Pumps, *Solar energy, Pumping heads, Pumping tests, Wells, Test facilities, Flow rates, Costs, Cost analysis.

Two electric, motor-driven water pumps were tested in conjunction with a photovoltaic (PV) array that provided the electrical energy to run the pumps. The purpose of the tests was to evaluate the performance of currently available, low-cost pumping systems powered by PV arrays. The performance and cost of these systems were compared with analogous data from similar, higher priced pumps and motors currently used with many PV water pumping systems. The two pump systems considered represent production equipment available from U.S. industry and cost less than 50% of equivalent pumps installed with PV pumping systems in the U.S. and in developing countries. Flow rates, pumping heads, and efficiency were comparable in both test pumps and equivalent pumps. Motor performance, when the motor was directly connected to the PV array and loaded with the pump, was examined. It is concluded that commercially available, low-cost water pump systems will perform satisfactorily when powered by PV arrays.
W85-06988

8D. Soil Mechanics

EMPINGHAM DAM - DESIGN, CONSTRUCTION AND PERFORMANCE,
R. C. Bridle, P. R. Vaughan, and H. N. Jones.
Proceedings of the Institution of Civil Engineers, Vol. 78, p 247-289, April, 1985. 27 Fig, 2 Tab, 30 Ref, 2 Append.

Descriptors: *Empingham dam, *England, *Dam design, *Dam construction, Earthfill dams, Dam foundations, Drainage, Monitoring.

Empingham Dam (England) is the earthfill embankment 37 m high, 1200 m long. The dam foundation is Upper Lias clay extensively sheared and brecciated by valley bulging and periglacial disturbance. The weak foundation was the controlling factor in design and made a wide cross-section with extensive berms necessary. Determination of the reliable strength of the foundation was difficult and was to be confirmed at full scale by a trial bank placed early in construction and incorporated within the dam. The tender design allowed for the uncertain strength by indicating a range of dam volumes corresponding to the likely range of foundation strength values. Various measures, including 10,800 vertical sand drains and zoning of fills incorporating an inclined core, were utilized to minimize the volume of earthfill required. The bulk of the 5 M cu m of fill was Upper Lias clay excavated from borrow pits upstream of the dam, and was placed over three summer seasons. The performance of the dam is monitored by a comprehensive range of instruments, including a movement monitoring system. Finite-element methods were used to predict early movements. The instrumentation records show the behavior of the dam to be satisfactory. (Author's abstract)
W85-06174

ENGINEERING-GEOLOGIC SURVEYS AND FORECASTS FOR HYDROTECHNICAL CONSTRUCTION ON SLUMP-PRONE LOESS SOILS,
S. L. Skiba, I. F. Karyakin, and Z. M. Murtizaeva.
Hydrotechnical Construction, Vol. 18, No. 2, p 63-69, August, 1984. 3 Fig, 8 Ref. Translated from Gidrotekhicheskoe Stroiltel'stvo, No. 2, p 20-25, February, 1984.

Descriptors: *Loess, *Slump deformation, *Seepage, *Construction, Soil properties, Hydraulic structures, Soil mechanics, Deformation, Reservoirs, Reservoir management.

Unfavorable processes often develop during construction and operation of hydraulic structures constructed on slump-prone loess soils. Most of the problems are related to nonuniform slump deformations of primarily a vertical character occurring as a result of a change in the physical and mechanical properties of the soils under the prolonged action of water and the weight of the rocks and structures being constructed. As a result of the planning and surveying work done to determine the engineering and economic feasibility of a reservoir in an area with loess soils, a number of guidelines for construction in slump prone loess soils were developed. The types of problems addressed include the nature and character of slump deformations of loess soils; seepage properties and possibility and character of seepage deformations of loess soils; development of unfavorable engineering - geologic processes and phenomena as a result of the interaction of the hydraulic structures with slump-prone soils; methods of reducing or completely eliminating the slumping of soils; and design, construction, and operation of hydraulic structures on slump-prone soils, especially in seismically active regions. (Keenan-IVI)
W85-06591

EVALUATION OF THE ENGINEERING-GEOLOGICAL PROPERTIES OF CLAY FOUNDATIONS OF EARTH DAMS,
N. F. Aripov, S. V. Bortkevich, V. I. Vutsel', N. A. Krasil'nikov, and V. M. Ivannikov.
Hydrotechnical Construction, Vol. 18, No. 2, p 80-85, August, 1984. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Dam foundations, *Clay, *Earth dams, Monitoring, Measuring instruments, Embankments, Soil physical properties, Dam construction.

Engineering-geological investigations of earth dams having a weak clay foundation are insufficient to obtain complete and objective data on the geological and soil characteristics, because of the disturbance of the natural clay structure during the investigations as well as the insufficient consideration of specific characteristics of individual foundations. To overcome these shortcomings, the investigation of test embankments equipped with monitoring and measuring apparatus is recommended. This alternative approach allows the determination of the properties of weak clay soil in a natural and undisturbed manner. Field data obtained from two test embankments constructed in Mexico and France have demonstrated that this approach is feasible for investigation of weak clay foundation of earth dams. In order to promote an increase in reliability and economy of earth dams, refinements of the engineering-geological conditions of the foundation and properties of clay soil of earth dams being constructed should be carried out at the design stage to test embankments as well as in the initial period of construction of the real structure. (Shieh-IVI)
W85-06594

INFLUENCE OF GRAIN SIZE DISTRIBUTION ON THE UNDRAINED DYNAMIC PROPERTIES OF SATURATED SAND,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. L. McNearny.
July 1984. Thesis Submitted as Requirement for Degree of Master of Science, University of Colorado, Department of Civil and Urban Engineering, 1982. 163 p, 29 Fig, 13 Tab, 42 Ref, 5 Append.

Descriptors: *Soil mechanics, *Soil dynamics, *Sand, *Particle size, *Shear stress, *Soil water, *Saturated soils, Computer models, Model studies, Statistical analysis, Seismic properties, Hysteresis, Cyclic loads, Triaxial tests.

The gradation characteristics of a clean sand, as defined by the coefficient of uniformity and the mean grain size, did not influence the dynamic properties (dynamic shear modulus and damping ratio) when subjected to undrained cyclic loading. A functional relationship was seen between four of the five shear moduli and the level of shear strain. The damping ratios decreased with increasing shear strain over the strain range of 0.001 to 0.2 inch/inch. This conclusion was opposite to results of past research into the damping ratios of dry sand.
W85-06905

ANALYSIS OF FIELD COMPACTION DATA, DEGRAY DAM, CADDO RIVER, ARKANSAS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
W. E. Strohm, and V. H. Torrey.
Miscellaneous Paper GL-82-4, March 1982. Final Report. 102 p, 32 Fig, 6 Tab, 24 Plates, 5 Ref.

Descriptors: *Soil mechanics, *Hydraulic structures, *Dams, *Compaction, DeGray Dam, Caddo River, Arkansas, Earth dams, Earthworks, Embankments, Soil stabilization, Fill, Borrow pits, Construction, Density.

This report presents a review of the materials, specifications, procedures, equipment, and testing pertinent to construction and compaction control of the earth-fill embankment of DeGray Dam, Caddo River, Arkansas. The variation of fill water content from laboratory optimum water content and the variation of fill dry density from laboratory maximum dry density were statistically analyzed. The overall compaction control obtained for each major embankment zone is indicated by frequency histograms, cumulative frequency distributions, and various statistical parameters for variation of both water content and density. Fills in the core and shell zones were generally placed at average water contents slightly dry of optimum. The average value of fill percent compaction for the dam generally exceeded the desired value (100%) by 3 percentage points; for the dike (desired value, 98%), by 6 percentage points. Control of fill water content was better in the dam core than in the other sections of the dam. In the dike, better control was attained in the core and landside shell than in the remainder. The fill dry density for the dam and dike approached a normal frequency distribution. Better control of fill dry density variation was achieved in the dam's downstream shell and in the dike's core.
W85-06913

NONLINEAR RESPONSE OF COUPLED FLOW-STRESS PROBLEMS,
San Diego State Univ., CA.
M. N. Sharabi.
Journal of Engineering Mechanics, Vol. 110, No. 9, p 1303-1319, September, 1984. 5 Fig, 15 Ref, 1 Append. NSF Grant GK-35467.

Descriptors: *Flow, *Stress, *Mathematical models, Porous media, Deformation, Mathematical equations, Soil mechanics, Strain.

The main equations governing flow of fluid through deformable porous media are presented in a general form that considers finite deformations and nonlinear solid phase behavior. The mixture is assumed to be fully saturated, the fluid incompress-

ible and the solid nonlinear elastic. The balance of linear momentum and the continuity equations are given in Lagrangian form and a finite element procedure is presented for the incremental form of the equations of motion. The numerical model uses a modified bilinear interpolation for the displacement field and a bilinear interpolation for the pore pressure. For the temporal discretization, a finite difference technique with logarithmic interpolation. Numerical results are presented for several problems assuming infinitesimal strains. The mixture theory provides a consistent theoretical basis to describe the behavior of water transport in porous media. The computational study of the derived equations shows close agreement with the existing closed form solutions for the linear analysis. The influence of nonlinear soil skeleton properties shows a considerable deviation from the linear analysis. (Moore-IVI)
W85-07103

NONLINEAR HYSTERETIC DYNAMIC RESPONSE OF SOIL SYSTEMS,
Princeton Univ., NJ. Dept. of Civil Engineering.
J.-H. Prevost, A. M. Abdel-Ghaffar, and A.-W. M. Elgamal.
Journal of Engineering Mechanics, Vol. 110, No. 5, p 696-713, May, 1985. 13 Fig, 28 Ref. NSF grant CEE81-20757.

Descriptors: *Dynamic response, *Hysteresis, *Soil mechanics, Earth dams, Stress, Strain, Mathematical models, Earthworks, Kinematic plasticity theory.

A simplified analysis procedure for the nonlinear hysteretic dynamic response of soil or structural systems, or both, is presented. The method is based on a Galerkin formulation of the equations of motion in which the solution is expanded using basis functions defined over the spatial domain occupied by the soil system. The basis functions are selected as the normal eigenmodes of the linearized problem. The hysteretic stress-strain behavior is modeled by using elastoplastic constitutive equations based on multisurface kinematic plasticity theory. Accuracy and versatility of the technique are demonstrated by applying it to analyze the nonlinear dynamic response of an earth dam. The dam is modeled as a one-dimensional hysteretic shear wedge. Parametric studies assessing the influence of the nonlinearities on the response are presented. Finally, comparisons are made with results obtained through a more elaborate finite element representation of the dam. (Author's abstract)
W85-07104

8E. Rock Mechanics and Geology

EMPINGHAM RESERVOIR - SEEPAGE CONTROL MEASURES,
J. M. McKenna, P. Horswill, and E. J. Smith.
Proceedings of the Institution of Civil Engineers, Vol. 78, p 291-326, April, 1985. 20 Fig, 6 Tab, 25 Ref.

Descriptors: *Empingham Reservoir, *England, *Seepage control, Aquifers, Groundwater level, Hydrogeology, Geology, Relief wells, Reservoir construction, Postimpoundment.

The Marlstone Rock Bed provides a potential seepage path for water from Empingham Reservoir. The Marlstone is an aquifer up to 2.5 m thick underlying the Upper Lias clay forming the bed of the reservoir. It has been affected by valley bulging, resulting in suballuvial outcropping along the valley floor. Local and regional investigations were carried out including cataloguing of old well records, sinking boreholes, analyzing river-water chemistry and carrying out field seepage trials. Much additional hydrogeological data was obtained after dewatering of the aquifer after the rupture, early in the construction period, of the base of a tunnel shaft caused by uplift from the water pressure in the Marlstone. The investigations revealed that the pre-reservoir behavior of the aquifer was controlled largely by an outlet into an adjoining valley, and that changes in groundwater levels there might result in landslipping so it was concluded that post-impounding levels near the outlet must not be allowed to exceed pre-reservoir levels. Various means of preventing seepage were considered but the most appropriate solution was to install relief wells downstream of the dam to release the additional water. Soon after first filling of the reservoir a sudden rise in levels and discharges occurred. Extra relief wells were installed while unsuccessful searches were made for connections through the reservoir floor into the Marlstone. Various other causes were considered but the mechanism is not fully understood. However, the discharges soon stabilized to acceptable values and the behavior of the aquifer continues to be satisfactory, with a steady discharge from the relief wells about 185 l/s. (Author's abstract)
W85-06175

EXPERIENCE IN THE USE OF SATELLITE PHOTOGRAPHS FOR ENGINEERING-GEOLOGICAL CHARACTERIZATION OF CONSTRUCTION SITES OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 7B.
W85-06589

METHODS OF DETERMINING THE STRESS STATE OF ROCK MASSES AT CONSTRUCTION SITES OF HYDRAULIC STRUCTURES,
V. D. Parfenov, A. I. Savich, and Y. A. Fishman.
Hydrotechnical Construction, Vol. 18, No. 2, p 15-19, February, 1984. 1 Fig, 1 Tab, 15 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 15-19, February, 1984.

Descriptors: *Stress, *Rock mechanics, *Geology, Deformation, Geophysics, Strain gages, Boreholes, Geologic fractures, Semiacoustic method, Foundation rocks, rock testing.

For understanding the natural stress state of rock masses, three groups of methods are used: deformational, geophysical and geological. Deformational methods measure deformation upon removal of rock material (strain relief) or measure the strain needed to restore a deformed void to its original position (compensation). The borehole relieving method uses strain gauges (10-15 mm) which may only measure stresses pertaining to elementary rock units and not to the entire rock mass. Larger cavities would provide large measurement bases, substantially exceeding the dimensions of elementary rock blocks. To gauge how stress changes with time, photoelastic methods or alternatively a slot method can be used. The slot method allows one to determine average stresses in the plane of the excavated slot and is accomplished by placing a flat hydraulic jack or 'cushion' which acts as a deformometer into a test slot freshly cut from the surrounding rock. Stress dependence of seismic velocities in geologic media is governed not only by their elastic properties but also by jointing, anisotropy, and lithologic and structural inhomogeneities. Two geophysical methods for evaluating stress have been developed, the correlation method and the seismoacoustic method. Data obtained using the correlation method indicate complex states of stress for near surface rocks and that horizontal stress components considerably exceed the value of the vertical components. Geologic stress measurement methods are generally aimed at reconstructing the paleostress state of rocks using permanent strain elements and fractures. These methods are based on kinematic analysis of the spatial distribution of displacement vectors, slip, fracture distribution and crystal element orientation. The analysis can be done statistically, or geometrically using a Wulff stereographic net. (Giegangack-IVI)
W85-06590

EXPERIENCE IN STUDYING TECHNOGENIC UNLOADING IN CONSTRUCTION PITS,
V. N. Andreev, and L. D. Lavrova.
Hydrotechnical Construction, Vol. 18, No. 2, p 70-74, February, 1984. 2 Fig, 1 Tab, 3 Ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 2, p 25-28, February, 1984.

Descriptors: *Geology, *Stability, *Construction, *Foundations, Hydroelectric plants, Rocks, Dam foundations, Geologic fractures, Locks, Rock slopes.

At the site of the Dnepr-II hydrostation, unloading was studied in the sides of the pit of the second lock, 40 m deep. The lock is located in grey, highly metamorphosed Archean plagioclase granites of the Zaporozhe massif. The rock mass is severely broken by tectonic joints and in the near-surface part by short, sinuous release joints. The thickness and character of the technogenic unloading zone depend on the degree of jointing and crushing of the mass, its weathering, depth of excavating the pit, and blasting method. The results of studying technogenic unloading made it possible to regionalize the foundation according to the degree of unloading and jointing of the rocks; to construct a model of jointing with unloading zones characterizing various parts of the mass and serving as the basis for calculating the stability of rock slopes and foundation of concrete structures; or to refine the contours of the cut for concrete structures at the site of the Krapivinskii hydropower project; to develop stabilization measures (anchoring of the pit sides), which saved 400,000 rubles (Dnepr-II). The results of this study are being used for refining the parameters of contact grouting and the grout curtain, siting drainage structures, and installing monitoring equipment in the rock foundation of concrete structures. (Baker-IVI)
W85-06592

BASIC PRINCIPLES OF RECOMMENDATIONS ON ON-SITE OBSERVATIONS OF DEFORMATIONS OF ROCK FOUNDATIONS OF HIGH CONCRETE DAMS,
G. K. Khakimova.
Hydrotechnical Construction, Vol. 18, No. 2, p 75-79, February, 1984. 1 Tab, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 28-31, February, 1984.

Descriptors: *Dam foundations, *Foundation rocks, *Deformation, Foundation failure, Monitoring, Measuring instruments, Displacement, Concrete dams, Dam construction.

Methods for determining and monitoring on-site horizontal and vertical displacement as a means to assess the deformation of the rock foundations of high concrete dams consist of several measurement techniques and comparison of data with mathematical models. The deformation of rock foundations can be observed using geodetic and specially embedded, monitoring equipment. Vertical displacements are determined using bench marks and direct leveling (accuracy 1-2 mm). Less accurate, trigonometric leveling applicable for inaccessable areas and hydrostatic leveling applicable only for closed spaces (accuracy 0.03-0.25 mm) can also be used. Horizontal displacements may be evaluated by triangulating, using plumb lines (accuracy no less than 0.1 mm), rock deformometers and gap meters (accuracy of approximately 5 mm) or deep bench marks (accuracy of the order of fractions of a millimeter). Reference points should be chosen so that they are outside the zone of influence of the structure under observation (1.5-5 km from the dam) and so they are underground but tie in to local vertical and horizontal control networks. Instruments which monitor effects of decompression resulting from excavation should be located at different depths in order to constrain the extent of maximum decompression. The same instruments and observation points should be used over time in order to ensure consistancy. Observations should begin before construction, carry on for at least five years until stabilization has occurred and then can be reduced but never phased out. When comparing actual results to a theoretical model a 20-30% difference in displacement values is considered acceptable. Post-construction detailed analysis may be required in order to evaluate unforseen complications or original model shortcomings. Neither direct comparison of actual and theoretical data nor statistical analyses provide insight into the physical causes of deformation, therefore it may be necessary to study these cases using direct examination or rather complex mathematical models. (Giegangack-IVI)

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W85-06593

STRENGTH OF A JOINTED ROCK MASS,
A. B. Fadeev, and I. I. Protopopov.
Hydrotechnical Construction, Vol. 18, No. 2, p 91-95, February, 1984. 5 Fig, 1 Tab, 13 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 40-43, February, 1984.

Descriptors: *Rock mechanics, *Jointing, *Strength, Geological fractures, Mathematical equations, Deformation, Weathering, Blasting.

Rock masses are usually penetrated by joints grouped into several sets. The presence of jointing reduces the strength of the rock mass compared with the strength of a small sample, and a nonuniform distribution of joints in space imparts strength anisotropy to the mass. Joints, joint sets and their distribution relative to local compressive stress are examined in order to develop a working formula for determining the coefficient of structural weakness of rock or a rock mass. On-site stress tests can be conducted and measurements of stress can be made by observing the deformation of a test rock block. These so called strain relief methods offer varying degrees of accuracy. The most accurate method utilizes a test block cut on five sides. Other strain relief methods utilize blocks cut on four sides or slots cut out of the surrounding rock. Inverse calculations are used in order to estimate the strength properties of a particular rock mass. In the equation developed, the coefficient of structural weakness is a function of the rocks composition and strength and also the orientation and density of joints or joint sets relative to the direction of maximum compressive stress. Tables of coefficient values range from 0.03 to 0.06. The minimum value for the strength of the loaded portion of a mass relative to the distribution of the local structural elements should be used when estimating its stability. Exposure to natural weathering and blasting caused a marked decrease in the strength properties of a given rock mass. (Giegangack-IVI)
W85-06596

GEOLOGICAL AND SEISMOLOGICAL INVESTIGATIONS AT RIRIE DAM, IDAHO,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
D. M. Patrick, and C. B. Whitten.
Miscellaneous Paper GL-81-7, September 1981. Final Report. 139 p, 52 Fig, 3 Tab, 21 Ref, 2 Append.

Descriptors: *Geologic fractures, *Dam foundations, *Dam stability, *Damsites, *Seismology, *Seismic properties, *Core drilling, *Rockfill dams, Earth dams, Earthquakes, Aerial photography, Satellite technology, Seismic waves, Remote sensing.

Geological and seismological studies were conducted at Ririe Dam to identify and define potential seismic hazards at the site and beyond. The studies were supplemented by core drilling data, aerial photography, LANDSAT imagery, and aerial overflights. Regional fault studies indicated that active or capable faults were present in the Yellowstone National Park (YNP) area. High levels of seismicity were detected in the YNP area and along the Utah-Idaho border and intermediate levels occur in the Caribou Range south of the site and to the west of Palisades Reservoir. Seismic velocity levels at the dam site and the nearby Snake River Plain (SRP) were low. On the basis of seismicity and tectonics, three seismic zones - A, B, and C - were identified. Zone A was the YNP area about 105 km from the site. Zone B included the seismically active area along the Utah-Idaho border and within approximately 40 km south of the site. Zone C included the SRP, the site and areas between A and B. These studies resulted in the conclusion that two offsets in basalt flows in the embankment foundation were due, in one case, to a landslide and, in the other, to topography. The design basis earthquake ground motions are those from Zone B, and the operating basis earthquake ground motions are those from Zone C.
W85-06966

8F. Concrete

DURABILITY OF REINFORCED CONCRETE BEAMS EXPOSED TO MARINE ENVIRONMENT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
E. F. O'Neil.
Miscellaneous Paper SL-82-1, April 1982. Final Report. 18 p, 8 Fig, 2 Tab, 2 Ref.

Descriptors: *Concrete testing, *Weathering, Concrete technology, Reinforced concrete, Marine environment, Durability.

A study was begun in 1950 to determine the effects of severe natural weathering on stressed, reinforced concrete beams of various composition and degrees of stress. The beams were placed on the beach at the natural weathering exposure station on the south side of Treat Island, Cobscock Bay, Eastport, and Lubec. The beams were subjected to twice daily tidal cycles exposing them to wetting under considerable head and drying to surface dry conditions. During the winter months, the beams were also subjected to cycles of freezing and thawing. The beams were inspected annually and evaluated to determine the degree of deterioration. Maximum crack widths were also measured annually beginning in 1956 and continuing until 1975, when the exposure period was concluded after 25 yr. of weathering. At the end of the exposure period, 13 of the 82 beams still remained at the testing site. (By 1956, 60 of the beams, all fabricated from non-airentraining concrete, had been destroyed by freezing and thawing.) Of the 13 beams remaining in 1975, 11 were returned to the laboratory for testing. The results of the exposure study and the laboratory investigation indicated that stressing the steel to various levels over the exposure period did not adversely reduce the moment carrying capacity of the beams even though rusting and spalling had occurred; corrosion to the steel could not be found at any flexural crack < 0.40 mm; and sustained levels of stress to the reinforcing did not reduce the tensile properties of the steel to below acceptable standards.
W85-06986

8G. Materials

EVALUATION OF MEMBRANE-TYPE MATERIALS FOR STREAMBANK EROSION PROTECTION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
For primary bibliographic entry see Field 4D.
W85-06979

8I. Fisheries Engineering

EVALUATION OF TILAPIA SPP. IN LAKE MANZALAH AS POND FISHES, (PROCJENA TILAPIA SPP. U JEZERU MANZALAH KAO RIBNJACARSKIH VRSTA),
Institute of Oceanography and Fisheries, Alexandria (Egypt).
For primary bibliographic entry see Field 6G.
W85-06424

SEASONAL VARIATION OF DISSOLVED ORGANIC MATTER IN FUNKA BAY,
Hokkaido Univ., Sapporo (Japan). Research Inst. of North Pacific Fisheries.
For primary bibliographic entry see Field 2L.
W85-06441

FORMATION OF ICHTHYOFAUNA IN THE SASYK RESERVOIR UNDER CONDITIONS OF FRESHENING (FORMIROVANIE IKHTIOFAUNY SASYKSKOGO VODOKHRANILISHCHA V VSLOVIYAKH OPRESNENIYA),
For primary bibliographic entry see Field 6G.
W85-06468

STUDY OF A SHALLOW CARP (CYPRINUS CARPIO L.) POND AND ITS RELEVANCE TO INLAND FISH FARMING IN LIBYAN JAMAHIRIYA,
Garyounis Univ., Benghazi (Libya). Dept. of Zoology.
C. S. Wood, and S. A. Ghannudi.
Aquaculture, Vol. 44, No. 2, p 125-131, February, 1985. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Fish farming, *Aquaculture, *Carp, *Libya, Climates, Temperature effects, Salinity, Solar radiation, Reservoirs, Fish food.

The construction of rainwater storage reservoirs in the Libyan Jamahiriya for agricultural purposes may provide opportunities for culturing fish on a large scale. Environmental variations were studied in an artificial experimental pond in an effort to find out the suitability of Libyan conditions for fish farming. While the results obtained with the fish cannot be extrapolated to compare the yield in large field conditions, the performance of the fish under Libyan environmental conditions seems to be equal to normal standards. Water temperature data are also favorable for the growth of carp. Adult mirror carp consumed all mollusks and higher plants and were feeding on Cyanophyta prior to spawning in May 1978. The young grew to 136 mm fork length and yielded 2.2 kg in 14 months without food or fertilizers being added. They stayed under cover for five winter months and at this time growth was not affected much. Quantitative or semi-quantitative data are given for water depths, salinity balance, maximum and minimum water and other temperatures, solar radiation, and for biomass of producer and consumer species, together with observations on algal species, carp and goldfish. (Baker-IVI)
W85-06486

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 5, FISH STUDIES: PILOT REPORT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. H. Pennington, H. L. Schramm, M. E. Potter, and M. P. Farrell.
Miscellaneous Paper E-80-1, November 1980. Report 5 of a Series. 101 p, 6 Fig, 23 Tab, 1 Append.

Descriptors: *Aquatic habitats, *Fishing gear, *Fish populations, *Sampling, *Baseline studies, *Species composition, *Species diversity, *Lotic environment, Stream fisheries, Habitats, Fish, Biological samples, Rivers, Nets, Gill nets, Standing waters, Trawling, Banks, Dikes, Channels, Sandbars, Fisheries.

A pilot study was conducted on the Lower Mississippi River (mile 480 to 530) to familiarize field crews with habitats, test sampling gear and study procedures. The diversity of sampling gears used adequately represented the fish fauna of most habitats. Seines were valuable for estimating diversity and abundance in shoreline habitats, hoop nets and electroshocking were effective along natural and revetted banks, dike fields and other lotic habitats, and gill nets were useful in slack-water areas. Trawling was effective in dike fields and areas with unobstructed bottoms. Catch per unit effort (C/f) was used as an index of fish abundance. C/f varied over time, among habitats, sites within a habitat, and between samples within a habitat. The standing-water fish community was most abundant in abandoned channels and the oxbow lake. C/f in flowing water was highest in the chute joining Lake Lee with the river. The lotic fish community was collected in similar abundance from the natural bank, revetted bank, dike field, sandbar, and temporary secondary channel habitats, with the temporary secondary channel habitats showing the greatest abundance. Standing-water, flowing-water, and inshore fish communities are well represented in dike fields.
W85-06943

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE

480-530; REPORT 4: DIEL PERIODICITY OF BENTHIC MACROINVERTEBRATE DRIFT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2A.
W85-06995

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

DESIGN OF A WATER RESOURCES TRAINING PROGRAM FOR OPERATION, MAINTENANCE AND MANAGEMENT,
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt, T. J. Karikari, and A. Bunyan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157600/AS, Price codes: A10 in paper copy, A01 in microfiche. D.C. WRCC Report No. 56, October 1983. 207 p, 4 Fig, 13 Tab, 140 Ref, 10 Append.

Descriptors: *Training, *Water distribution, *Sewer services, *Job analysis, *Wastewater treatment, Plant operation, Maintenance, Management, Curriculum development, Need-to-know, Local organization, Washington (DC), On-the-job training, Apprenticeship, Certification.

A long-term training program was designed for operating personnel in three bureaus (Water Services, Sewer Services, and Wastewater Treatment) within the Water Resources Management Administration (WRMA), a division of the D.C. Department of Environmental Services (DES). The project consisted of: an analysis of the agency's structure; a survey of the employees background; a survey of job and task requirements; an assessment and documentation of training needs based on workers and supervisors views; analysis of job and performance functions; and the implementation of a pilot program aimed at providing information about the training level of workers, trainees and supervisors acceptance, selection of training methods, training facilities, and other factors relating to a long-term training program. Recommendations on a comprehensive long-term curriculum leading to certification are provided. The report also gives guidelines for apprenticeship, certification and a comprehensive list of courses related to the training of water resources operators and technicians.
W85-06308

INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT REPORT 1981 (ICLARM).
International Center for Living Aquatic Resources Management, Manila (Philippines).
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-114249. 1982. 112 p. Edited by Jay L. Maclean.

Descriptors: *Aquaculture, *Fisheries, *Resources development, Education, Resources management report, Resources allocation, Research.

This annual report of the ICLARM has sections on its research programs in aquaculture, traditional fisheries, resource development and management, and education and training; information service; advisory services; conferences, symposia, courses, and workshops; a list of papers presented at conferences and seminars; publications; linkages and agreements; and sources and application of funds.
W85-06977

9D. Grants, Contracts, and Research Act Allotments

ANNUAL REPORT OF GEORGIA WATER RESOURCES RESEARCH INSTITUTE ACTIVITIES UNDER PUBLIC LAW 95-467 IN FISCAL YEAR 1983,
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
B. Kahn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157774/AS, Price Codes: A04 in paper copy, A01 in microfiche. Report No. ERC 08-84, September 1984, 46 p, 5 Tab, Project No. USGS G-836(01).

Descriptors: *Water Resources Institute, Water resources research and training, *Georgia, Groundwater, Water use, Sedimentation, Acid rain.

The FY 1983 Program included the following seven projects: Municipal Use of Existing Wells for Supplemental Water Supply in the Piedmont and Blue Ridge Provinces of Georgia, by James E. Kundell and Robert C. Chambers, Parameter Identification in Layered Aquifer Systems, by M. M. Aral and M. Zakikhani, Long Term Sediment Deposition in the Riparian Zone of an Agricultural Watershed, by Richard Lowrance and James Cooley, Characterization of Acid Rain Phenomena, by Kevin C. Beck and Judith Demere, Geological Factors Influencing Well Productivity on the Georgia Piedmont, by George A. Brook, Chinhong Sun and Terrence S. Lloyd, Fracture Trace Analysis to Increase the Probability of Locating Ground-water in Murray County, Georgia, by R. E. Tschirhart, D. W. Kolberg, and N. L. Faust, Effective Use of Cooling Lakes and Cooling Towers in Hybrid Cooling Systems, by Terry W. Sturm. The research was supported by Federal (US Dept. of the Interior) and State funds and performed at the University of Georgia Institute of Technology during the period June 1983 - September 1984. Technical completion reports of all projects are available from the Environmental Resources Center publication series under the numbers 0184 to 0784. The Environmental Resources Center managed these and associated training and information transfer activities as the state water resources research institute. During this period, also, all ongoing research projects from earlier years were completed and published.
W85-06320

FY 83 PROGRAM SUMMARY REPORT OF UTAH CENTER FOR WATER RESOURCES RESEARCH,
Utah Water Research Lab., Logan.
L. D. James.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157790/AS, Price codes: A04 in paper copy, A01 in microfiche. General Series UWRL/G-84/01, Sept. 1984. 52 p, 2 Tab, 17 Fig, 50 Ref, Project No. USGS G872-01.

Descriptors: *Utah, *Water resources research, Groundwater pollution, Salinity, Irrigation, Aquifer characteristics, Soil chemistry, Saline soils, Alluvium, Subsoil, Model studies, River basin development, Management planning, Water allocation, Resources development, Drinking water, Water treatment, Filtration, Particulate matter, Turbidity.

The FY 1983 research program funded cooperatively by the U.S. Geological Survey and The Utah Center for Water Resources Research supported four projects. Studies were completed on 1) the effectiveness of direct filtration in drinking water treatment and 2) organizing a modeling capability for systematic application to water management issues in the Colorado River Basin. More stringent standards are causing many communities to treat to remove drinking water turbidity. Mixed media filters permit the direct filtration without passing the water through costly settling basins. The objective of this research was to compare the performances of direct filtration and conventional treatment plants. The data showed no significant difference and that direct filtration produced a water easily meeting the standard of 1 TU required by EPA. Studies will continue into FY 1984 on 1) instrumenting the buildup of groundwater salinity to collect data for use in geohydrologic and geochemical modeling to guide farm water management for soil salinity control and 2) measuring water salinity levels in observation wells between fields and drains to model the induced upward movement of salts from underlying saline formations to guide the design and operation of irrigation systems serving agricultural lands with this problem. These continuing studies continue a long series of Center projects on salinity control at the river basin level and fit within the framework formulated in the systematic assessment of modeling in the Colorado River Basin.
W85-06322

INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT REPORT 1981 (ICLARM).
International Center for Living Aquatic Resources Management, Manila (Philippines).
For primary bibliographic entry see Field 9A.
W85-06977

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

ANIMAL SUBSTRATE RELATIONSHIPS AND PRODUCTIVITY OF INVERTEBRATE MACROBENTHOS OF MISSISSIPPI SOUND AND ADJACENT COASTAL AREAS: A BIBLIOGRAPHY WITH ABSTRACTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2L.
W85-06911

10F. Preparation Of Reviews

JET ENTRAINMENT IN PUMPED-STORAGE RESERVOIRS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-06921

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